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Burin Factory Site, Palmyra, Syria

By

Yoshito ABE

Department of Archaeology and Ethnology
Faculty of Letters, Keio University

and

Takeru AKAZAWA

Department of Anthropology, National Science Museum, Tokyo

The flint material described in this paper was collected from the site at Locality 79, Palmyra basin. The Locality 79 was one of some dozens of sites newly discovered in the Palmyra basin during the 1974 season's survey of the Tokyo University Scientific Expedition to Syria.*

The expedition investigated the inland areas of Syria that had been largely neglected by earlier research. The objective of our research was two-fold. The first was to excavate the Palaeolithic site at the Douara cave in the Syrian desert in order to examine the industrial succession. This eventually helps to establish a framework to which chronological work on the Palaeolithic in inland areas of the Levant can be related. The second was to perform overall geomorphological and prehistoric surveys in the vicinity of the cave for the purpose of obtaining the basic data required for the reconstruction of the paleogeography of the region at the time when the Douara cave deposits were being formed.

During the survey in the vicinity of the cave, many flint strewn fields were found. These fields are defined as places characterized by a concentration of flint gravel on their surfaces, although these concentrations may vary in dimension and density. Moreover, another important feature of these fields is that they are located adjacent to flint outcrops, with only a few exceptions. In many cases, the scattered flint did not prove to be of human workmanship, or else were so crudely crafted as to be undeterminable. However, in some fields, a certain amount of artifactual flint specimens were found. Locality 79 was one of these flint strewn fields with a certain percentage of flint artifacts.

The flint collected from this locality during the last season was small in number. But, upon closer examination, it was found that the collection was characterized by

* The 1974 season's expedition was one of the overseas field study projects organized by the University of Tokyo, and was headed by Professor Kazuro HANIHARA of the Department of Anthropology, the University of Tokyo. It was financed by the Japanese Ministry of Education under the name of the Grants for Overseas Research Program in 1974 and 1975.

specific features markedly different from those of usual lithic assemblages. The most outstanding feature is the extraordinarily high proportion, not equalled by any other lithic assemblage, of burins as secondarily retouched tools.

Generally speaking, the lithic assemblage from any given site consists of various types of implements such as scrapers, points, borers and burins although the quantitative composition of these tool types varies highly from assemblage to assemblage. But in any case, a lithic assemblage yielding only one type of tool as its lithic constituent rarely exists in actuality. The finding of such a peculiar assemblage may initiate new studies that will help to explain lithic data in terms of human activities in prehistoric times. Since the flint collected was all surface material, the analysis of the collection can only be performed under certain limited conditions of techno-typology. But, there are things of such great interest in these assemblages that they counterbalance if not cancel out completely this negative aspect. This paper consists of two descriptive parts. The first is a description of the techno-typological features of the collection, and the second is a description of the significance of the variablility of lithic assemblages.

The Site

Locality 79 is located about 8 km west of the town of Palmyra in the north Syrian desert. The site is on the northern end of Dahr Ruwesat-Abou el Fares, in the mountain masses that bound the Palmyra basin to the east. More precisely, it is situated on the highest point of the northern end of Dahr Ruwesat-Abou el Fares, about 1 km southwest from the peak along the Palmyra-Jerf Ajla desert road crossing the ridge between Dahr Ruwesat-About el Fares and Jabel An-Nuweser (Fig. 1).

The site is adjacent to exposed flint beds. In connection with these flint beds, a large number of flint chunks and flakes were found scattered on the surface of the site. Almost all pieces were not of human workmanship but rather of natural crushing of the exposed flint beds. However, together with this naturally fractured flint, a number of specimens definitely classifiable as human artifacts were found.

The pieces of flint are all characterized by a patination of light mahogany to very dark brown. Many specimens are slightly lustrous and very lightly abraded. The physical condition of the flint is quite similar in both the artifactual and non-artifactual specimens. Moreover, their condition is also identical with that of the exposed flint beds. Therefore, at first glance, it was realized that all the flaked materials were produced from the same flint resource, that of the adjacent flint outcropping.

Description of the Collection

A total of 281 pieces of flint were collected during about a two-hour stay at the site. The collection is categorized into the following five major classes (Table 1): 15 cores, 80 unmodified flakes, 68 modified flakes, 51 debitage and/or naturally fractured flakes, and 67 broken, unidentifiable flakes. (Henceforth, bracketed numerals

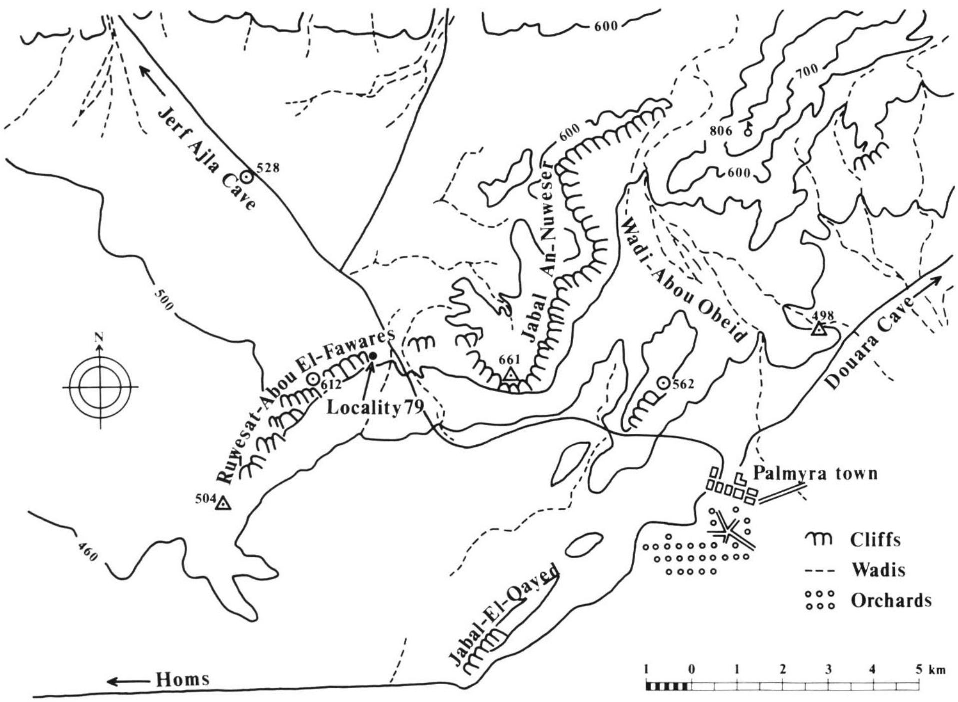


Fig. 1. Geographical map of the Palmyra basin showing the location of Locality 79.

Table 1. Categories of the Collection

	No.	%
Cores	15	5.3
Unmodified flakes	80	28.5
cortex flakes	(51)	(63.8)
secondary flakes	(29)	(36.3)
Broken, unidentifiable flakes	67	23.8
with striking platform	(31)	(46.3)
without striking platform	(36)	(53.7)
Modified flakes	68	24.2
burins	(63)	(92.6)
secondarily retouched flakes	(5)	(7.4)
Debitage/naturally fractured flakes	51	18.2
with cortex	(37)	(72.5)
without cortex	(14)	(27.5)
Total	281	100.0

will indicate the extant number of specimens). All these pieces of flint exhibit the same physical condition, including patination and abrasion.

Before describing the two important aspects of the analysis of the lithic material

—technology and typology—we will define the various techno-typological terms in alphabetical order so as to make effectual the description of the lithic materials and in due course prompt fair comparison of them.

Angle burins

A burin with one or more burin spall scars roughly parallel to the longitudinal axis of the blank.

Angles of the burin edge

An angle made by the spall removal surface and the spall scar. This angle is measured with a card specially designed by MOVIUS and others (1968: Fig. 14).

Blanks

Any piece of flake or core from which tools were made. Accordingly, we cannot observe the complete features of the blank nor examine a blank whose original forms were lost by various agencies such as secondary retouching to make working edges.

Change of orientation cores

A core with two striking platforms, either on the same or opposite surfaces, perpendicular to one another. This type of core is also characterized by having cortex on its surface with plain or unfaceted cortex striking platforms. The change of orientation core has been subdivided into two varieties, classified by whether the 90 degree change of orientation is on the same surface or on opposite surfaces as mentioned by MARKS (1968). The specimens studied in the present collection are characterized by having the flaking scars removed from opposite surfaces.

Cortex flakes

Unmodified flakes whose dorsal surface and striking platform retain the original cortex of the raw material to some extent. Cortex rarely occurs on the ventral surfaces of flakes.

Cortex striking platforms

A striking platform of cores and flakes having much of the original cortex of the raw material on its platform plane.

Debitage

By-products of lithic manufacture.

Distal and Proximal break

One type of spall removal surface formed by an unmodified break, truncated from the blank in either a straight or a slightly oblique manner. It is not possible to determine whether the break was produced intentionally or accidentally.

Dorsal surfaces

A surface of a flake which is on the side opposite the positive bulb of percussion.

Faceted striking platforms

A platform of cores and flakes showing traces of previous preparation through the removal of a series of small retouching.

Longitudinal axis of the flakes

A line which runs through the point of percussion and the farthest distal end from the point of percussion.

Maximum length of flakes

Length measured along a longitudinal axis of the ventral surface of the flake.

Maximum length of flake-scars on cores

The maximum distance between the point of percussion and the farthest distal end from the point of percussion, measured along the longitudinal axis of the main flaking scar left on the core.

Maximum width of flakes

The widest dimension perpendicular to the longitudinal axis of the flake.

Modified flakes

Flakes, regardless of whether whole or fragmentary, which have been modified intentionally by secondary retouching along one or more edges.

Multiple angle burins

An angle burin having its working edges formed by the intersection of the spall removal surfaces and the spall scars at two or more corners of a blank.

Natural surfaces

A type of spall removal surface formed by a natural edge of the blank in this present collection. However in the case of the collection examined here, this type of surface includes the striking platform surface of the blank.

Naturally fractured pieces

Chunks and flakes that do not exhibit any evidnce of human workmanship. Many pieces in this category were produced by frost action, and these usually do not have the bulb of percussion on the surface newly exposed by the fracture.

Opposed platform cores

A core with two platforms, one at each end of the core. These cores are also characterized by the presence of cortex on their surfaces and the lack of any core preparation except for the makings of a striking platform. The striking platform is plain and flat without secondary faceting. Cores of this type are subdivided into three types according to the form of flaking technique used. One type has a series of bi-directional, parallel flaking scars showing a number of flake removals from both ends of the same side. The second type has a series of uni-directional, parallel flaking scars on either surface showing the flake removals from opposite sides. The third type is a combination of the above two types. The first type is made on relatively flat and thin flint of a rectangular-shaped outline. The other two are made on flint of a cylindrical to conical shape.

Retouched truncations

The secondary removal of small flakes for creating a striking platform on the blank from which a burin spall or spalls are removed. The removals are usually directed from the ventral surface of the flakes. The chisel-like working edge is formed by the intersection of the retouched truncation and the spall scars. Forms of the retouched truncations can be divided into four types: straight, convex, concave and oblique. The first three types of truncations are roughly perpendicular while the last type is made obliquely to the longitudinal axis of the flakes.

Secondary flakes

Unmodified flakes without any cortex which have uni- or bi-directional flaking scars on their dorsal surfaces. Flakes of this type were removed from a core after primary flakes such as the cortex flakes were struck off.

Single angle burins

A burin having its working edge formed by the intersection of the spall removal surface and the spall scar at a single corner of the blank.

Single platform cores

A core with only one striking platform. These cores share several characteristic features. The core preparation is completely absent except for the striking platforms. All cores have cortex except for the surface exposed by the primary removals. The striking platform is plain and flat without any secondary faceting and it has a series of parallel flaking scars running from it. The forms of the flaking surfaces of these cores fall into two types: one is a single flat surface, and the other is a flaking surface extending around the piece. The first type is made on a flat tabular-shaped flint of roughly rectangular to triangular outline. The second one is made on an elongated and cylindrical flint with a roughly rounded cross-section.

Spall removal surfaces

A surface or a striking platform on the blank from which a burin spall or spalls were removed. Davis (1969) classified the form of the spall removal surfaces into four types according to technological characteristics: retouched truncation, distal or proximal break, transverse burin blow and natural surface. A burin edge is formed by these spall removal surfaces and spall scars.

Spall scars

A flaking scar from which one or more burin spalls were detached from the spall removal surface by a blow. Adjacent to and immediately below the point of percussion, a negative bulb of percussion can be observed.

Transversal burin blow
A type of spall removal surface formed by one or more blows struck across a burin more or less at right angles to its central surface. The working edge of the burin is formed by oblique or perpendicular intersections of spall scars and the burin's longitudinal axis at the distal end of the blank. In the same manner, a dihedral burin cutting edge is produced.

Unfaceted striking platforms
A type of striking platform of cores and flakes, whose surfaces are plain without any evidence of preconditioned preparation.

Unmodified flakes
Whole flakes, either cortex or secondary flakes, which exhibit no macroscopic evidence of intensional retouching or usage after removal from a core.

Ventral surfaces
A surface of a flake which bears the positive bulb of percussion.

Width of the burin edges
Distance measured in a straight line between the point of intersection of the spall removal surface and the spall scar or scars.

Technological description
In this section two aspects of the technological characteristics of the collection, that is core technique which corresponds to the manner of blank production and forms of the blank on which implements were made, will be described.

Core technique
The 15 cores identified comprise about 5 per cent of the total collection. These cores are classified into three types according to the morphological features of their striking platforms (Table 2). The dominant types are the single platform core (6) and the opposed platform core (6).

The cores of each type classified above are further subdivided according to the manner of the flaking technique used. Of the single platform type, three specimens have flaking scars on their single flat surfaces (Plate 1: 2) and another three pieces have flaking scars extending around the core (Fig. 2: 5; Plate 1: 1, 4). The opposed platform cores consist of two subtypes: (1) a core with bi-directional flaking scars on the same surface (Fig. 2: 6; Plate 1: 3, 6) (2) a core with uni-directional flaking scars on both surfaces (Fig. 2: 1, 4; Plate 1: 5). The change of orientation core is a type characterized by showing a change of orientation on its opposite surface (Fig.

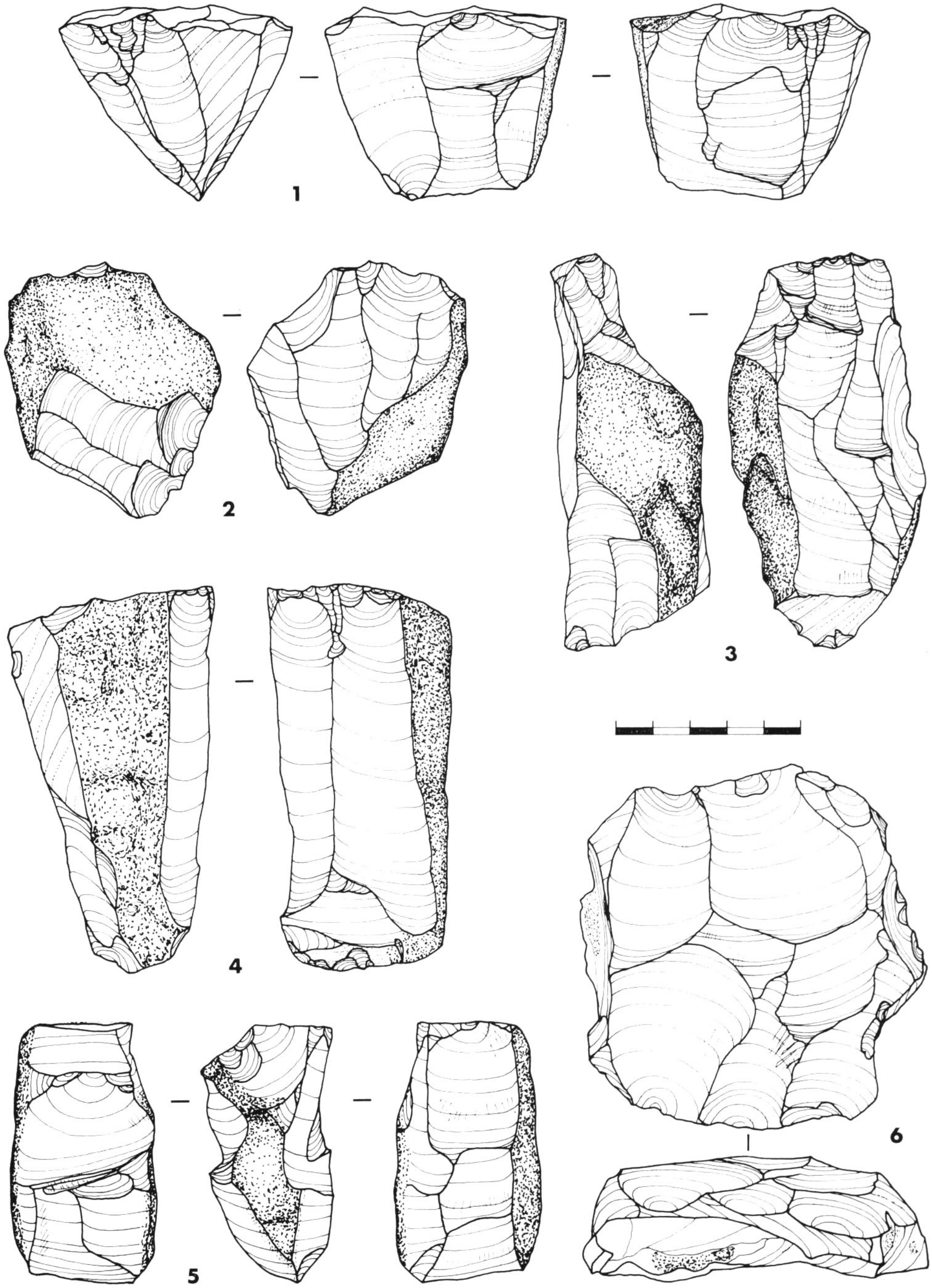

1
2
3
4
5
6

Table 2. Core Types

Core types	No.
Single platform	6
blade type	(2)
flake type	(2)
conical type	(2)
Opposed platform	6
same surface	(4)
opposite surface	(2)
Change of orientation	1
Broken, unidentifiable	2
Total	15

2: 2).

Although the forms of the cores collected are variable as stated above, they equally share the following features. They have no preparatory flaking on their surfaces except for the production of the striking platform. They have the original cortex of raw material except for the surface exposed by flaking. The striking platforms are produced by a single blow without any evidence of secondary faceting.

As to the forms of flaking scars left on the core, there are uni- and bi-directional types running from one or both ends of the core. But specimens with centripetal flaking scars, similar to a Levallois core, were not found. These features well coincide with those of blanks appearing to be taken from the same core, as is described below.

Blank forms

The blanks studied in the present collection fall into two types, cortex flakes and secondary flakes. The cortex flakes are usually considered to be the products after the removal of the cortex from flint nodules. But in this collection, a certain percentage of cortex flakes were secondarily modified into burins (Figs. 4: 6, 9, 10, 12; 5: 7, 11, 12; Plate 2: 3, 5, 6). It is obvious that these cortex flakes were used as blanks on which tools were made.

The cortex flakes outnumber the secondary flakes. The 80 pieces classifiable as unmodified flakes include 51 cortex flakes (Plate 2: 10, 11, 15). Although burins and broken, unidentifiable flakes do not give complete information on whether they had cortex or not, in every case the proportion of the cortex flakes is larger than the proportion of flakes without cortex.

The patterns of the flaking scars observed on the dorsal surfaces of the blanks consists of uni- and bi-directional types. However blanks with more or less centripetal flaking scars on their dorsal surfaces were extremely rare. This centripetal pattern of flaking scar apparently corresponds to that observed on the main surfaces

Fig. 2. Cores collected from Locality 79. Opposed platform cores: 1, 3, 4, 6. Change of orientation core: 2. Single platform core: 5.

of the other cores in this same collection, allowing us to deduce that these blanks were also produced from the cores found in the same locality.

The faceting of the striking platforms of the flakes is variable (Table 3): faceted, unfaceted and cortex. When examining the specimens with recognized striking platforms, the unfaceted type together with the cortex type constitutes over 80 per cent of all examples. The specimens with faceted striking platforms are very small

Table 3. Types of Striking Platforms of Flakes*

Types	No.	%
Unfaceted	85	76.6
Faceted	6	5.4
Cortex	12	10.8
Unidentifiable	8	7.2
Total	111	100.0

* of all specimens having recognizable striking platforms

in number (6), and the manner in which these striking platforms were prepared is very coarse and irregular. These features suggest that this type of striking platform is not an intentional faceting to make a true secondary platform, but rather produced accidentally by natural crushing. The faceting of the striking platforms of both cores and blanks shows a similar tendency, further suggesting that these two elements had close connections technologically.

Examining the size frequency of the blank represented by the unmodified flakes,

Table 4. Length Distribution of Burins, Unmodified Flakes and Core Flake Scars

Length intervals (in mm.)	Burins		Unmodified flakes		Core flake scars	
	No.	%	No.	%	No.	%
30–40	5	19.2	8	10.0	4	8.7
40–50	5	19.2	19	23.8	13	28.3
50–60	6	23.1	15	18.8	14	30.4
60–70	6	23.1	14	17.5	3	6.5
70–80	0	0.0	10	12.5	5	10.9
80–90	2	7.7	4	5.0	2	4.3
90–100	0	0.0	8	10.0	3	6.5
100–110	1	3.8	1	1.3	1	2.2
110–120	1	3.8	1	1.3	0	0.0
120–130	0	0.0	0	0.0	0	0.0
130–140	0	0.0	0	0.0	1	2.2
Total	26	99.9	80	100.2	46	100.0
Mean	57.6		61.5		59.7	
Variance	401.9364		364.6500		414.7245	
Standard deviation	20.0484		19.0958		20.3648	

the maximum lengths range widely from 33.4 to 116.2 mm. The size distribution of the maximum length of the blanks resemble that of the flaking scars on the cores examined. The 46 flaking scars on the 15 cores were also measured for their maximum length. Comparing the results of these two measurements, the length distributions obtained from both flakes and cores agree well (Table 4). Although in the strictest sense, mean and average should not be on equal basis for comparison, the mean length, 59.7 mm, of the maximum lengths of flake-scars on cores is also a fairly good approximation of the average of the maximum length of the unmodified flakes. That is, the dispersion pattern of these two size frequencies exhibits a close resemblance to one another (Fig. 3).

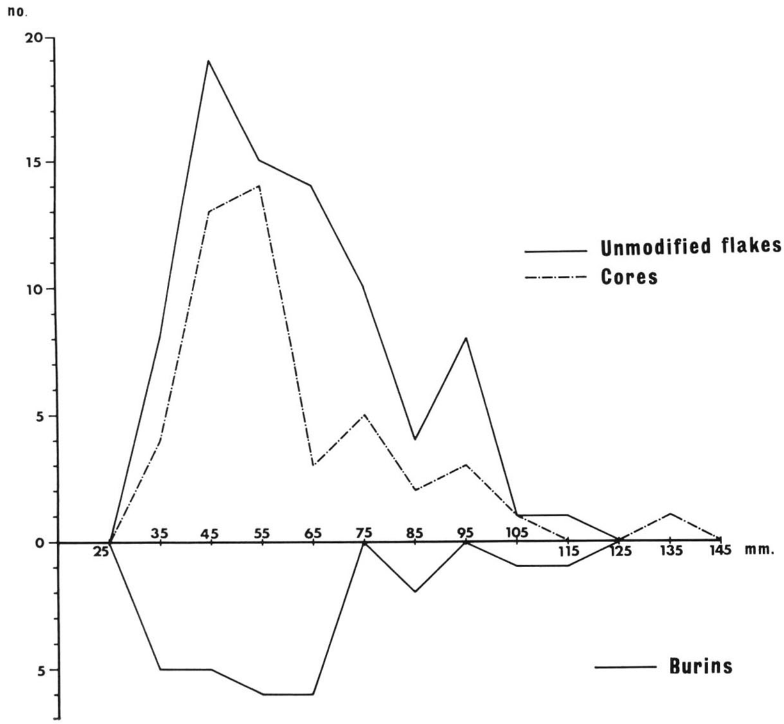


Fig. 3. Distribution of the maximum lengths of umnodified flakes, burins and the main flaking-scars of cores.

Finally, to examine the flake-blade proportion in the collection, we calculated the length-width ratios of blanks. Those with ratios over 0.5 are considered to be flakes while those with less are blades (Table 5). The results show that the relative quantity of flakes is larger than that of blades. Further, the length-width ratios of flaking scars recognized on the cores are nearly the same as that of the blanks but the former has a somewhat greater range of variance. This evidence supports the possibility that both cores and blanks from this locality constitute a part of a single as-

Table 5. Length-width ratios of unmodified flakes and core flake scars

W/L ratio	Unmodified flakes		Core flake scars	
	No.	%	No.	%
0.1–0.2	1	1.3	0	0
0.2–0.3	2	2.5	2	6.5
0.3–0.4	5	6.3	3	9.7
0.4–0.5	12	15.0	9	29.0
0.5–0.6	12	15.0	6	19.4
0.6–0.7	14	17.5	6	19.4
0.7–0.8	10	12.5	3	9.7
0.8–0.9	7	8.8	1	3.2
0.9–1.0	7	8.8	1	3.2
1.0–1.1	4	5.0	0	0
1.1–1.2	2	2.5	0	0
1.2–1.3	3	3.8	0	0
1.3–1.4	1	1.3	0	0
Total	80	100.3	31	100.1
Mean	0.69		0.53	
Variance	0.0643		0.0221	
Standard deviation	0.2537		0.1486	

semblage.

Typological description

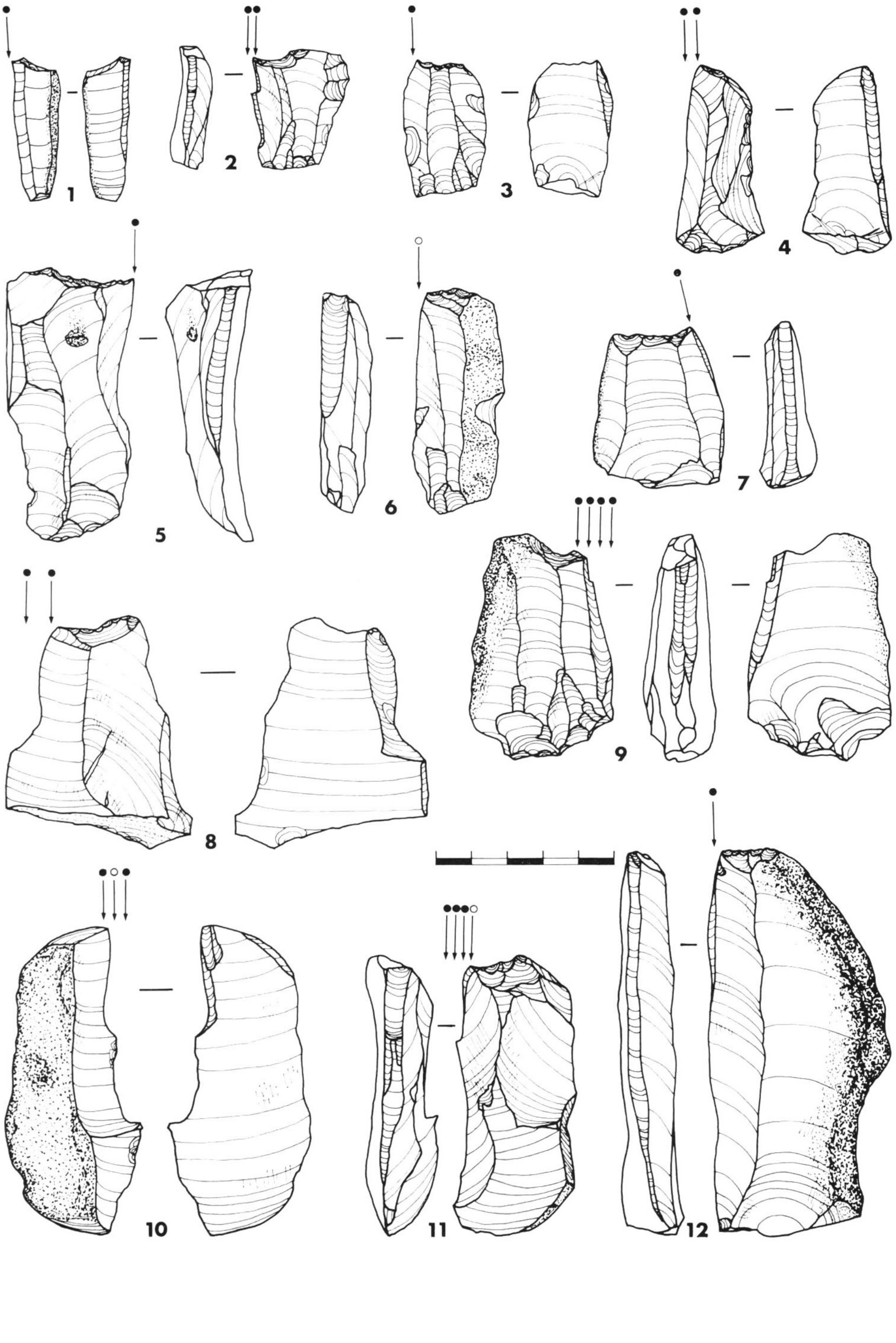
Many flakes examined have an extensive edge-retouch along their margins. However, the retouch is, with a very few exceptions, very abrupt, irregular and intermittent on both dorsal and ventral surfaces of the flakes. In addition, the majority of these retouches are somewhat fresh, and patinated in a slightly different color from the rest of the flakes. These points suggest that this type of retouch was not intended to make a true working edge, but rather produced accidentally by natural crushing.

As mentioned in the first section, the outstanding feature of the collection from this site is the extraordinarily high occurrence of burins. Apart from these burins the tool kit is very poor and undistinguished. A total of 63 burins including two fragmental pieces were collected. This constitutes 22.4 per cent of the entire collection. Accordingly, the typological description of the collection automatically covers the analysis of the technotypological features of burins identified. The burin types used below have been defined by de SONNEVILLE-BORDES and PERROT (1956) and by TIXIER (1963) while the technological definition of the burin follows MOVIUS and others (1968).

Burin types

Generally speaking, burins belong to a tool class characterized by having a

Fig. 4. Burins collected from Locality 79. The circle shows spall scars with negative bulbs, and the black dot shows spall scars with no negative bulbs.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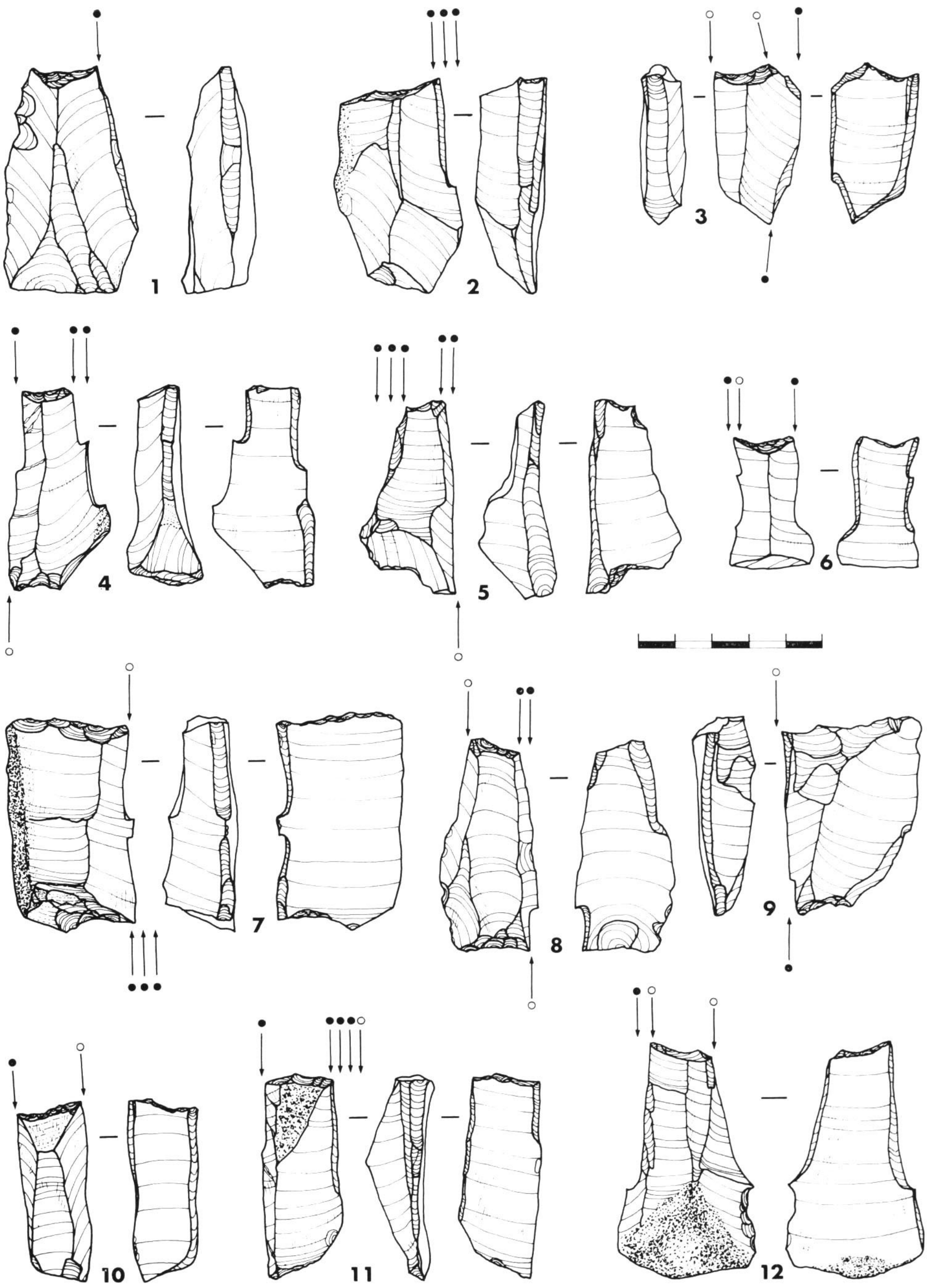

Fig. 5. Burins collected from Locality 79.

specific working edge, the burin edge. In our collection, the burin type appearing with the highest frequency is the angle burin on retouched truncations (Figs. 4, 5). This type is defined as having working edges formed by the intersection of a burin facet with a retouched truncation.

Burins are further classified into two major classes according to the number of the working edges: single, and multiple angle burins. Of 63 samples classifiable as burins, 46 specimens are single burins (Figs. 4: 1–12; 5: 1.2) and 17 specimens are multiple burins (Fig. 5: 3–12). Among the multiple angle burins, three pieces have a burin facet along three angles of the blank and the remainder has two working edges.

Movius and others (1968: 26) described the burin edge as having four important attributes: angle, shape, width, and number of major spall removals forming edges. But, in addition, other features such as its blank form and the type of the spall removal surface are also the attributes that cannot be ignored in the description of the features of burins.

Burin blanks

The blanks on which burins were made are of the same physical condition, including patination and abrasion, as that of the flint of other categories. All burins are patinated light mahogany to very dark brown. The great majority of burins are slightly lustrous and very lightly abraded.

As stated previously, the collection examined here is characterized by a high proportion of cortex flakes. The great majority of the burins were also made on cortex flakes, as is expressed by their high percentage, 63.5 per cent (40 of 63). This figure shows close agreement with the 63.8 per cent figure, the relative quantity of the cortex flakes to the secondary flakes of all the unmodified flakes.

Only 26 burins have recognizable striking platforms since the proximal parts of the larger specimens have been secondarily removed, presumably for making the spall removal surface (Figs. 4: 8, 10; 5: 3–7, 10–12). Accordingly, the type of the blanks' striking platforms on which these burins were made cannot be wholly examined, but, with regard to the 26 specimens with striking platforms, all are of the unfaceted type.

When compared, both the burin blanks and the unmodified flakes appear quite similar. Further, the size frequencies of these two categories also seem to resemble one another generally (Table 4). The maximum lengths of the burins range from 32.3 to 113.5 mm and the mean length is 57.6 mm. These figures attest to their similarity to the measurements of the unmodified flakes (Fig. 3).

It is yet difficult to grasp exact relationship between these burins and the other material in the collection, since the artifacts available are all surface material. However the burins resemble, physically and technologically, the other material as mentioned above. This, plus the fact that these specimens were all collected from a limited area, does suggest that all of the collection is very closely related.

Spall removal surfaces

Burins were manufactured by a specific technological process: the creation of spall removal surfaces and the removal of burin spalls. The manner of the formation of the spall removal surfaces is usually classified into four types: retouched truncation, transversal, break and natural. Of the 81 surfaces identified, 75 edges were formed by the intersection of retouched truncations and burin spalls. The others were made on breaks (4) and on natural surfaces (2). The last type is quite peculiar, because the striking platform of the blank is used as a spall removal surface.

The first process in the manufacturing of burins of this type is the creation of spall removal surfaces on one or both ends of the blanks, from which a burin spall or spalls are removed. The truncation is usually produced by a number of very abrupt, small retouches from the ventral surface. Of the total of 81 spall removal surfaces identified, over 90 per cent are classified as being of this retouched truncation type.

The spall removal surface is roughly perpendicular to the longitudinal axis of the flake. But if examined in detail, the form of the truncation is variable according to the concavity or convexity of the truncation (MOVIUS *et al.*, 1968: 36). The most dominant type is concave, occupying over 70 per cent of the total number of retouched truncations. Among them, about one half are of the pronounced concave type. The second most common type is the straight truncation. The convex type is very rare (5). However no examples of the pronounced convex type were identified in the collection. But these subdivisions are arbitrary and are based upon nonmetric observations of the profile of the spall removal surfaces. On the whole, the form of these spall removal surfaces resemble each other very closely, both technologically and typologically.

Generally speaking, the spall removal surfaces are made at the distal ends of the blanks. But in 36 cases, composing 45 per cent of the total number, the spall removal surfaces were made on the proximal part of the flakes. That explains why specimens removed at their proximal end are numerous in the burins examined.

Spall scars

In the second step of burin manufacture, one or more burin spalls are detached from the spall removal surface by a blow. In burin typology, the single (one blow) burin is generally distinguished from the multiple (two or more blows) burin. In this assemblage, the number of spall scars includes not only the total number of spall removals involved in the production of a given burin edge, but also the overall total number of spall scars on any given specimen.

As stated previously, the burins examined consist of two major classes: single angle burins and multiple angle burins. However the burin edges of all these specimens were formed by a single spall scar. The removal of a spall scar is either more or less parallel or, at a slightly oblique angle to the longitudinal axis of the blank and at a certain angle to the ventral surface.

Removals of spall scars is mainly significant in relation to the shape and width of a given burin edge. In general, it has been found that the greater the number of burin spalls involved in the production of the tool, the wider and more complex the burin edge. But in the case of the burins examined here, the form of the burin edge is rather simple, since all the pieces were made by a single blow.

Burin edges

The burin edge is formed by the intersection of the spall removal surface and the spall removal scar. Accordingly, variation of the shape of the burin edge is directly due to (1) the preparation of the spall removal surface, and (2) the number of the spall removals, as illustrated by MOVIUS and others (1968: 27).

As stated above, the form of both the spall removal surface and the spall removal of the burin examined show strikingly uniform features throughout the entire collection. This suggests that the burin edge was manufactured uniformly. Examining the four important attributes, that is shape, angle, width, and the number of spall scars forming the burin edge, every attribute is found to have a very small range of variation within the collection.

The shapes of the burin edges are classified into six types based upon a morphological judgement of the overall shape of the actual edge resulting from the intersection of the spall scar and the spall removal surface (MOVIUS *et al.*, 1968). But the 81 burin edges identified fall into only two categories: straight and bevelled. Of these, 71 edges are of the straight type.

The angles and widths of the edges are considered significant characteristics of burins, analogous to modern engraving tools. The variations within the dimensions of both attributes are small. The angles measured tended to be approximately 90 degrees, while the burin edge with an acute angle was very rare. The width also showed little variation around its mean of 4 mm.

Rejuvenation of burin edges

Rejuvenation of burin edges may be accomplished by consecutive detachment of spall removals. Although the burin edges examined here were all formed by a single spall removal, it should be noted that throughout the total collection of burin edges studied, the frequency of rejuvenated burins is very high. In all the instances of burin edges, 51 were made by a single spall removal, but the remaining 30 edges have two or more earlier detachments of two or more spall removals suggesting that the burin edges were rejuvenated. These earlier spall scars have no negative bulb, although the latest spall scar has a negative bulb immediately below the burin edge (Figs. 4: 6, 11; 5: 11).

Rejuvenation of the burin edge was performed either by: (1) later detachment of spall removals from a truncation or a break burin or (2) spall removals either from the spall removal surface or from the burin spall scar itself in the case of dihedral burins (MOVIUS *et al.*, 1968: 30). However, in the collection examined, break burins are very rare and dihedral burins do not exist at all. The majority of the burins which have been rejuvenated are characterized by showing later detachment of spall removals from the spall removal surface which had been truncated secondarily.

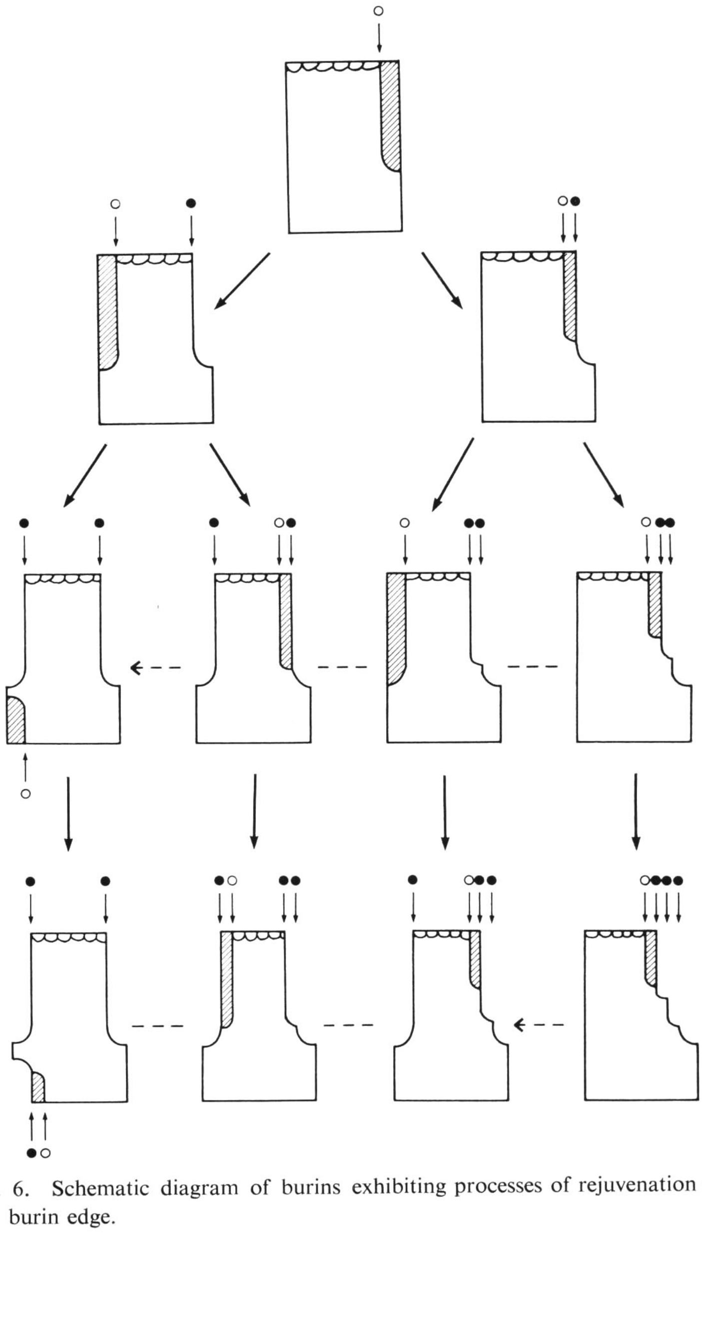

Fig. 6. Schematic diagram of burins exhibiting processes of rejuvenation of the burin edge.

Summary and Conclusions

The pieces of flint described in this paper were all surface material, and the technique of describing them has been based upon techno-typology alone. In dealing with a collection of this kind, classification is confirmed by the physical condition of the flint such as abrasion and patination. Needless to say, the physical condition of flint varies from place to place and it is no sure guide to age determination of surface collections from different localities. However, in studying the collection from a single locality in a restricted area, it is highly possible to decide whether the results of techno-typological classification are reasonable or not. Examining the physical condition of the present collection, all specimens are quite similar in both patination color and abrasion, suggesting that all the material were derived from a single assemblage belonging to a single period.

The most outstanding feature of the collection is the extraordinarily high proportion of burins. Also, unmodified flakes and cores are found in high frequencies. If the collection examined here represents a single assemblage, these three lithic elements must exhibit a linear relationship to each other. That is, the unmodified flakes are blanks upon which the burins were made, and these flakes were removed from the associated cores. Investigating the relationships among these elements, the following points have been ascertained.

1) In the collection, the modified specimens consist of burins alone. Apart from these burins the tool kit of this assemblage is very poor and undistinguished. Actually, it is not certain whether or not the other retouched pieces were modified intentionally or by natural crushing. Accordingly, the only specimens definitely classified as burins were implements retouched secondarily.

2) The burins were usually recognized by a set of specific manufacturing techniques that are definitely peculiar to tools of this type: the first is the production of the spall removal surface, and the second is the removal of the burin spall. The morphological features and the manufacturing processes are astonishingly uniform in all the burins examined. The great majority of the spall removal surfaces were created by retouched truncation, and the spall scar is mostly of the single type and is usually perpendicular to the spall removal surface.

3) Accordingly, the specimens classifiable as burins are mostly angle burins on retouched truncations, formed by the intersection of a burin facet and one end of a truncation. The former is parallel to the longitudinal axis of the blank while the latter is perpendicular to it.

4) The burin edges manufactured by the above precedure also show strikingly uniform features. Examining four important attributes—angle, shape, width, and the number of spall scars—of the burin edge, every attribute shows only a very small range of variation within the present collection. The angles measured are for the most part approximately 90 degrees, and the burin edge with an acute angle is very rare. With regard to the overall shape of the burin edge, only two types were identi-

fied: straight and bevelled; the former type is found with extraordinary frequency. In the process of measuring all the burin edges, the resulting figures exhibited but small variation around the mean of 4 mm. Finally, we examined the number of spall removals, this being mainly significant in relation to the shape and width of the burin edge. Clearly, this attribute is highly uniform because almost all burin edges were made by a single blow.

5) About half of the burin edges show evidence of earlier detachment of spall removals, characterized by a loss of the negative bulb of percussion. The negative bulb of these spall scars was removed either by: (1) a series of detachments of spall scars from a removal surface, or (2) a series of retouches in order to rejuvenate a spall removal surface. It is suggested that this particular feature of the burin edges was responsible for the resharpening of them. Rejuvenation of the burin edge was invariably accomplished by a single blow.

As summarized above, the collection examined shows some strikingly unique features not equalled by any other lithic industry. The most outstanding feature of the collection is that the lithic assemblage is markedly simple, and, in fact, only burins were identified as intentionally retouched implements. After examining the forms and the manufacturing processes of these burins, an astonishing uniformity was established.

Although final conclusions should be withheld until excavation of the stratified deposits of the site is accomplished, the findings mentioned above provide a good basis for classifying the collection into a single industrial assemblage.

In addition, the assemblage provides very important information for further investigation of human activities. Because of the extraordinarily high percentage of a single tool type, we may assume that very specialized activities were carried out at the site. Certainly, the activity was very restricted, concentrating upon work requiring engraving tools such as burins. Moreover, the work might also be specialized, because the burins collected are astonishingly uniform morphologically.

With regard to the age of this assemblage, it is, frankly speaking, still a question in the absence of a complete lithic composition. But the physical condition of the collection suggests that it belongs to a later stage rather than to the Palaeolithic age, judging from comparisons with the physical conditions of flint from various periods collected from the Palmyra basin. One thing of notable significance is that the degree of patination and abrasion of the collection closely resembles that of the Prepottery Neolithic assemblage of the surrounding area (AKAZAWA, 1975).

The burin forms of the present collection seem to be linked with those from the Wualian industry, a name given to a large collection of flint from sites scattered in Saudi Arabia (GARROD, 1960). This industry is also characterized by yielding an extraordinarily high proportion of burins. GARROD provisionally placed the Wualian in the Mesolithic stage of Palestine and identified it with the Dhobai site B industry found in inland desert areas (WAECHTER, 1938). However in the course of the recent study, it was found that the Dhobai site B industry has marked Pre-pottery Neolithic affinities and cannot be assigned with certainty to the Palaeolithic or Mesolithic of the Levant.

The Dhobaian industry is noted as a peculiar assemblage producing burins as by far its largest lithic constituent. Examining the burins of the Wualian and Dhobaian industries, their techno-typological features are found to be quite similar to one another; their most dominant type is the angle burin on a retouched truncation. Moreover, the other attributes, as examined in the present collection, of the Wualian and Dhobaian industries are also strikingly similar to one another and to the collection from Locality 79. In the light of this evidence, it is likely that the collection from Locality 79 belongs to the same stage as the Wualian and Dhobaian industries, although the cores of the naviform type, the most obvious type tool of the Pre-pottery Neolithic, are missing here. This final problem should be further investigated.

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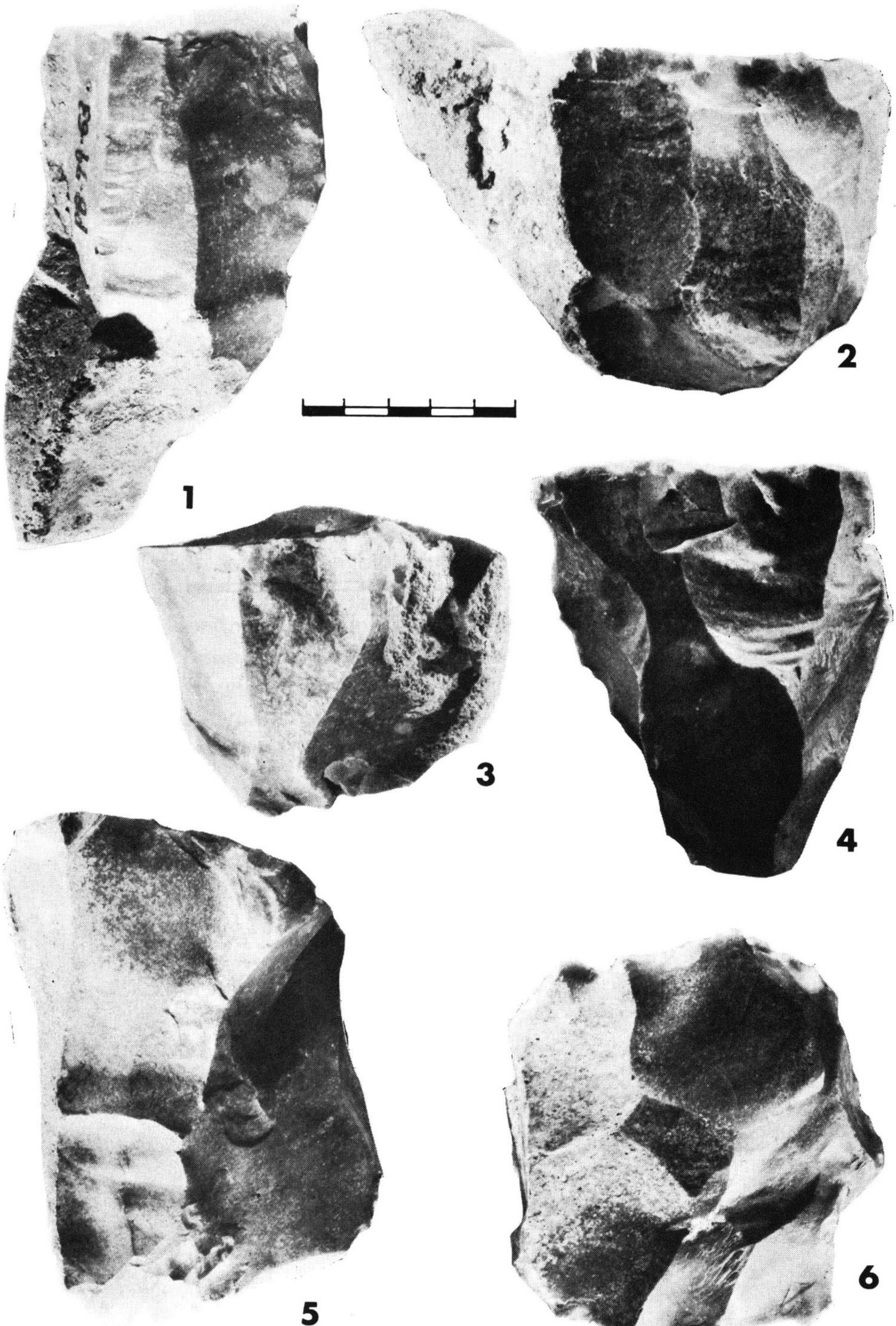
Explanation of Plates 1–2

Plate 1

Cores of the single platform type (Figs. 1, 2, 4) and opposed platform type (Figs. 3, 5, 6) from Locality 79.

Plate 2

Burins (Figs. 1–7) and unmodified flakes (Figs. 8–16) from Locality 79.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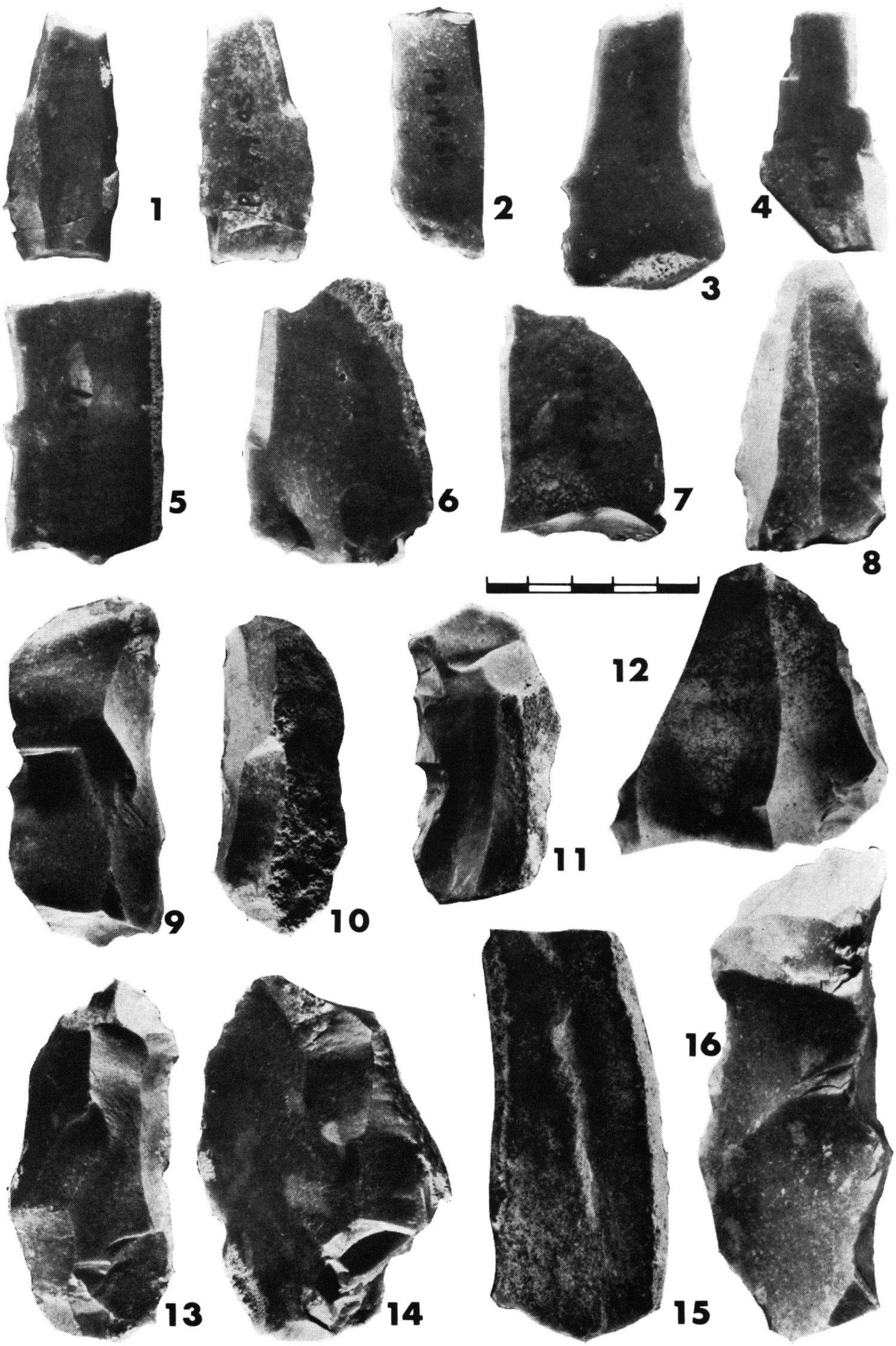
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