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Some criteria for recognizing stone artifacts

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SAMENVATTING

Stenen die door natuurlijke processen gebroken zijn, kunnen soms verrassend lijken op stenen werktuigen. Voor archeologen is het belangrijk om deze 'pseudo-artifacten' van de echte werktuigen te scheiden. In dit artikel worden sommige kenmerken gegeven, waaraan 'pseudo-artifacten' herkend kunnen worden. Aan de hand van een voorbeeld wordt duidelijk gemaakt, dat dit in de praktijk niet altijd even gemakkelijk is.

SUMMARY

Naturally flaked stone can show a surprising resemblance to artifacts. It is up to archeologist to recognize these 'pseudo-artifacts' from stone artifacts. This article gives several criteria. An example shows that in practice recognition may prove difficult.

Introduction

Just as it is up to paleoanthropologists to recognize hominid remains, so is it up to archaeologists to verify stone artifacts, that is, to declare whether or not flaked stone objects have been modified by either a human-hominid or a natural agent. This is not always easy; it is frequently not easy if the stone objects come from an earlier stratigraphic context, particularly one whose development is poorly understood.

This article briefly reviews criteria that archaeologists have established for determining the legitimacy of purportedly stone artifacts. As a concrete example, it will be shown using the work of the Agro Pontino survey in West Central Italy that even the simplest criteria can be difficult to apply in actual practice.

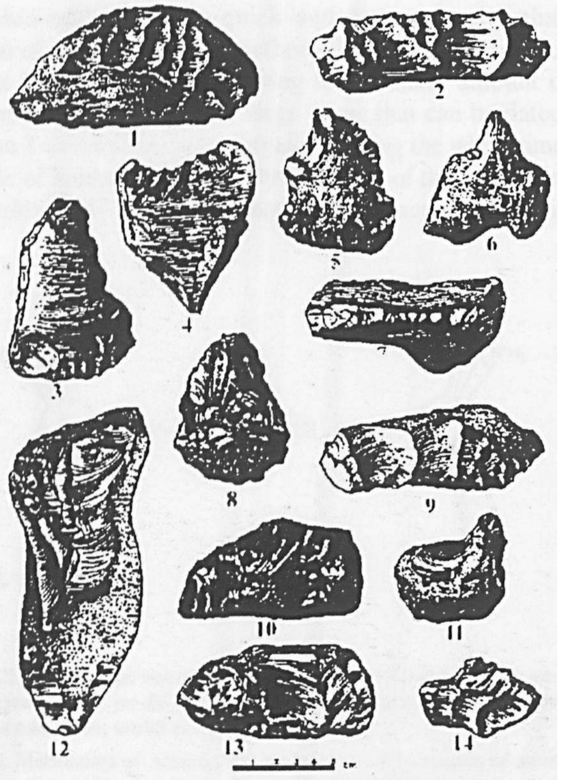

Fig. 1: Eolithen uit Europe, afgebeeld in Barnes, 1939, fig. 1

Fig. 1: Eoliths found in Europe, illustrated by Barnes, 1939, fig. 1.

Background

The idea that it should be possible to set up criteria to distinguish artificially flaked flint, or other brittle stone, from naturally flaked stone has been around since the beginning of this century. The necessity for such criteria arose as archaeologists realized that many of the eoliths being collected from all parts of the world were, in fact, made by natural agents. Eoliths were stones that pre-Paleolithic man supposedly selected on the basis of their shape and then used as tools; they were recognized by their association with Tertiary deposits or, just as often, it seems, by their 'old' appearance--heavy patination, staining, roundedness, etc.--and/or 'primitive'-looking flaking (BARNES, 1939; STAPERT, 1975). Fig. 1 illustrates some eoliths collected in France, England, and Belgium. Note the parallel flaking, the borer, the scraper, the opposing platform core.

Since it is conceivable that some eoliths were made or used by man, I will follow DICK STAPERT's (1975) usage and refer to naturally flaked stones that look like artifacts as pseudo-artifacts rather than referring to them as eoliths.

A first criterion

Possibly the easiest criterion for recognizing real stone artifacts is their occurrence outside their natural geological matrix. Transport of stone over distance is one of the more salient signitures of man, and even a whole cobble carried away from a river bed--a manuport, as archaeologists call it--can be considered a stone artifact. This criterion does not apply if there are signs of transport by natural agents, such as rounding and battered edges on flaked materials, unless their original place of deposition can be located and it too is outside where the raw materials naturally occur.

Naturally flaked 'artifacts'

Most doubts about putative artifacts concern those found in areas where the raw materials are ubiquitous. It is more difficult to find criteria for them.

The raw materials preferred by prehistoric man for stone tools were mainly cherts and quartzites, but also some basalts and limestones. Such stones are usually homogeneous and isotropic, that is, they are uniform in composition and respond to force equally in all directions. These properties make them easier to control while flaking. These same properties, however, make it possible for natural agents to produce items that look like stone artifacts.

Cherts and quartzites are found as nodules in limestone and sandstone and in tabular form in strata of former basins. Once dislodged from their contexts, they are unstable and subject to weathering processes such as percussion by other clasts, abrasion by aeolian sands, flaking and abrasion during water transport, etc. Eventually they acquire a more stable form; usually they occur secondarily deposited as cobbles in river beds, in glacial deposits, and on beaches. Such cobbles tend to be difficult to fracture. But, if fractured, they become unstable again and subject to flaking by natural agents.

Physical weathering is the major natural agent for initiating the production of pseudo-artifacts. Brittle stones are particularly affected by stress release. Stress release occurs when pressures exerted by overlying or underlying strata are removed through weathering and the rock expands and fractures. This was apparently the source of many of the eoliths in England, as noted by S.H. WARREN in England in 1923. Flints in the limestone fractured as the limestone weathered and were flaked by pebbles in the same matrix, as shown in fig. 2. The tool forms produced tend to have concave flaked sides, like the borers and nosed scrapers shown here.

Two other natural agents which cause internal fracturing are freeze-thaw and insolation (SELLEY, 1982). In freeze-thaw, which is associated with boreal and polar climates, small cracks in the stone are widened when

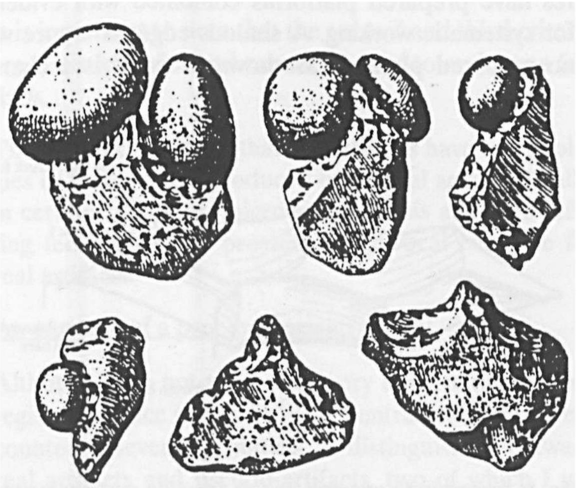

Fig. 2: Het ontstaan van pseudo-artefakten door kiezelstenen, zoals WARREN (1923) zich dat voorstelt (uit STAPERT, 1975, fig. 3)

Fig. 2: The working of pseudo-artifacts by pebbles, as proposed by WARREN (1923) (taken from STAPERT 1975, fig. 3.)

water trapped in them exerts pressure as ice; when the ice thaws the stone falls apart. Insolation occurs in hot, arid environments with wide ranges in diurnal, or daily, temperature. Different minerals in the stone expand and contract at different rates with changes in temperature and produce stresses in the rock until the rock fractures.

Heavy pressure, such as occurs in mud flows, can also fracture brittle stones, leaving flakes that resemble those produced by hard hammer percussion--large conchoidal bulbs, crushed or destroyed platforms, and parallel flaking on either side of the platform.

A new class of pseudo-artifacts called tephrafacts has been recognized by archaeologists working in France (Wil Roebroeks, personal communication). Tephrafacts are flaked, many of them quite elaborately, during a volcanic explosion and deposited along with other volcanic debris of the same size range.

Criteria for detecting pseudo-artifacts

It is up to the archaeologist to reject natural processes as the agents of a collection. How can this be done?

The American archaeologist DAVID MELTZER (1993) gives a general guideline for such contexts as pebbly beaches, gravelly river beds, and outwash plains in till: if artifact-like stones grade imperceptibly into non-artifact like broken cobbles that grade into whole cobbles, all the materials are probably natural.

Characteristics of the fracture may also indicate that an item is a pseudo-artifact. DICK STAPERT of the University of Groningen (1975) has cited certain features on the face of the fracture that are evidence for internal fracturing, such as may occur with freeze-thaw and insolation. Internal fracturing can leave a concentric bulb in the middle of the fractured surface; the bulb of flakes detached by an outer percussion blow, on the other hand, is always adjacent to the point of percussion. If rings or waves are present, they have a totally different profile from those on a fracture resulting from a blow on the outside surface of the stone. The fracture plane may also have a rough, stepped surface rather than a smooth one, as is usual from a percussion blow. The article by Stapert gives many more details and illustrates these fracture characteristics.

Fracture characteristics, however, may be difficult to discern on more coarsely-grained rock. In such cases, the putative artifacts can be compared with other stones in the geological matrix; if the artifacts are real, they should not have properties that make them more susceptible than the other stones to internal fracturing by natural processes. That is, they should not have more flaws or be less homogeneous than the other stones.

A spatial criterion may be applied if a natural agent is suspected. Hominid activity tends to be localized in space

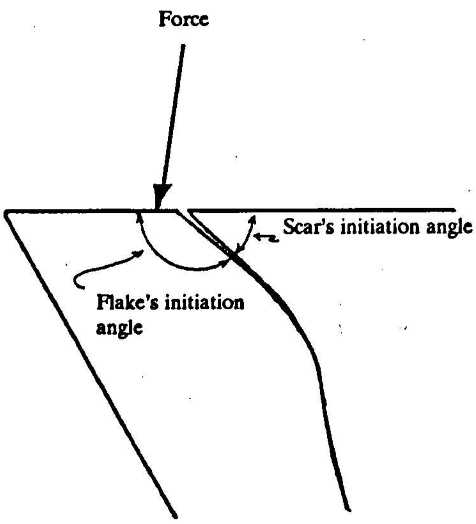

Fig. 3: De plaats van de beginnende hoeken op afslagen en kernen. Terminologie volgens Cotterell en Kamminga, 1987.

Fig. 3: Location of initiation angles on flakes and cores. Terminology taken from Cotterell and Kamminga, 1987.

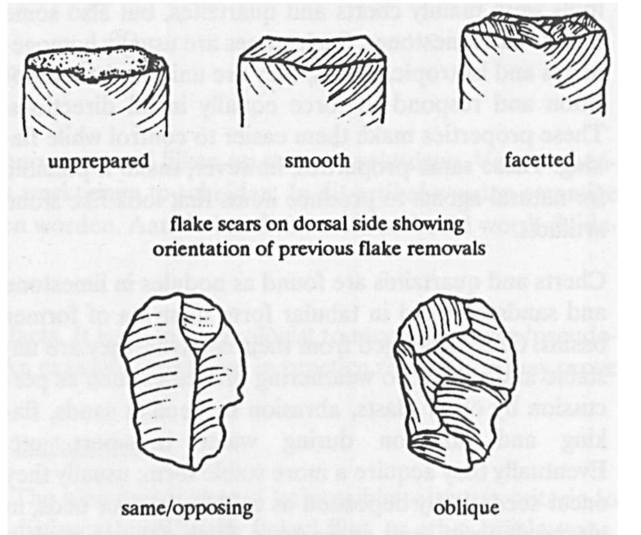

Fig. 4: Typen van slagvlakken en dorsale vlakken op Tertiaire afslagen.

Fig. 4: Types of butts and dorsal flaking found on tertiary flakes.

and this produces patterns in the distribution of artifacts. The distribution of pseudo-artifacts, on the other hand, tends to be random throughout the matrix. To apply this criterion, however, natural processes that may produce patterning, such as local or differential erosion, must be ruled out.

Archaeological criteria

In addition to criteria concerning the effect of natural agents in producing pseudo-artifacts, there are some purely archaeological criteria for identifying artifacts in a more positive fashion.

Alfred Barnes, the American archaeologist mentioned above, measured the angle between the negative of the flake scar and its striking platform on both real and pseudo artifacts; on this is the scar's initiation angle as shown on fig. 3. He found that angles above 90° on real artifacts from Acheulean, Clactonian, Mousterian, and Solutrean industries never exceeded 25% of the collection whereas such angles constituted upwards of 40-50% in all the collections of pseudo artifacts.

The same data can be collected by measuring the flake initiation with a goniometer. Most of the flaking angles, say 75%, on real artifacts should be greater than 90°.

This so-called Barnes test was used on the collection from Calico Hills in Southern California, a putative early man site in an Interglacial alluvial fan discovered by Louis Leakey. The collection flunked the test. This and other evidence eventually led to its rejection as an archaeological collection.

I have a dataset collected from materials recovered from four excavated archaeological sites in Central Italy, from four different paleolithic periods. Unlike the Calico Hills collection, there is no question that these materials are of human manufacture. Over 90% in each of these collections have angles greater than 90°.

The final criterion is the one that most people think of when talking about artifacts: artifact morphology. The examples of pseudo-artifacts that resemble the morphology of tools illustrated in figs. 1 and 2 show that this criterion does not apply equally to all formal types of artifacts. One should be suspicious, for example, of a collection that includes a lot of 'tools' with retouched concave edges--concave side scrapers, borers, and notches--and little else. A rather simple form that seems not to be produced by natural agents is a tertiary flake showing two or more flake removals on its dorsal face and having a prepared butt, either smooth or facetted as shown in fig. 4. In fact, pseudo-flakes do not as a rule have prepared butts (CLARKE, 1958), nor do pseudo-cores have prepared platforms combined with evidence for systematic working. A sinuous edge on a core with no prepared platform as shown in fig. 5 is a charac-

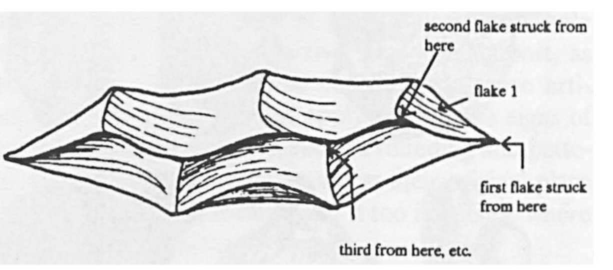

Fig. 5: Schematische weergave van de gegolfde rand van een kern zonder voorbewerkt platform, die gemaakt is door afslagen aan alternerende zijden.

Fig. 5: Schematic of the sinuous edge of a core without a prepared platform produced with alternate side flaking.

teristic of flaking by hominids and is particularly common on Lower and Middle Paleolithic cores; it shows that the core was flaked centripetally along the edge of what is usually a more or less two-sided piece with the blows being alternated from side to side. The model for the production of this type of core is, in the words of DE LOECKER (1992: 451), "... the first flake is at the same time the dorsal preparation for the second one, the second for the third, etc." Such cores have been reproduced experimentally by Don Crabtree of the Idaho State University Museum, and the process of making them is shown in a video entitled "The Flintworker: Principles of Flaking Stone" (edited by Earl H. Swanson).

The problem with using only morphological criteria is that it may lead to ignoring or discarding much archaeological evidence. There are probably more studies about how chimpanzees use stone tools than about how humans do. But the few ethnographic studies available indicate that flakes are selected for use as tools according to such attributes as the angle and form of the edge, size, and facility in hafting, whereas overall morphology, as represented in archaeological classificatory systems, is not usually recognized (e.g. WHITE and THOMAS, 1972). This is a complex issue, and archaeologists are using microwear analysis for, among other things, finding out how and if tool form can be related to function (e.g. ANDERSON-GERFAUD, 1990).

<u>Summary</u>

In summary, there are a number of criteria that can be used for recognizing stone artifacts. The first is that the artifacts are made of raw materials not present in the local geological matrix. The second is a set of criteria to rule out natural agents in situations where the raw material is present locally. These include investigation of the total geological matrix and of fracture characteristics of the stone. Initiation angles as measured on cores and flakes provide the third major criterion.

It is important to note that the second and third criteria are statistical ones and cannot be used to evaluate a few finds.

The fourth criterion is that the artifacts have morphologies or features not produced by natural agents. Finally, in certain situations, microwear analysis and core refitting techniques can provide unequivocal evidence for real artifacts.

<u>An example of a problem in central Italy</u>

Although I do not work with very early materials, our regional surface survey in West Central Italy (fig. 6) encountered several problems in distinguishing between real artifacts and pseudo-artifacts, two of which I will discuss here.

The survey region was occupied through much of the Upper Pleistocene as a series of absolute dates for archaeological deposits show. The earliest date is an average ESR of 110,000 BP on the lowest archaeological strata of Grotta dei Moscerini along the coast (SCHWARCS *et al.*, 1990-91). The older deposits in the region have rather stable surfaces according to physical geographers from the University of Amsterdam who mapped the soils. The older deposits include former coastal beach ridge and lagoonal systems, inland lagoons, aeolian sands, travertines, and tuff (SEVINK *et al.*, 1984).

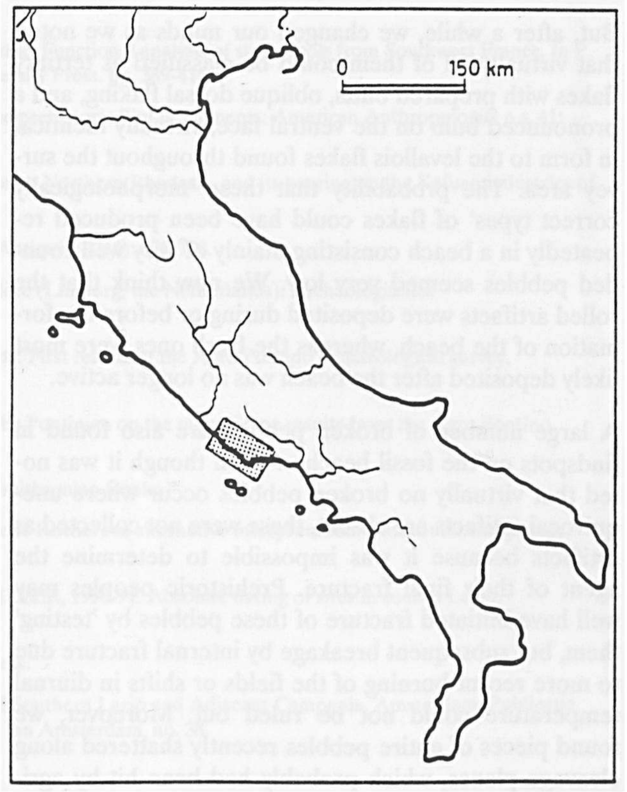

Fig. 6: Kaart van Italië met de plaats van de Agro Pontino onderzoeksgebied.

Fig. 6: Map of Italy showing location of the Agro Pontino survey.

Most of the stone artifacts found in the region are made from rounded, rather small pebbles, many of which are flint, found in fossil beaches. These beaches ceased to be active after isotope stage 5 and today are located slightly inland away from the present day coast.

In a number of places the pebble beds are exposed on the surface, and collections from findspots on them include recognizable tools--Mousterian points, déjeté side scrapers, carinated end scrapers, backed bladelets, etc.--and systematically worked cores, such as discoidal and prismatic cores, along with a hefty proportion of flaking debris. These items have a relatively fresh appearance. In association with these fresh artifacts, what appeared to be rolled artifacts also occurred in a number of findspots; most of these findspots were on the fossil pebble beach dated to about 90,000 BP (the Borgo Ermada level). At first, thinking that these rolled artifacts were 'ecofacts', we collected them as curiosities.

But, after a while, we changed our minds as we noted that virtually all of them could be classified as tertiary flakes with prepared butts, oblique dorsal flaking, and a pronounced bulb on the ventral face, virtually identical in form to the levallois flakes found throughout the survey area. The probability that these 'morphologically correct types' of flakes could have been produced repeatedly in a beach consisting mainly of very well-rounded pebbles seemed very low. We now think that the rolled artifacts were deposited during or before the formation of the beach, whereas the fresh ones were most likely deposited after the beach was no longer active.

A large number of broken pebbles are also found in findspots on the fossil beaches. Even though it was noted that virtually no broken pebbles occur where unequivocal artifacts are absent, these were not collected as artifacts because it was impossible to determine the agent of their final fracture. Prehistoric peoples may well have initiated fracture of these pebbles by 'testing' them, but subsequent breakage by internal fracture due to more recent burning of the fields or shifts in diurnal temperature could not be ruled out. Moreover, we found pieces of entire pebbles recently shattered along cleavage planes, which probably had been hit by agricultural implements. On the other hand, whole and broken pebbles *were* collected as artifacts if they were not

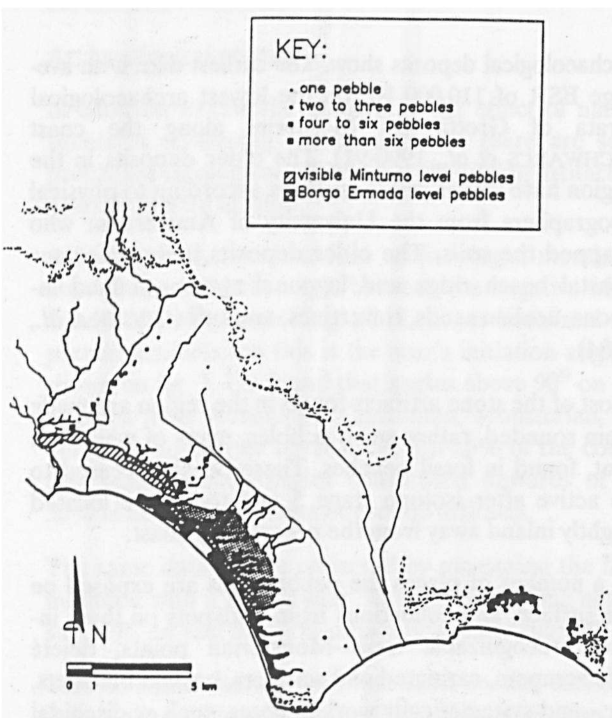

Fig. 7: Kaart van het Agro Pontino onderzoeksgebied met daarop de verspreiding van kiezelstenen die verzameld zijn als artefacten buiten de kiezelstranden (kartering volgens bodemonderzoek). De donkere gebieden geven aan waar ondergrondse afzetting van kiezelstranden kunnen worden aangetroffen.

Fig. 7: Map of the Agro Pontino survey area showing the distribution of whole pebbles collected as artifacts outside the gravelly beach ridges as mapped by the soil survey. The shaded area indicates where subsurface deposits of gravelly beaches may be located.

on the fossil gravelly beach ridges as mapped by the physical geographers and if our observations showed that pebbles did not occur naturally in the matrix. That is, it was assumed that they had been transported by prehistoric peoples. Although this would seem to be a relatively straightforward criterion for distinguishing artifacts, two major problems with it have subsequently emerged.

First, the physical geographers did not determine the subsurface extent of the pebbly fossil beach ridges; about all that is certain is that pebbles are not associated with the oldest littoral formation, the Latina level, nor with the inland lagoonal formations. Second, after several years, we noted that a reasonable number of whole and broken pebbles had been collected in some places not far from the fossil ridges (the shaded area shown in fig. 7). Although we suspected that pebbles did exist in the matrix at those places, possibly at some depth, we could not establish this definitively in the field or in analyses using our locational and topographic data. A combination of aeolian deposits (LOVING *et al.*, 1990-91; 1992) and tectonic movements could account for the field situation. For the present, we assume this was the case and will interpret the collections accordingly. The matter, however, needs more investigation.

The criterion that artifacts are real that show transport away from their geological source, therefore, is simple in concept but may be quite difficult to apply.

Conclusion

The problem of pseudo-artifacts and means of detecting them have been in the literature for almost a century. Yet, the problem keeps coming up, in some cases, apparently, because of ignorance or wishful thinking, as at La Belle Roche (ROEBROEKS and STAPERT, 1986) and in other cases because of the complexity of geological formation and post-depositional processes. Criteria have been established on a number of grounds, and we can expect that future experiments and investigations will lead to more of them. But to be effective, such criteria have to be applied as well.

Acknowledgements

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