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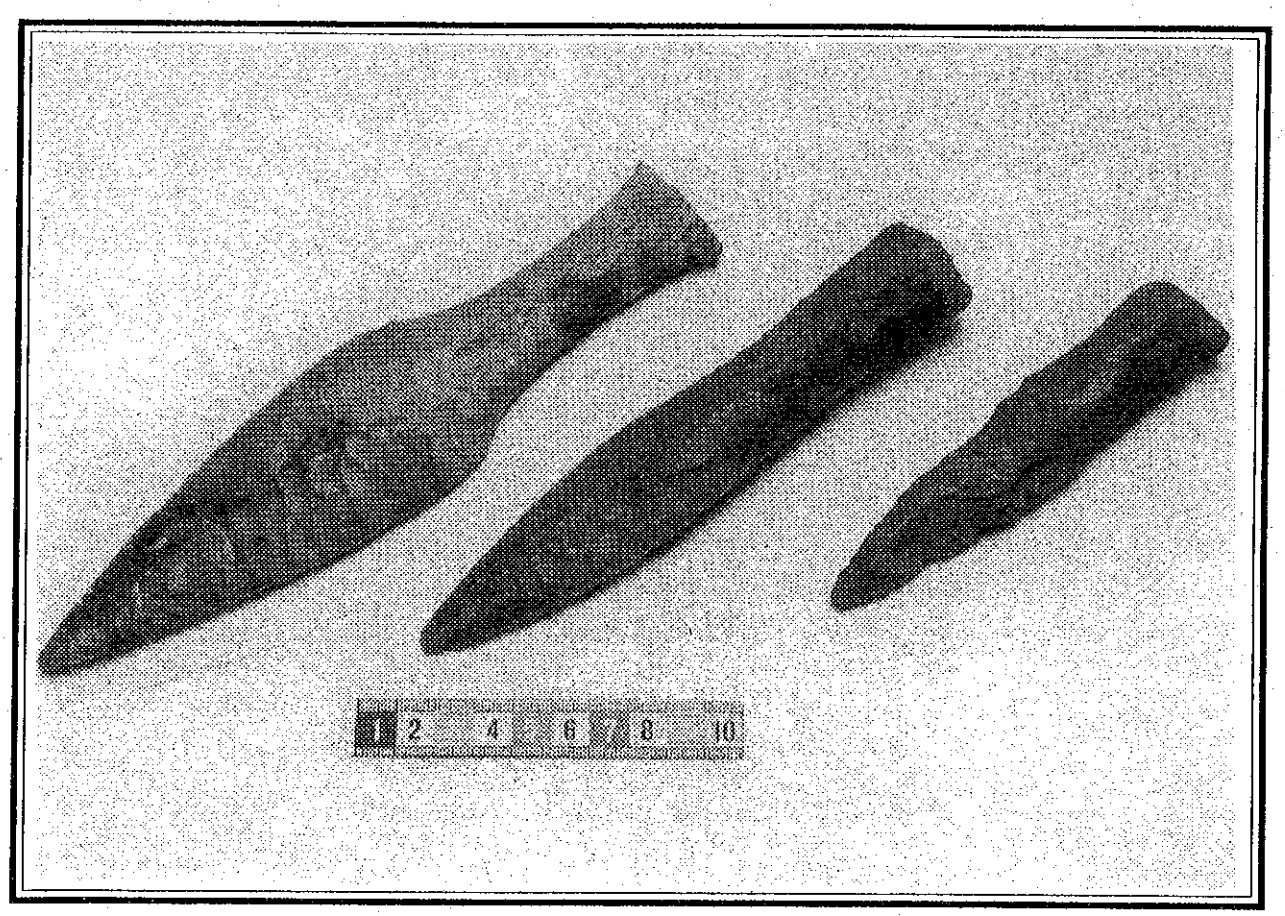

DIFFERENT STROKES FOR DIFFERENT FOLKS POSSIBLE REASONS FOR VARIATION IN QUALITY OF KNAPPING

Deborah Olausson

INTRODUCTION

When one studies the various classes of flint tools from Scandinavia, one quickly becomes aware of differences in the quality of how the objects are knapped. In the case of Neolithic thin-butted flint axe blades, for instance, I noted a connection between blade length and chipping quality; longer axe blades were generally better-made than shorter blades (Olausson 1983:21). In like manner, my examination of 600 Late Neolithic flint daggers from Scania indicated that these also show a range of knapping quality. Classifying knapping quality into the categories "poor," "fair," "good," and "excellent," I considered 54% to be "good" quality, while 7% showed poor quality knapping and only 1.5% exhibited excellent knapping (Olausson n.d.) (Figure 1). And at the Magdalenian site of Pincevent, Karlin and Julien (1994) identified at least three levels of knapping skill evident in the refitted cores at the site (Figure 2).

Why does this difference exist? In the case of daggers and thin-butted axe blades, at least, many archaeologists have argued that the better-made items are prestige goods. In this paper I will be looking at one of the possible mechanisms that can lead to the social acceptance of some items as prestigious, namely, manufacture by skillfull artisans. First let us look at the arguments that link manufacturing competence and prestige goods. Hayden (1995:68) theorized that certain enterprising members of society, whom he called aggrandizers, introduce prestige technology in order to channel food surpluses into concrete objects which can then be used in social transactions. Such objects retain their value as long as they are rare, which means that aggrandizers must continuously strive to maintain control over these items in some way.

However, at least for axe blades and daggers, it is difficult to speak of prestige technology with regard to entire classes of objects. The well-made daggers and axe blades are elaborated members of their respective classes, but they are not unique. Apparently, no one held a monopoly over the manufacture of these classes of items *per se*; any prestige value which some members of the classes may have had must have depended on certain characteristics of individual items. I am suggesting that one of the means of controlling rarity is by controlling an especially talented artisan who can make special items.

The argument that prestigious qualities of individual artifacts may lie in the high quality of workmanship they represent leads to the question of whether all members of Neolithic society were capable of high quality workmanship. If they were not, gaining control over (or being) a knapper who possessed both unusual ability and high skill would be one means for an aggrandizer to control the potentially prestigious products made by that knapper. In other words, if substantial knapping ability is a limited quantity, then gaining control over this can be just as viable a means for an aggrandizer to limit access as gaining control over the source of a rare raw material. That is why it is important to find out how to recognize and explain differences in knapper ability in prehistoric populations. One possible way to do so is to examine knapper products (Olausson n.d.); another means is by examining contemporary knappers to investigate reasons for differences in quality of knapping, which is the subject of the present article.

It is important to make a distinction between "skill" and "ability." In this paper I will use the term "skill" to denote actions which can be learned and improved with practice. A skill is often asso-

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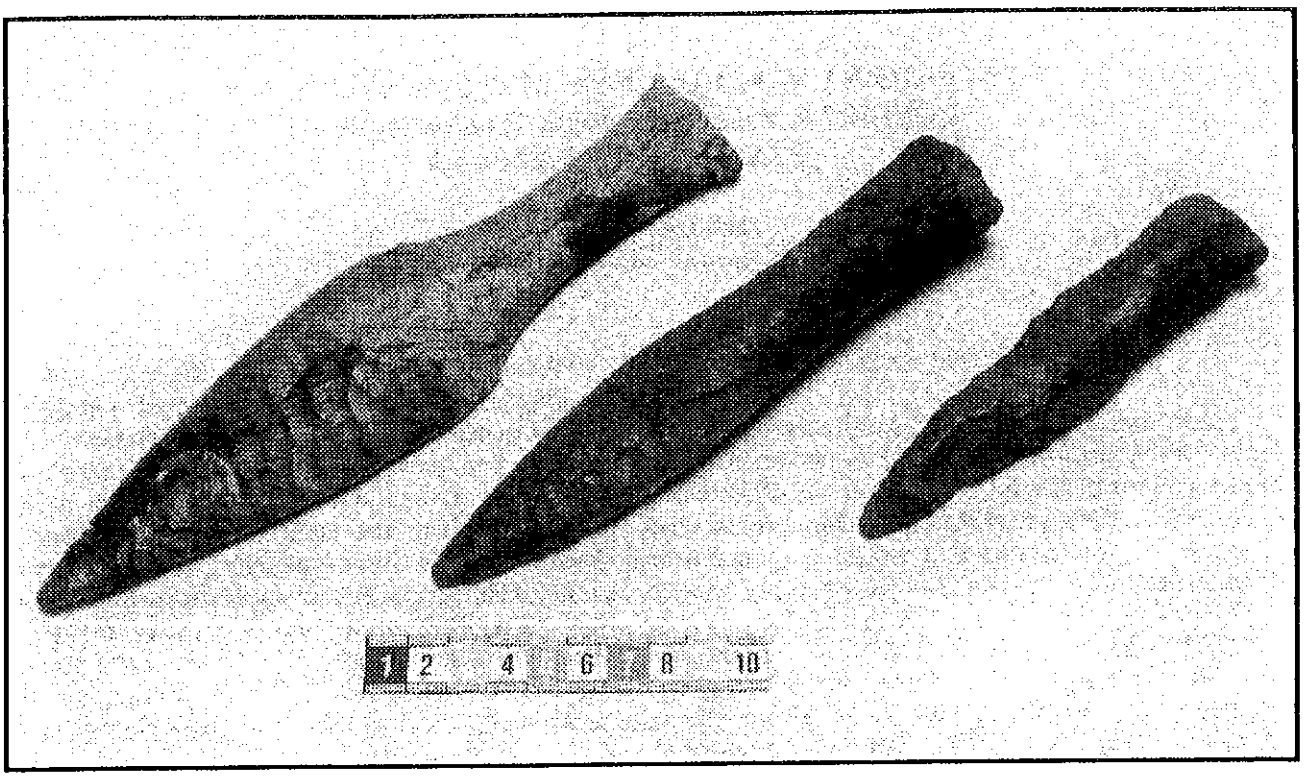

Figure 1. Three Late Neolithic flint daggers from Southern Sweden. These illustrate to some extent the range in knapping skill evident in the prehistoric material. The object to the right is probably reworked, thus separating poor quality knapping from damage and reworking can be difficult. Qualities such as regularity, balance and symmetry, and number of gross knapping errors were considered. Scale in cm.

ciated with precision, regularity, optimization, swiftness, and so on. In other words, skill is the result of some learning process that enables the level of dexterity to increase (Roux et al. 1995:66). I use the term "ability" to denote inherent talents or proficiencies -- high ability means that an individual has an aptitude for learning knapping skills but, by definition, ability cannot be improved by learning. In practice, I doubt that it is possible to separate these qualities in humans. What I would like to find out is if high knapping ability enables some individuals to reach higher skill levels than can be attained by individuals who lack this ability.

EXPLAINING DIFFERENCES IN QUALITY OF KNAPPING ON PREHISTORIC OBJECTS

Let us re-examine the original question: How can we explain observed differences in knapping quality on prehistoric objects? There are at least three possible explanations for this phenomenon.

1. Strategic or situational: First let us consider the possibility that differences are not due to differences in knapper ability. In other words, anyone was capable of what I have called excellent quality knapping, but circumstances dictated that one did not always use one's abilities to the utmost. If everyone in a group had equal access to dagger-making abilities, then no aggrandizer could use excellent-quality daggers (or thin-butted axe blades, or whatever) for prestige purposes. I can think of no way to test this possibility using archaeological material in which only the results of actions, not processes themselves, are visible to us.

2. Apprenticeship: A second possibility is that poorly knapped objects are practice pieces made by more inexperienced knappers on their way to reaching top-level skills. There exist archaeological examples in which the evidence has been interpreted in this way (Figure 2). For instance, Pigeot's (1990:131) refitting analyses of flint material from the Magdalenian site of Etiolles revealed different degrees of mastery. Among sev-

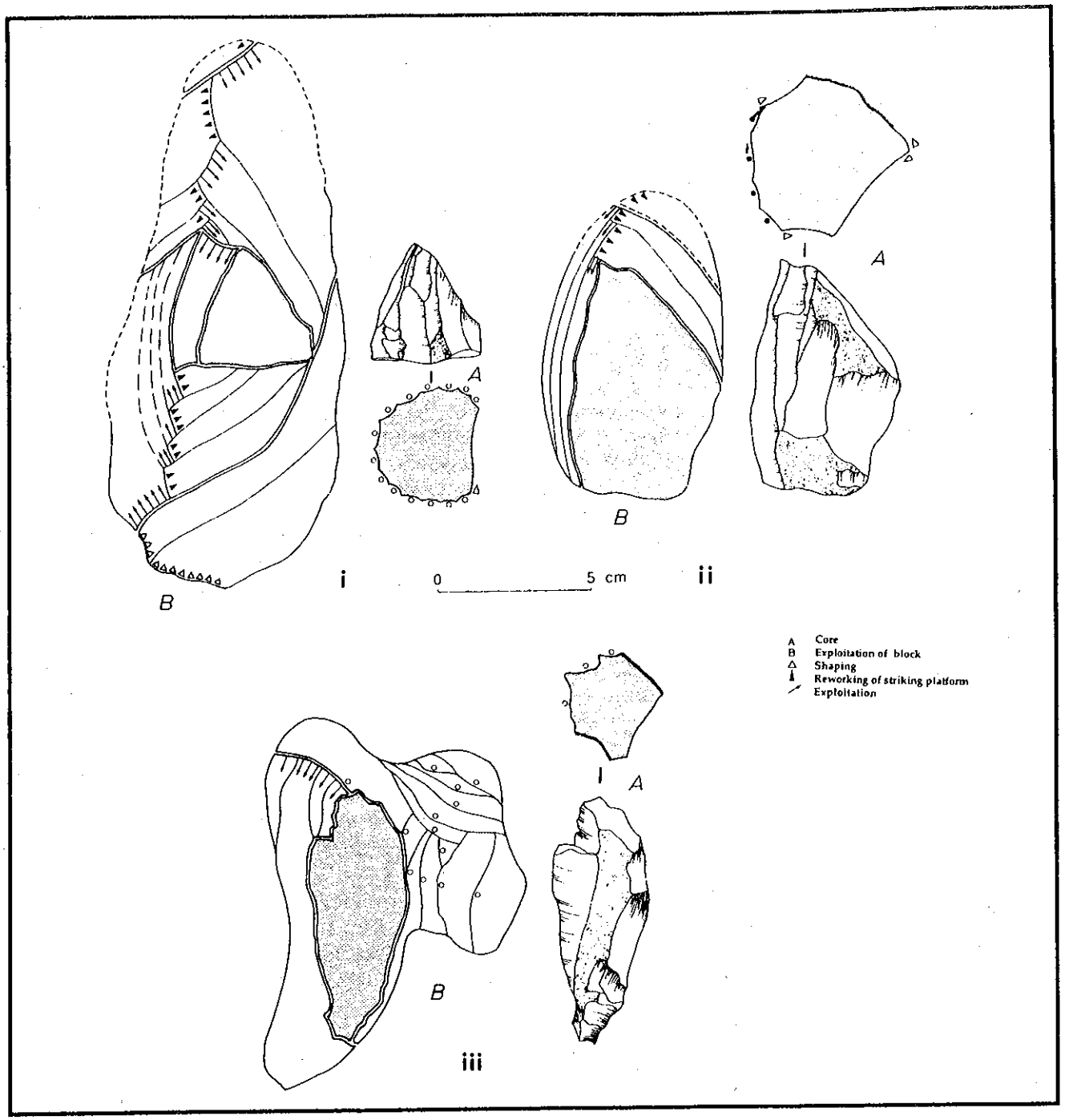

Figure 2. The differences between the three levels of technical skill identified in Magdalenian knapping at Pincevent.

I. Level 1 knappers implemented a complex work program optimizing the primary material, which implies a mastery of concentration and appraisal.

II. In the debitage of level 2 knappers the capacities for evaluating all the data and forward planning are absent. Errors of movement and use of defective material may lead to premature abandonment of the core.

III. The work of the level 3 knappers (novices) was characterized by lack of knowledge, difficulty with forward planning, and poor control of movement (reprinted from Karlin and Julien 1994: Figure 15.2, with permission).

eral scores of refitted clusters from one habitation site, 25 displayed an excellent mastery of knapping procedures, implying the presence of theoretical reflection as well as manual skills. On the other hand, 11 of the debitage clusters were burdened by errors of conception and execution, by approximate and, at times, incoherent reduction strategies, and by groping and tentative behavior. Pigeot concluded that these clusters represent clumsy and stumbling attempts by novices, that is, individual knappers still lacking the necessary knowledge for the successful manufacture of desired products. And at the Magdalenian site of Pincevent, Karlin and Julien (1994:162) discovered refitted cores from which no pieces were missing. These they interpreted as evidence for apprentice flintknappers who were trying to learn new techniques rather than producing usable material.

A similar case is Fischer's analysis of collections from the Danish Late Paleolithic site of Trollesgave. Here, too, refitting analysis yielded evidence for at least two qualities of knapping. One showed a high degree of control and regularity while the other evidenced less precision in force and accuracy. Fischer (1990:44) interpreted this as evidence for a master craftsman and a younger, more inexperienced knapper.

No doubt there is a great deal of further evidence for practice pieces in the archaeological record -- evidence that goes largely unrecognized, since it lacks the characteristics of formal tools or preforms (see, for instance, Liversage & Singh 1985:71). Where raw material is limited, beginners' mistakes may have been corrected by a more experienced knapper and would be invisible for this reason (Shelley 1990). In the Etiolles and Trollesgave examples, conditions for identifying apprentice knappers were ideal: both sites had a limited spatial extent that permitted the identification of discrete knapping episodes, collections of manageable size, and expedient use of raw materials, which permitted refitting. A further prerequisite for such analysis is control of differences in material quality and available technology. That is, we can make comparisons only within a particular cultural or archaeological context.

I am convinced that the less skillfully worked nodules at Etiolles and Trollesgave could, in fact, have been practice pieces worked by learners. However, the question remains whether these apprentices ever reached levels represented by the master knappers at these sites. Would time and training have been sufficient for this to occur? Again, we cannot answer this question on the basis of the archaeological evidence. Pigeot (1990:139) speculated that the 25 elaborate debitage clusters represent one or more knapping specialists whose knowledge *surpassed* that of the average adult in Magdalenian society. The high level of technical skills shown on these refitted nodules indicates unusual ability. Her analysis further revealed at least seven technical levels of successive know-how acquisition (Pigeot 1990:134). If Pigeot is correct in her assumption that the highest knapping level seen at Etiolles could not have been reached by all Magdalenians, then presumably not all of the apprentice knappers would have been able to attain that level, even with the instruction they seem to have been given at Etiolles. However, once again archaeological data are insufficient for our purposes, since we cannot follow one individual's development through time.

3. Inherent ability: The third possibility is that, as Pigeot and others have suggested, and indeed as our own experiences in the present world seem to tell us, some people are "naturally" better knappers than others. Using the daggers in Figure 1 as an example, I can envision a situation in which the maker of the middle dagger was "aiming" for an end product like the dagger on the left. Different abilities and levels of skill, however, meant that he or she was unable to realize the template in flint, which is a difficult raw material to master. Further, according to this hypothesis, additional practice and training would never have lifted that knapper to the level attained by knapper 1.

INVESTIGATING DIFFERENCES IN KNAPPER COMPETENCE

The possible existence of natural ability cannot be investigated using archaeological data alone, because we cannot interview prehistoric knappers. There is, however, some evidence to be found in the contemporary knapping world which supports this idea. For instance, Whittaker carried out an experiment in which he asked five contemporary knappers to copy the same projectile point from Grasshopper Pueblo. The resulting points showed quite a range of variation. This he attrib-

uted to, among other things, differences in knapper competence (Whittaker 1994:292). Applying these results to the point collection from Grasshopper Pueblo, Whittaker concluded that evidence for different skill levels in point manufacture indicated many knappers at many levels of skill, rather than a few skilled specialists (Whittaker 1994:297). In another example, Dickson's (1981) ethnographic study of Australian Aborigine axe blade manufacture revealed that all members of the group were skilled workers, having learned from childhood how to make tools and manipulate materials. Nevertheless, differences in abilities between individuals meant that not all tools were equally well made. Callahan has written of his experience from teaching biface reduction to 350 university students over a 7-year period. The students grasped the simplest reduction strategy in two hours. The next phase, flaking to the median line so as to cover the entire surface of a biface with flake scars, could be learned in 4 to 8 hours. As early as this second phase, however, Callahan observed differences in ability. He noted that some students could achieve success within the first session (with considerable instruction), while others might fail to master it in a semester (Callahan 1979:38).

These examples indicate to me that there is some component of inherent ability involved in flintknapping. As one example of a contrary belief, I can cite an unpublished study of contemporary knappers by John E. Clark (Clark n.d.). He postulates a direct relationship between knapping skill and time spent knapping. Hypothetically, he sees no limit to the level of skill a knapper can reach, although time constraints mean that, in practice, each craftsman will reach a plateau of skill dictated by his or her annual production.

Archaeological evidence alone is inadequate for choosing between these three alternative explanations. My only means of insight into prehistoric levels of skill and/or ability is through the physical results of the excercise, and I can never follow one prehistoric flintknapper's development through time. Capacities which are not realized in material culture will not be visible to us. As Thomas Wynn wryly remarked, "there is no way logically to eliminate the possibility that prehistoric Einsteins were making crude stone tools while speculating about general relativity" (Wynn 1985:33).

Why should it be important to try to find out if knapping ability -- or perhaps I should say the aptitude for knapping -- is evenly or unevenly distributed in a population? In order to answer this question, I must return to the introductory discussion and consider the social as well as the practical roles played by material culture -- or, in our particular case, by flint tools :

> It seems that, as with all creative activity, making stone implements may have a dual purpose; an instrumental function, and an aesthetic, communicative or even social function.... It would seem to me that in order to interpret an artefact we need to decide whether its maker meant anything by it, other than that s/he was going to cut some meat or the rind of a vegetable. (Graves 1990:104)

As anyone who has tried to knap is aware, flint and flint-like materials are difficult to master. Trying to "say" anything in flint means mastering flint grammar. Therefore, the better one has mastered knapping, the closer one is able to make the knapped product conform to one's ideas or what one wishes to say.

Let us consider whether innate knapping ability -- the ability to become a top-notch knapper -- is or is not evenly distributed in any population, leaving aside the question of how much one's level of skill can be raised by practice. If knapping ability is evenly distributed -- if everyone in a society is equally adept at knapping daggers -- then the especially well-knapped dagger sends the relatively modest message that its maker has taken special pains in making this particular dagger. However, such a dagger will only moderately impress the Neolithic neighbor to whom it is shown, since theoretically the neighbor would also be capable of making such a dagger (providing of course he or she had the time to do so). If, on the other hand, the ability to make such a dagger is *not* attainable by all or most of the adult members of the group, a more significant -- a more social -- message can be encoded in the dagger. Ownership or control over such a dagger implies unequal access to ability, which may in turn be translated into unequal access in social standing. Just as limitations in access to raw materials can be manipulated to gain economic and/or social inequality, so also limitations in access to persons with exceptional knapping ability can be manipulated for such purposes. That is why it is impor-

tant to determine whether knapping aptitude is unevenly distributed in a population and, thus, potentially liable to control by aggrandizers.Here we find ourselves face to face with the familiar nature-nuture problem.

My intuitive response to the question is that differences do exist and that they are to some extent innate. In spite of four weeks of intensive training at Jeffrey Flenniken's Flintknapping Fieldschool in 1978, and subsequent (sporadic) practice, my own knapping abilities remain at a basic level. Also, after several years of experience teaching a few knapping techniques to archaeology students, I feel I can separate those with a natural aptitude for knapping from those who lack it. Furthermore, it seems to me that this difference is already apparent quite quickly in our session. Frustrated by an absence of archaeological data suitable for answering this question, I decided to survey contemporary flintknappers instead.

The aim of the investigation was to answer the following questions: What qualities make up a good knapper? And are there inherent attributes (physical and/or mental) that enable some individuals to reach a level of proficiency which those who lack these qualities can never attain? I was also interested in finding out who takes up knapping: What sort of individuals are drawn to this craft -- so essential in prehistoric times but so exotic today? In performing this analysis, I assumed that the modern knapper population is representative of the prehistoric knapper population. In at least one respect we can be quite sure they are not. Clark (n.d.) calls this the "Crabtree caveat." By this he means that contemporary knappers rarely master any one technique to the the degree that some of their prehistoric counterparts did. Modern knappers do not restrict themselves to any one knapping tradition, but tend to try out many techniques and to replicate pieces from varied temporal and spatial contexts. In at least one other important respect, I think a sample of modern knappers is not representative of prehistoric knappers. Survey responses indicated that most contemporary knappers see themselves primarily as artists rather than "mere" craftsmen. I will argue that prehistoric knapping populations included both artisans and artists.

SURVEY METHOD

I devised a simple questionnaire (Appendix 1) to try to find out what characterizes the modern knapper. Let me confess at the outset that my questions were mostly based on my own ideas of what might be important for my purposes. As we shall see, my subsequent examination of the literature yielded support for some of these ideas, while there were other capacities about which my questions failed to elicit the information I sought. Initially I mailed the questionnaire to 359 knappers whose names appeared on a list of addresses compiled in 1986 (Atwood & Harwood 1986). Questionnaires were also mailed to the knappers I know and administered to a group of beginning knappers attending a weekend course near Lund. I administered the questionnaire in English or in Swedish, depending on the context. As a native English speaker who has lived in Sweden for more than 20 years, I feel that I was able to eliminate bias due to translation problems. The total number of questionnaires which I mailed or administered directly was 443. I received 126 replies from these (a 28% response rate). I also published the questionnaire in the newsletters "Chips" (ed. D.C. Waldorf) and "Flintknapper's Exchange" (ed. Charles Spear). These appeals resulted in a further 71 responses. The total survey results reported here are thus based on 197 replies.

It is difficult to judge to what extent these answers are representative of the contemporary knapping population. In particular, the motives of respondents reached by "Chips" and "Flintknapper's Exchange," whose participation I did not directly solicit, are unknown. Many of these knappers sent photographs or newspaper articles pertaining to their knapping. It is quite possible that knappers in academic professions were more apt to respond to an appeal emanating from an archaeological department than those outside this sphere; on the other hand, non-academic knappers may have been flattered by the attention and eager to be taken seriously. The majority of the population (81%) consists of residents of the United States. The distribution of the remaining respondents was as follows: Sweden 18, Denmark 4, Canada 3, Scotland 3, France 3, England 2, Germany 2, Colombia 1, and Argentina 1. To respect respondents' anonymity, I have assigned a number to each reply. Where comments on the questionnaire have been quoted in this paper, I have referred to that number only.

A shorter version of the questionnaire, encompassing questions 6 through 15, was administered to first- and second-term archaeology students at the University of Lund in order to gain a comparative population of non-knappers. Fifty-eight students replied to this questionnaire.

The principal aim of the survey was to elicit information about natural talent in certain areas of physical and/or mental proficiency. However, I also included questions about knapping habits and preferences, and about how individuals learned to knap. In most cases the questions are self-explanatory; however, some may deserve further comment.

Questions 6-9 dealt with possible musical abilities among contemporary knappers. These questions were intended to elicit information about an activity which, it seemed to me, requires inherent talent and manual dexterity but in which regular practice can raise performance levels; in other words, a combination of qualities I would expect to find among good flintknappers as well. In fact, Wynn has noted that the capacity of sequence construction required in flintknapping is not limited to tool behavior. This capacity is commonly encountered in any human behavior requiring precise motor coordination, such as playing a musical instrument or engaging in certain sports in which units of action are learned by repetition (Wynn 1993:394). Questioning knappers about playing chess was based on an idea that chess requires high concentration and intellectual engagement, as well as the ability to foresee and plan for the consequences of one's actions several steps in advance. Questions 12-14 dealt with artistic ability. These questions were prompted by an observation I had made that several of the most skilled knappers I know have talent in two-dimensional arts (i.e., drawing and painting). Question 14 dealt with this link plus the ability to see three-dimensional shapes and translate them into two-dimensional forms.

As will be evident in the following analysis, question 17, in which knappers were asked to rate themselves in terms of knapping skill, is a pivotal question. Naturally, such a question is highly subjective and, as one knapper pointed out, ambiguous. Clark's (n.d.) study of the relationship between knapper skill and product quality focused on this variable. Clark noted several sources of bias that can disturb an assumed relationship between knapper skill and product quality. These are, for instance, the frequency of knapping episodes, how much practice one has with making a specific item, aging and loss of physical capability, etc. In the present study I asked knappers to rate themselves on a scale of one to ten. Using a scale with ten gradations allowed me to consolidate ratings into the coarser categories "excellent", "fair" and "poor", which should yield a fairly accurate picture. Many knappers included verbal comments which illuminated their answers, or shared their own thoughts on the information I was seeking. In any case, it was not feasible for me to arrive at any objective measure of knapper skill, given the geographical spread of the population.

The results of the survey were analysed by means of StatView 4.1 (Haycock et al. 1992). The nominal form of most of the data prohibited the use of powerful statistical tests. On the other hand, the simplicity of the analyses makes them readily understandable.

PRESENTATION OF THE DATA

Characteristics of the knapping population

Handedness (Figure 3). The majority of the respondents (86%) were right-handed; five were ambidextrous. Our knapper sample is therefore representative of the population at large, in which aproximately 10% are left-handed. Comparable figures for prehistoric populations are difficult to ascertain, but there is some evidence for the prevalence of right-handedness in prehistory, as well (Michaels 1984:17; Springer and Deutsch 1989 :141-42).

Sex. Modern knapping is a male-dominated activity; 95% of the respondents are male. Gero (1991) has commented on this bias, noting that, while many women archaeologists have learned to knap, there is virtually no published literature by women as flintknappers. Flintknapping requires no unusual strength (Whittaker 1994:2; Johansen 1996:21). However, Whittaker observes that male students are easier to teach than females. He attributes this difference to cultural factors: boys from an early age are more likely to be taught hitting and related skills that are applicable to knapping and other crafts (Whittaker, personal communication). Another social factor was captured by one respondent who commented that the

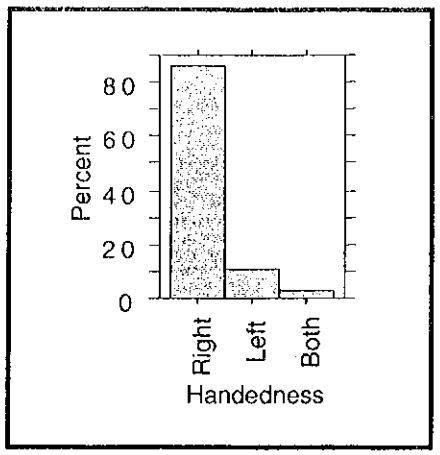

Figure 3. Percentage distribution of handedness in the contemporary knapper population.

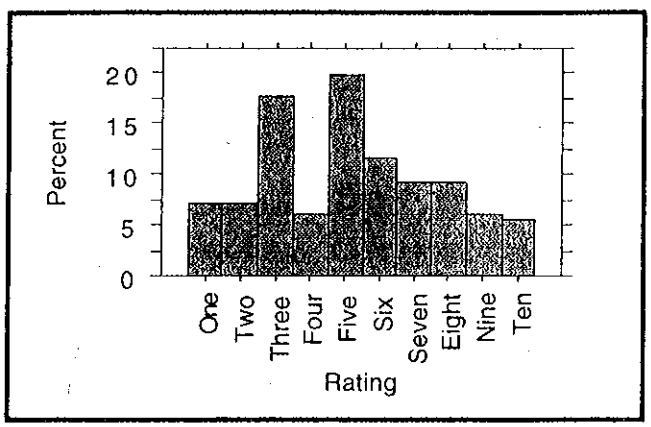

Figure 4. Knappers' assessment of their knapping skill. "One" denotes excellent, "ten" is poor.

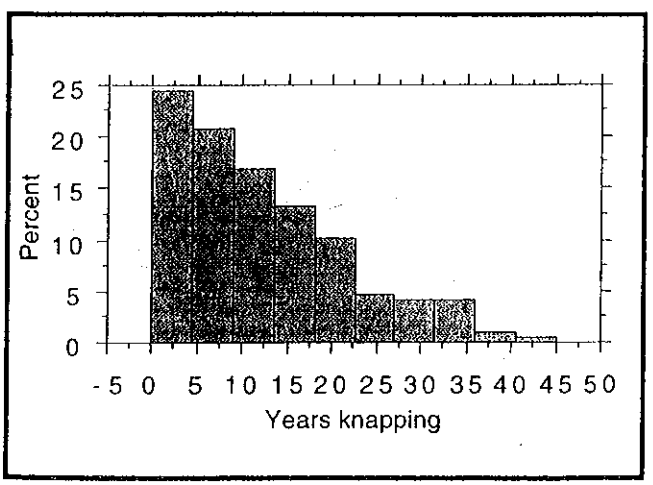

Figure 5. Percentage distribution of the length of time repondents have been knapping.

contemporary knapping world is characterized by a markedly male ethos (#80).

Rating. In question 17, knappers were requested to rate their knapping skills on a scale from one (excellent) to ten (poor). The frequency distribution of the results is illustrated in Figure 4. As should be expected, there is a normal distribution with the exception of an unusually low count for rating category four. In Figure 5 we see a fall-off curve for the length of time the respondents have been knapping (Q 16). Note that this question elicited information about how long the respondent had been knapping, but says nothing about intensity. To obtain a somewhat more informative picture, we can examine the relationship between skill rating and years knapping, as shown in Figure 6. There is no simple relationship. For instance, one knapper who has been knapping for 30 years considers him/herself to be a poor knapper (rating nine), while several who have been knapping for less than five years consider themselves to be level three. One question pertaining to this conclusion is to what extent this applies to the prehistoric situation. Was knapping a steadier activity and skill thus more age-correlated? More central is the question, Does further practice result in higher skill? I will return to this question below.

Profession. Figure 7 shows the distribution of professions among survey respondents. Approximately 20% of the knappers who answered the survey listed their occupation as archaeologist. There may be some sample bias here, resulting from fellow archaeologists being more inclined to respond to a questionnaire sent out by an archaeologist. The second most common professions involve technicians or craftsmen. These include plumber, printer, electrician, carpenter, etc., and emphasize working with the hands. About 11% of the knappers had outdoor professions such as park ranger, farmer, or forester. It comes as no surprise that an interest in flintknapping coincides with these professional choices. More surprising are those surgeons who risk their livelihood by pursuing a hobby as dangerous to the fingers as flintknapping!

A chi-square analysis comparing rating and profession weakly supports Whittaker's suggestion that there are probably more nonacademic knappers than archaeologists at the highest levels of knapping skill (Whittaker 1994:61). Among

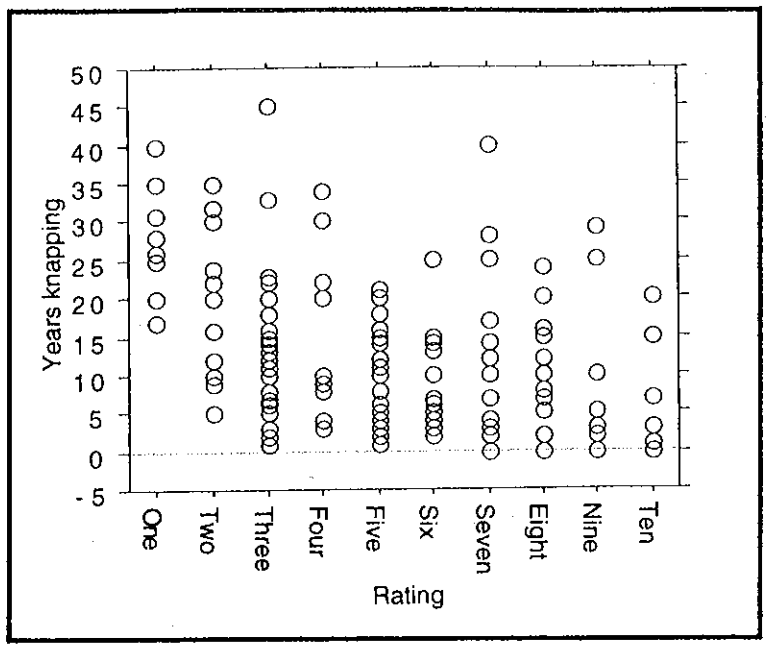

Figure 6. Scattergram relating years knapping to knappers' skill rating. Each circle represents one knapper.

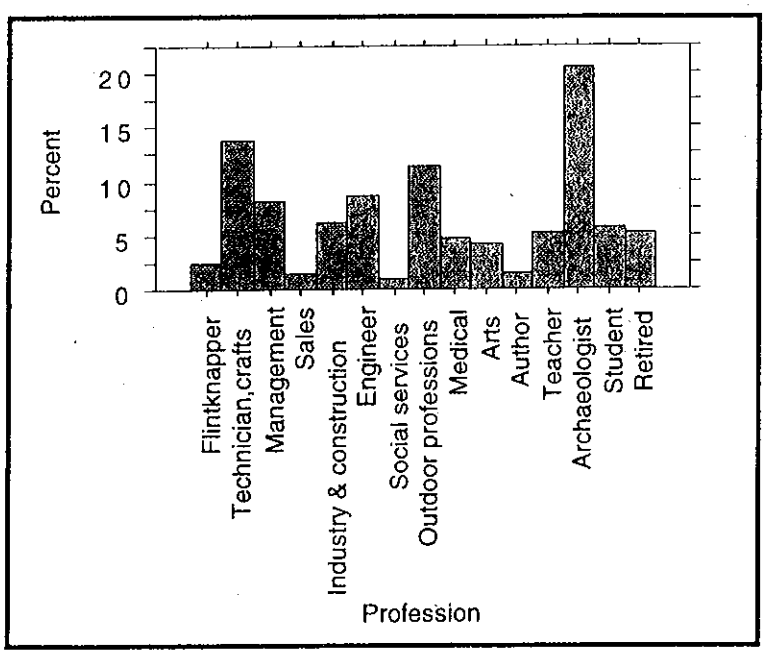

Figure 7. Distribution of professions among contemporary knappers.

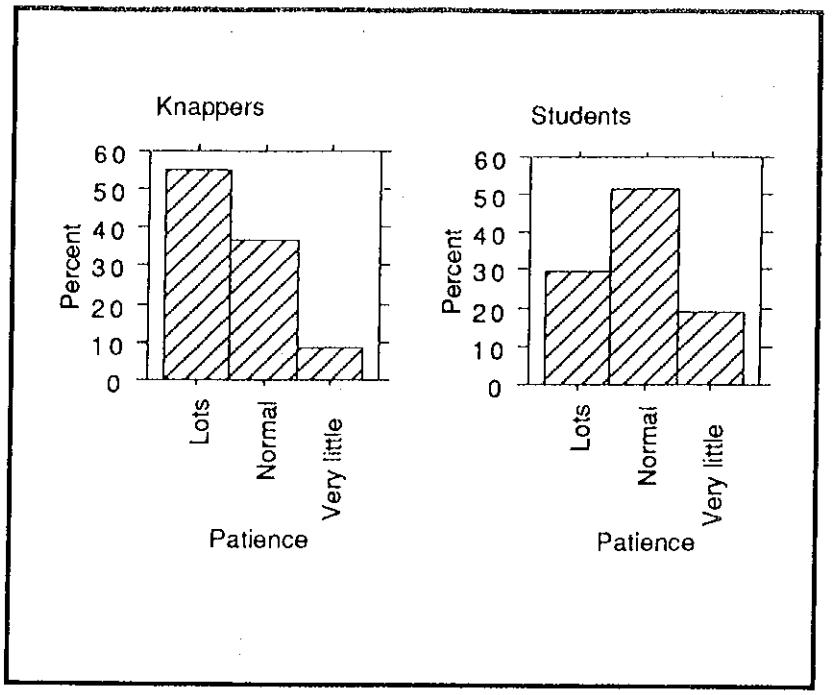

Figure 8. Reponses to the question, How much patience do you have?

those who rated themselves as skill category one, the professions "flintknapper," "sales," "outdoor professions," "arts," "archaeologist," and "retired" yielded the highest *post hoc* cell contributions.

Patience. Are flintknappers especially patient people? In general, most knappers considered themselves to be more than normally or normally patient. By contrast, only about 29% of the students considered themselves to be especially patient (Figure 8). With regard to the question of whether the best knappers are also the most patient, a Chi-square test indicated no significant relationship.

Other qualities possessed by knappers

Musical Instrument. An interest in playing a musical instrument is not strongly correlated with an interest in knapping: 60% of the knappers replied negatively to this question. In contrast, 55% of the non-knappers said they did play an instrument. Among the knappers who play, only 25% said they played regularly. Together, these figures indicate that flintknappers have a weak interest in playing, and practicing, a musical instrument. Regular practice with the aim of improving musical skill is the exception in our sample of knappers.

The ability to play an instrument is a combination of manual skill, which can be improved with practice, and an ephemeral quality known as musical talent. I hypothesized that similar qualities should be required for the accomplished knappers. An explanation for the low correlations by knappers may be that playing an instrument and knapping are competing activities, i.e., the cost of achieving high knapping skill may mean giving up the piano. Another aspect of this can be found in the following comment from the questionnaire:

> Knapping -- music: no, no, no; No musical ability; nor my family; I tried trumpet for 5 years, hated it. Perhaps composing music or making it up as you go is like thoughts in knapping. (#32)

Another respondent commented that, although he does not play an instrument, he is very musical. The reason he did not play, he said, is that he is too lazy and his parents did not force him when he was young (#119). Perhaps the musical attribute most significant for knapping is creativity, rather than the discipline involved in learning to

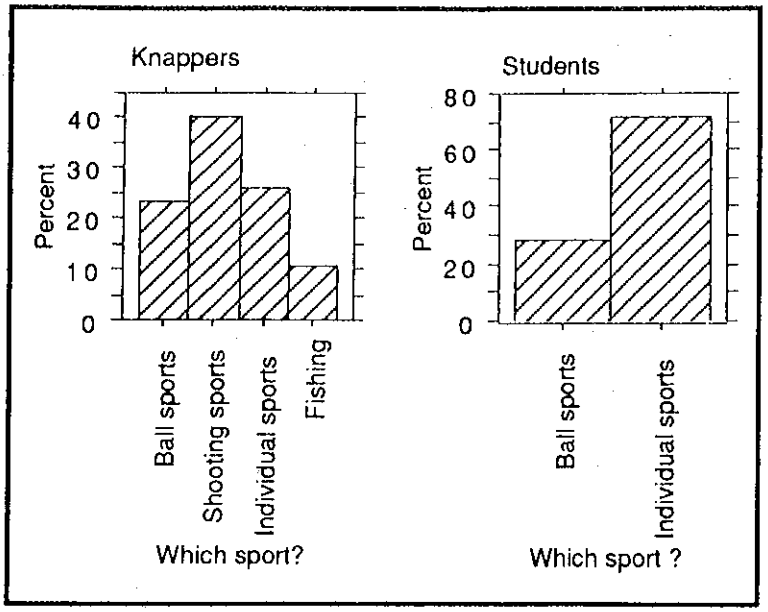

Figure 9. Distribution of sports preferences among those who participate in some sport.

play an instrument. I will return to the question of creativity below.

Chess. As indicated in the introduction, the reasoning behind the question, "Do you often play chess?" was that a good chessplayer, like a good knapper, must plan ahead. The importance of this for flintknapping can be illustrated by a passage from *Flintknapping: Making and Understanding Stone Tools*:

> Each flake, or each goal, such as removal of a lump, needs to be prepared for. Sometimes this is simple platform preparation, sometimes it requires thinking several or even many flakes ahead. Each flake that is removed has consequences for later flakes, making them easy or causing problems that have to be overcome. At each stroke you have to be thinking of the whole biface. (Whittaker 1994:206)

The results here do not confirm our expectations, however. The vast majority of the knappers (85%) answered "no" to this question. The lack of correspondence could be partly a result of the unfortunate use of the word "often" in the question. Those who do play, although not often, as well as those who do not play chess at all, may have answered "no" to the question. A smaller proportion among the student population, 56%, answered that they did not play chess. When applying a chi-square test to determine if there is a statistically significant relationship between knapper skill and playing chess, I found no significant relationship. These results, therefore, are the opposite of what I had expected.

Sport. The response to the question, "Are you active in some sport?" showed that 67% of the respondents engaged in some sport. Figure 9 shows the distribution by category. The most popular category, "shooting sports," includes archery and hunting. "Individual sports" include running, hiking and skiing and make up 26%, while 23% of those who practice sports are interested in ball sports such as soccer or tennis. None of the respondents from the student survey engages in shooting sports. Among those who participate, 70% practiced individual sports and 30%, ball sports.

Artistic. In posing the question, "Are you artistic?" I consciously abstained from defining what I meant by "artistic." In most cases the follow-up question, asking respondents to specify artistic medium, clarified for them and for me their answers to

question 12. By "artistic" I mean both creativity and the capacity to express this creativity through a physical medium. Respondents who identified, for instance, poetry or creative writing as their medium were therefore coded as "no" for question 12.

Based on the results of this questionnaire, it would appear that knappers are (or consider themselves to be) creative people. When I split artistic ability by rating (Figure 10), I found that only among knappers of skill rating four and ten did those who considered themselves not artistic outnumber those who were.

Figure 11 shows that the most popular media (43%) among knappers are the sculptural media requiring three-dimensional abilities: wood, metal, clay, soapstone, etc. This result does not surprise me, since it is not difficult to conceive of the ability to manipulate these media as similar to the ability required for flintknapping. Both are based in forming three-dimensional objects or materials to reach a mentally conceived final product. However, nearly as many knappers (41%) listed drawing or painting as a favorite medium. Among the students, drawing or painting was most popular (54%), and none listed sculptural media as a first choice.

I assume that drawing or painting requires talents slightly different from the sculptural media. Drawing usually involves translating our three-dimensional world into a two-dimensional form. Elaboration on this theme can be found in Figure 12, in which 65% of the knappers answered "yes" to the question, "Do you find it easy to draw three dimensional objects?" Nearly as many of our archaeology students also claimed this ability. My original reason for asking this question was the observation that one of our best contemporary knappers is also very good at drawing his knapped products. Checking for a possible relationship between this ability and skill rating by the chi-square statistic, however, I found no statistical significance. The best knappers are no more likely than the poorest knappers to possess this skill. I had assumed that the ability to render the three-dimensional world in two dimensions by means of perspective was an inherent quality. However, according to Gärdenfors (1995), this competence is not inherent, but learned.

Knapping Characteristics

Learning to knap. Table 1 shows the relative frequencies of how respondents have learned to knap, broken down into rating categories. In the "total" row we see that 41% of the sample checked more than one alternative, 31% learned from an experienced knapper, and only 1% learned through trial and error with a group. Interestingly, many of the excellent knappers (rating "one") learned by trial and error on their own, whereas among the poorest knappers (rating "ten"), nearly half learned from an experienced knapper. John Whittaker, for instance, wrote that the major development of his skill took about a year and was mostly self-taught (Whittaker 1994:7). I would venture that this difference reflects in some measure an individual's interest in knapping: quite a number of the best

Table 1. How respondents have learned to knap, broken down into rating categories and expressed as percentages.

	Trial & Error	Group	Reading	Experienced knapper	Several of above	Total
Total	19	1	8	31	41	100
One	43	0	0	0	57	100
Two	21	0	14	21	43	100
Three	23	0	6	26	46	100
Four	8	0	0	42	50	100
Five	21	0	10	36	33	100
Six	17	0	4	26	52	100
Seven	22	0	6	28	44	100
Eight	6	0	11	44	39	100
Nine	0	8	8	58	25	100
Ten	27	0	18	45	9	100

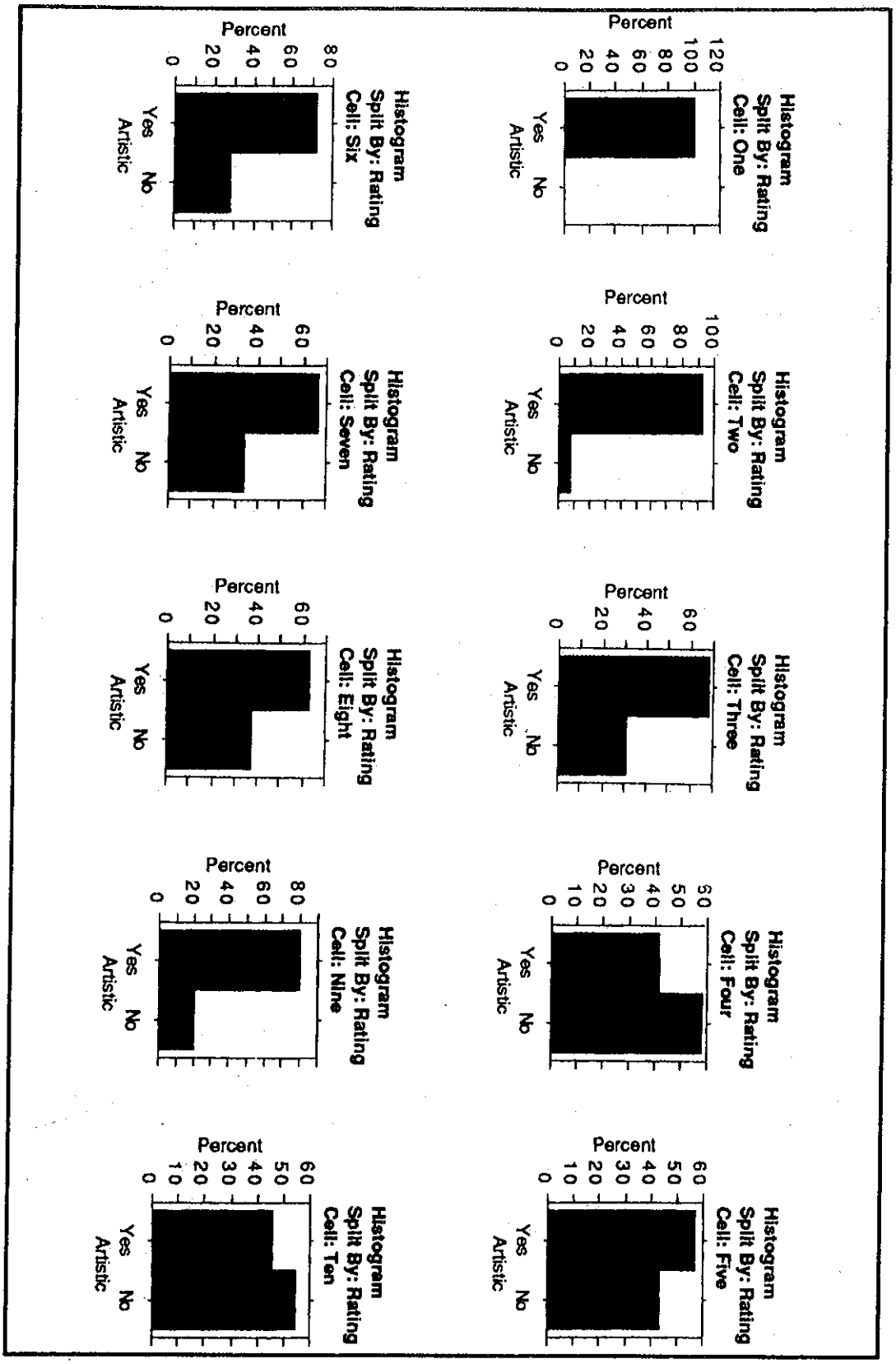

Figure 10. Distributions of artistic ability split by skill rating (one = excellent, ten = poor).

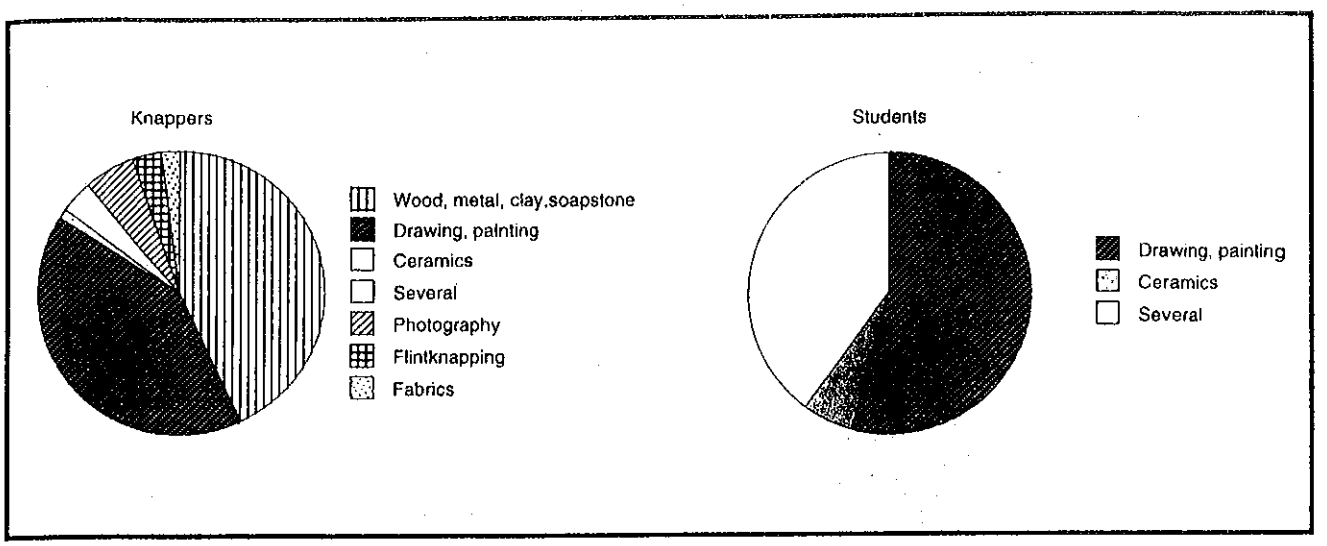

Figure 11. Pie charts showing the relative frequencies of preferred media among knappers and students who engage in artistic activities.

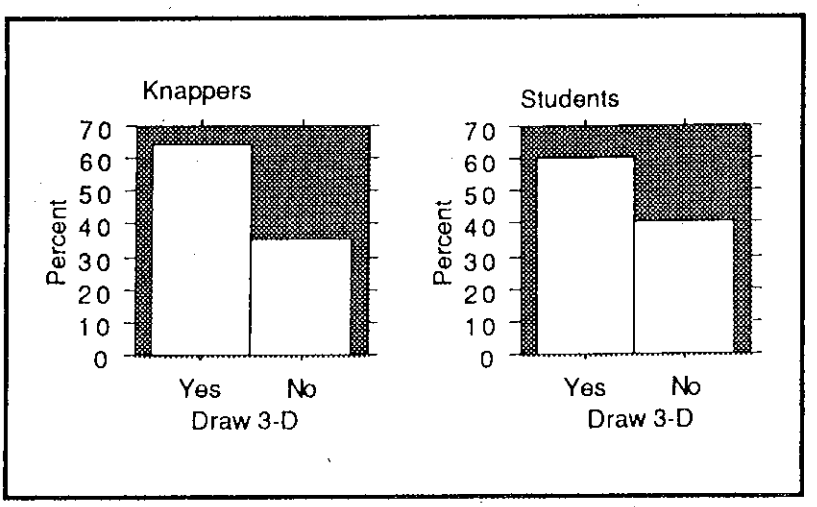

Figure 12. The response to the question, Do you find it easy to draw three-dimensional objects?

knappers I know have a burning interest in and curiosity about flint tools, which led them to experiment on their own when they began. Among the less motivated, whose interest is not as intense, taking a course in knapping was a simpler and less demanding introduction to the craft.

We must also bear in mind that the revival of flintknapping in modern times is a fairly recent phenomenon (Whittaker 1994). When many of today's best knappers were starting out, there were few other experienced knappers available from whom to learn. In this respect, our survey results probably have no relevance for the prehistoric learning situation. Children growing up in a stone tool society would have been surrounded by stone-working activities (Reynolds 1993:412). Learning to manipulate a hammerstone or a pressure-flaker was probably as natural to these children as learning to manipulate a computer mouse is for ours. Of course, cultural taboos may have dictated that only children of one sex were trained in this particular skill. Toth and Schick (1993:357) have speculated that flintknapping skills are probably more easily learned prior to puberty. Young adolescents can learn a foreign language more

efficiently than adults, presumably because hormonal changes modify the way the brain learns new communicative systems after puberty. Based on his experiences as a knapping instructor as well as a parent, Flenniken (1984:199) claims it is easier to train a child three to six years old to make stone tools by specific techniques than to teach adults the same techniques. Once children begin to mentally process the flintknapping data they are learning, teaching is more difficult. Whittaker (personal communication) disagrees with this view, however. In his experience, young children have rarely developed either the general motor skills or the cognitive ability to produce sequences or constellations of knowledge. In particular, lack of basic motor skills and strength make it difficult to progress vary far in knapping at a young age. The fact that even chimpanzees have been observed actively to teach their children how to crack open nuts with a hammerstone (Boesch 1993:181) suggests to me that human parents would have taught essential flintknapping skills to their offspring.

As with most manual skills, those aspects of knapping that can be taught are usually acquired more quickly with an instructor than by trial and error (Whittaker 1994:5). The learner is placed, with the requisite equipment, in a practical situation. He or she is told to pay attention to how this feels or how that looks or sounds -- to notice those subtleties of texture that are essential to good judgement and the successful practice of a craft (Ingold 1993:462). Several respondents noted the importance of instruction; for instance:

> My flintknapping skill improved five-fold due to attending various knap-ins. Watching other knappers, seeing different techniques, trying different materials and tools and discussing with others is what helped me. (#44)

Apparently it is the opportunity to observe other knappers at work, rather than any verbal instruction they might volunteer, which provides the most important advantage. Wynn (1995:20) cited studies of how humans learn to use tools. These have shown that words play a minor role in learning a craft. The novice comes to an understanding of what is acceptable and appropriate largely from the experience of producing acceptable or unacceptable results. However, it is crucial that the novice sees actual procedures at work and the products that result.

Another interesting question is how long it takes to learn to knap. While the basics can be taught to beginning archaeology students in an hour, I know from experience that reaching a level of proficiency whereby the knapper is in full control of the techniques takes considerably longer. One survey respondent estimated that becoming a good flintknapper requires several years (#174). Errett Callahan has offered the following estimate:

> For predetermined flake removal sequences and surface attributes to be achieved with some consistency on bifaces which are preceeded [sic] by all the previous phases, I estimate that at least a year of lithic training, with instruction, might be required. (Callahan 1979:38)

Knapping frequency. A histogram showing how frequently respondents knap is shown in Figure 13. Approximately 37% characterized their knapping as sporadic, while about 32% claimed they knapped every week. Since knapping is a manual skill, I would expect a correlation between the frequency of knapping and knapper rating. This expectation is borne out by a chi-square test of frequency and rating, which indicates a non-random relationship. Knappers rating themselves as excellent noted a higher incidence of daily or weekly practice, while knappers rating themselves as poor knapped less frequently. François Bordes once mentioned that, after seasons when he had made no blades, it took him about two weeks of practice before he could again remove good blades consistently (Hayden 1987:37).

Raw material. Figure 14 shows knappers' raw material preferences. Flint is the first choice among 34% of the respondents, followed by obsidian and chert. In responding to this question, many knappers pointed out that their raw material was largely dictated by what was locally available and was not really a free choice.

Knap-ins. In response to the question "Do you participate in knap-ins or organized knapping meetings?" 60% said no. A cross-tabulation of this variable and rating shows, not surprisingly, that for ratings 1-3, those who do participate outnumber those who do not, while for poorer knappers the reverse is true

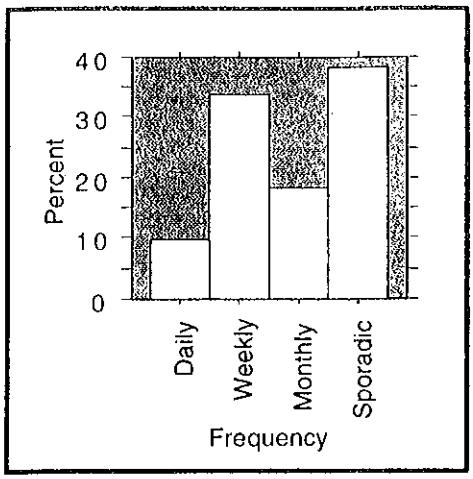

Figure 13. Knapping frequency for contemporary knappers.

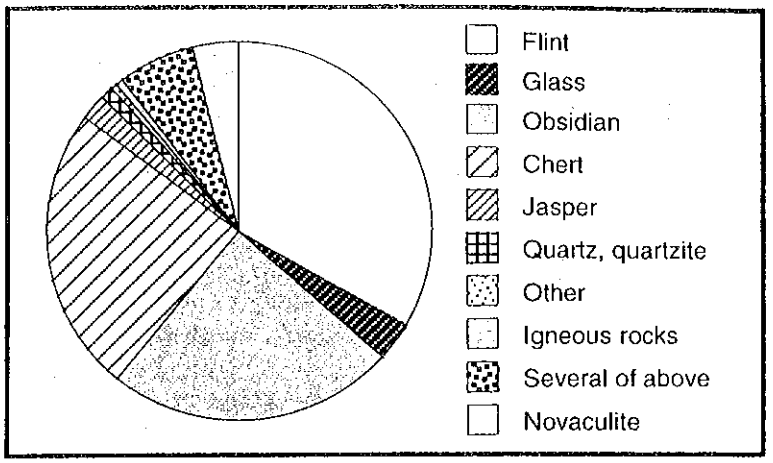

Figure 14. Contemporary knappers' raw material preferences.

DISCUSSION

Having presented the results of the survey, we should now be in a position to evaluate them and to arrive at a synthesis of those qualities that characterize contemporary flintknappers. Perhaps then we can evaluate to what extent knapping competence is inherent or learned.

Flintknapping As a Cognitive Process

> Flintknapping is like mountain climbing because to succeed in your journey you must see things in your mind before they become material and real. (#162)

It is apparent that flintknapping is a process which requires intimate cooperation between intellectual and motor abilities. That is, the successful knapper must be able to envision the three-dimensional product, as well as the general sequence of stages leading to it. Keller and Keller (1996:132) cited the importance of imagery and visualization in all craftwork. Payson D. Sheets (1975:372) wrote that, because the chipped stone industry is fundamentally a subtractive one, considerable planning is necessary to arrive at the desired end product. Each step in the knapping process should logically lead to the next; thinking ahead is therefore essential (Whittaker 1994:135). However, since every knapping situation is also unique, the process is by no means simply mechanical. Mark Edmonds (1990:57) emphasized that choice is also part of flintknapping. The artisan is capable of implementing a number of different strategies to create a particular artifact. The knapper therefore constantly evaluates the current situation and chooses, from the methods at his or her disposal, the one that is preferable and possible, a decision that implies continuous mental assessment of possible consequences (Karlin and Julien 1994:154; Schlanger 1994:148).

As modern knapping experiments have made us more and more aware of the complex interplay between cognition and workmanship, research has focused on the use of stone tool complexity to gain insights into human and pre-human cognition (see, for instance, articles in Gibson and Ingold 1993). Schick and Toth (1993:220) suggested that Oldowan technology represented a new cognitive plateau in primate evolution, one that emphasized planning and foresight and was therefore a precursor to the thought processes and behavior of humans today. Wynn (1985:41) instead placed the significant threshold between 1.5 million and 300,000 years ago. He said that the geometry of later Acheulean handaxes required a stage of intelligence which is typical of fully modern humans. No subsequent development in stone tool technology requires a more sophisticated intelligence.

Flintknapping is a complicated cognitive process which seems to require the cooperation of both hemispheres of our brains. The left hemisphere is involved with analytical processes, especially the production and understanding of lan-

guage. This hemisphere processes input in a sequential manner. The right hemisphere controls nonlinguistic functions that involve complex and visual spatial processes and perceptions of part-whole relations. It processes information simultaneously and holistically. We know that the hemisphere that controls speech (the left) also usually controls the individual's dominant hand. Doree Kimura and others have proposed that left-hemisphere specialization for speech is a consequence of the evolution of certain motor skills. Research also suggests that our ability to generate mental maps, rotate images, and conceptualize mechanical models could be an abstract, right-brained counterpart of the motor skills of the left brain (Springer and Deutsch 1989; Gibson 1993:189). The cognitive processes which are required for successful knapping are both analytical/linear and spatial/holistic. Unfortunately, the only question on the survey form which could have elicited information about knappers' left-brained skills was the clumsily-worded question about chess playing. The high responses to questions about artistic abilities and the ability to draw 3-D objects confirm that right-brained perceptual abilities are important.

Translating the Idea: the Importance of Manual Dexterity

> I see the blade or point in the stone as a kind of mental 'print'. The rest is removing the stone using different approaches till the point is released. (#61)

The ability to envision the desired product is not sufficient for making it: the knapper must also be able to translate theoretical knowledge into a practical outcome. Thus the knapping process involves constant interplay between the knapper's brain and his or her motor skills (Pelegrin 1990: 117; Karlin and Julien 1994:154). At the Etiolles site, Pigeot (1990:136-7) suggested that, when the prehistoric knappers were learning to knap, the acquisition of theoretical knowledge went hand-in-hand with practical training. In the Trollesgave example, Fischer found two nodules of high quality flint which had been clumsily worked. He could ascertain that the knapping techniques used on these were, in principle, the same as those used by the master knapper at the site. In practice, however, the execution of the techniques differed. For instance, trimming of the platform edges had been done less frequently and with less care on these nodules. Furthermore, the percussion blows were delivered with less precision. Fischer likened the degree of manual control shown here to what is achieved by schoolchildren in their initial attempts at learning to write. The apprentice knapper apparently had a mental picture of what to strive for, but lacked the manual skills to realize this picture (Fischer 1990:44).

The knapper survey revealed that many knappers work at technical or craft professions requiring manual skills. The high scores on sculptural media among those who practice art (Figure 11) may also indicate a propensity for manual skill.

Hand-Eye Coordination

Calvin's description of what happens when we throw darts applies to flintknapping kinematics as well:

> Your arm is an unguided muscle shortly after the throw has begun. So you must plan perfectly as you get set -- create a chain of muscle commands, all ready to be executed in the right order. (Calvin 1993:234)

Several respondents pointed out that good hand-eye coordination is an advantage when knapping. One knapper said that, although flintknapping is a learned skill, certain inherent abilities enable one to excel in biface thinning in which touch is necessary and innate hand-eye coordination an advantage (#27). Pelegrin (1990:118) claimed that becoming adept at percussion techniques requires both natural talent and intensive practice (i.e., "ability" and "skill"). Because percussion movements are so rapid they cannot be controlled by vision, they must rely on prior practical experience to be successful. As a prehistoric illustration of this, Karlin and Julien (1994:162; this article, Figure 2) found that the poorer knappers at Pincevent practiced new techniques on less valuable raw material. Unlike the products made by skilled knappers, these practice pieces remained at the knapping site because they were not practically useful.

As we saw in Figure 9, ball sports and shooting sports, both of which require good hand-eye coordination coupled with practice, account for 63% of

sports choices among contemporary knappers. The intuitive link between knapping proficiency and hand-eye coordination would seem to be confirmed by these data.

Competetiveness

Those who have followed the various knapping journals, newsletters and catalogues will have noted an aspect of competetiveness in much of contemporary knapping. Knappers agree that not only aesthetic qualities but also the size of the knapped artifact are indications of knapper competence. This is because knapping difficulty increases exponentially with the dimensions of the object being made. It is much more difficult to produce a blade 30 cm long than one 10 cm long. The necessary force for an adequate fracture is substantially increased, and precision and control of the striking gesture are more difficult to achieve (Pigeot 1990:130). Many modern knappers strive to push the art of flintknapping to its limits and challenge the constraints imposed by flint--as indeed the prehistoric knappers engaged in elaborate knapping did (Figure 1). One respondent wrote, "I am trying to make a point with which I am completely satisfied. Part of the fun is to strive to make the next one bigger, thinner, prettier, larger, etc." (#41). Among our contemporary knappers, as certainly also among prehistoric knappers, there are both ordinary knappers, content to have some measure of control and an understanding of processes, and those who explore their limits in elaborate knapping activities.

DOES PRACTICE MAKE PERFECT?

Even an orangutan can be taught to make flakes (Wright 1972), and even I can make a scraper or a flake axe. However, I doubt that either of us could be taught to copy the best quality Danish Late Neolithic dagger, even after plenty of practice, although there were and are clearly individuals who can. On the question of whether ability is genetic, Tim Ingold (pers. commun.) has pointed out that there are, obviously, things that humans can do that gorillas cannot, which has something to do with the genetic differences that lead us to classify humans and gorillas as belonging to different species. In Ingold's view, this implies that there is some genetic component to aptitude, although he categorically rejects the view that aptitudes are genetically determined.

Many authors and knappers agree that that we should distinguish between ordinary knapping and what Pelegrin terms "elaborate knapping." I would like to offer the following quotation as a description of the difference:

> Provided that a core possesses an adequate knapping volume and that a striking gesture is correctly applied, even an ordinary knapper should be able to produce a single blade. However, when proceeding to extract dozens of long blades in series, average craftsmanship will not do. The knapper needs then to be able to assess the correct options, and execute them successfully, for each of the hundreds (or even thousands) of flaking actions.... (Pigeot 1990:128)

Numerous examples of a difference in knapping quality can be found in the archaeological record (Fischer 1990; Pigeot 1990; Karlin and Julien 1994; Whittaker 1994). Many of the survey respondents also commented on this; for instance: "I teach stone-age skills on weekends. Very few students ever become proficient" (#156) or "I think everyone can knap, but like all talents, because of natural inborn talents some are more adept than others" (#50).

This brings us at last to the thorny question at the heart of this study: the question of natural aptitude or ability. To explore this further, I find it helpful to refer to Thomas Wynn's article "Layers of Thinking in Tool Behavior" (Wynn 1993). Wynn speaks of tool behavior as a system of three layers: biomechanics, sequence construction, and constellations of knowledge. The lowest level is that of biomechanics, which consists of the constraints imposed by the anatomy and physiology of the tool-users. These constraints include the amount of force that can be delivered, the scale of precision, and so on.

Wynn notes that tool behavior is sequential. It consists of motor actions strung together into episodes, usually terminated by a recognizable result, which is the completed task or artifact. Wynn terms this "sequence construction." As an example of this layer, Wynn cites a study by John Gatewood, who set out to illuminate how we acquire technical skills. The novice first learns tasks by serial memorization and has no clear idea of how each action relates to others or, indeed,

how they combine to accomplish the result. After beginning to master some of the tasks, novices begin to assemble smaller tasks into larger complexes of action. Initially a novice learns by chaining actions into longer and longer sequences by memorization like a string of beads. Action is sequential, but the sequence does not initially have any hierarchical structure. Here I would say we are at the level of skills which can be learned and improved with practice. I suggest that the practice pieces at Trollesgave and at Pincevent are examples in which novices practiced certain discrete knapping tasks before they were able to combine them into meaningful chains which resulted in completed pieces.

How old were these novices? Barring the discovery of knapping tools in individual burials, it is difficult for us to answer this question. It seems reasonable to assume that all or most members of stone age society were trained from childhood in the basics of flintknapping, since knapping competence was crucial for survival.

Because tool sequences are organized like strings of beads and learned by observation and memorization, apprenticeship is essential to the learning of tool-use and tool-making. Every individual learns a tool sequence by constructing his or her own string of beads through repetition and rote memorization. Significantly, Wynn uses the example of instrumental musicians, who employ much the same technique in learning passages of music. This level requires practice, repeating basic actions and sequences until they have been learned at a very primitive cognitive level. In flintknapping, the speed of many of the actions means that learning of individual sequences must occur in this way (as I discussed above in the section "Hand-eye Coordination"). The following quote from Don Crabtree illustrates this very well:

> Technological evaluation is based, in part, on understanding the muscular motor habits and the rythmic removal of flakes. After the rough material has been reduced to a stage where the worker can repetitiously remove a series of flakes from the margin, the mind, eye and muscular responses often develop a rhythmic and subconscious reaction to applying the force. Experience and habit eventually cause the worker's muscles to respond subconsciously to induced forces. (Crabtree 1972:3)

Crabtree seems to be saying that, by practicing sequences of action over and over again, the knapper internalizes them. This allows him to bypass conscious thought for these particular actions.

Biomechanics and sequence construction do not fully explain the complexities of tool behavior. In mammals, at least, tool behavior also entails problem solving and the ability to adjust behavior to a specific task at hand: constellations of knowledge. These constellations are not learned by rote memorization. Rather, they come into existence at the time of use. The elements involved are determined by the task at hand, especially by visual images the artisan has of his or her goal. The elements in such constellations are quite varied and they include, according to Wynn, aesthetic, stylistic, and functional standards. An important consequence of apprenticeship is that each actor constructs his or her own constellations. The artisan brings idiosyncratic ways of doing things, aesthetics, etc., to any task. Here I believe we begin to enter the area of natural ability or talent.

Wynn goes on to state that there is some agreement on the idea that humans possess partly innate cognitive structures for the acquisition of language. However, the same cannot be said of tool behavior: many people never acquire competence in tools comparable to competence in language. Instead, apprenticeship seems to be an entirely cultural system whose role is to force novices to construct their own technologies only some of whose elements are shared with others. This would seem to me to argue against the idea that all members of a stone age society would have been able to reach an equivalent level of knapping competence.

I have quoted Wynn's ideas at some length because I believe them to be relevant for understanding how flintknapping skills are acquired. It is time now to return to the archaeological evidence. Jacques Pelegrin, an accomplished knapper himself, has noted the frequent coexistence of two levels of lithic production in Neolithic and Chalcolithic contexts. He distinguished between ordinary production, on the one hand, and what he termed "elaborate knapping," on the other. The long blades from Grand Pressigny are an example of elaborate knapping. Analysis of stone age production, as well as his own experimental work, has convinced Pelegrin that a suitably larger flint

nodule and a little more patience are not sufficient for achieving levels required for elaborate production -- say the successful manufacture of blades 30-40 cm long. This requires a much higher level of know-how (Pelegrin 1990:123). Similarly, Karlin and Julien (1994:161) observed two levels of knapping competence at Pincevent. One level was domestic and less planned and with a minimum of preparation, while the other was long-termed and planned and showed good control. They suggested that every member of the group performed the first level, while the second level was reached only by more skilled knappers.

I maintain that all or most members of any human group can achieve a level of knapping sufficient to enable them to produce workable tools, but that only some individuals have the propensity to surpass this level. In Wynn's terms, all human beings have the biomechanical prerequisites for flintknapping, and we can all learn to sequence the actions into a string of beads leading to the production of, say, a serviceable dagger or thin-butted axe blade. However, when we come to Wynn's third level, we differ in regard to our ability to handle complex constellations of knowledge. Remember that this level involved, among other things, an aesthetic element as well as the ability to sequence motor actions. There are at least two components here: one is the ability to conceive of an aesthetically pleasing object, the other is the capacity to realize this in the physical material. Pye defines craftsmanship as workmanship in which the quality of the result is not predetermined but depends on the judgement, dexterity, and care which the maker exercises as he works. Pye (1968:4) says that, in true craftsmanship, the quality of the result is continuously at risk during the process of making. According to him (p.21), we ought to judge the quality of workmanship by reference to the intended design: the better the product conforms to the design, the higher the degree of workmanship. The best knappers, then, are those who have mastered constellations of knowledge to such an extent that they are not hampered by flint's limitations. Ingold (1993:462) said the novice becomes skilled not through the acquisition of roles and representations, but at the point where he or she is able to dispense with them.

Creativity and Aesthetics

Above I have suggested that constellations of knowledge involve an aesthetic element as well as an ability to successfully translate an idea into flint. Aesthetic considerations seem to be involved in what we consider high quality knapping. In support of such an idea, I can quote Kenneth Oakley:

> The artistic impulse appears to have manifested itself in exceptional individuals long before the Upper Paleolithic period, indeed probably from the dawn of tool-making. The great Acheulian hand-axe...from the gravels at Furze Platt, Maidenhead, is evidently the product of an artistic craftsman. (Oakley 1961:127)

Taçon (1991) maintained that qualities such as shimmer and color govern the choice of raw material for certain Aboriginal tool forms in western Arnhem Land, Australia. Schick and Toth (1993:282) described some exceptionally symmetrical Acheulean bifaces as "strikingly beautiful." They seem to be saying that such beauty would have been appreciated even by the makers of the bifaces some 500,000 years ago. Some might argue that there are some qualities which *all* humans -- regardless of time or place -- would call beautiful or aesthetically pleasing (Douglas 1970).

There is no mistaking that many contemporary knappers are striving for regularity and symmetry in their products (Figure 15). One survey comment can serve to illustrate the reponses:

> I think the artistic types definitely lean towards knapping and usually the more artistic they are the better their work is. I've seen this in a lot of people. Also the artistically inclined people pick up flintknapping much faster. (#33)

Quite a number of respondents commented on an apparent correlation between knapping and creativity. We have seen in Figure 10 that the majority of knappers consider themselves artistic. The chi-square statistic confirmed a relationship between skill rating and an artistic sense. Further, all the best knappers (rating one) claimed such talent, while more than half of those who rated themselves as poor knappers said they were not artistic.

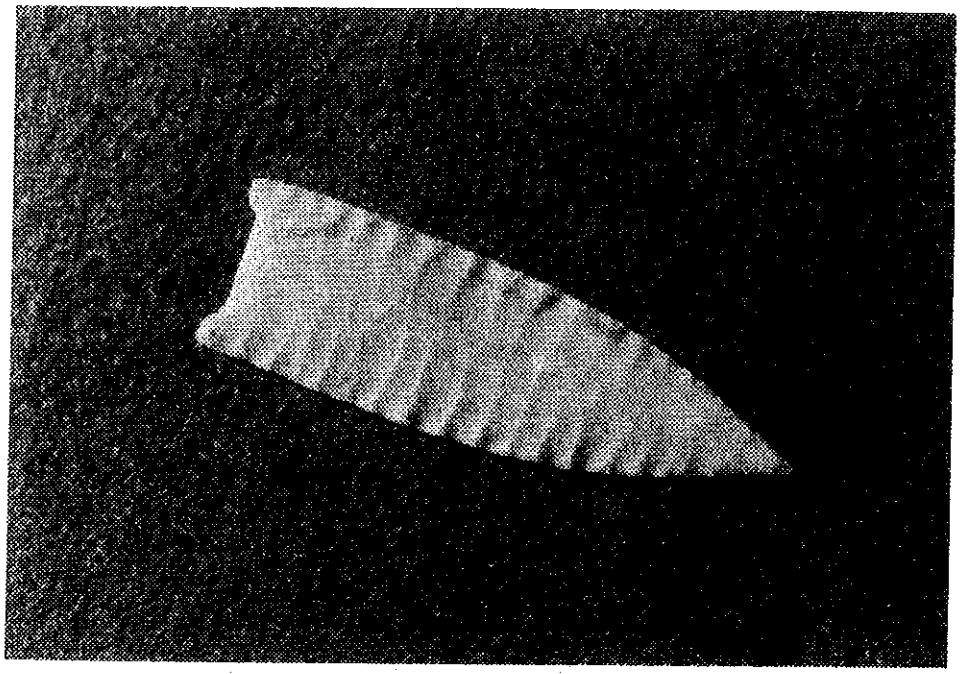

Figure 15. Contemporary knapper # 83 sent me this sample of his work in response to the survey.

When the knapper's aim is to make a stone tool which will enable him or her to put food on the table, practical considerations are likely to be paramount over aesthetic ones. Here, the ordinary knapping skills which all individuals could learn would suffice. However, when making a collection of matching ogival points for a Bell Beaker burial, elaborate knapping skills as well as high ability are called for. The best knappers, both today and in the past, would have needed an aesthetic sensitivity as well as good motor skills to be able to realize this in flint.

CONCLUSIONS

What kinds of people take up knapping? Characteristic for the general population of contemporary knappers is that they are male, somewhat artistic, find it easy to draw three-dimensional objects, enjoy sports such as hunting or archery, and are interested in the past. Knappers' most common professional choices are technician/crafts, outdoor professions, and archaeologist. About half of them play a musical instrument, but only one-fourth of these play regularly. The majority do not often play chess but they do have more than average patience. Thirty-four percent knap daily, 38% sporadically.

The question of whether all individuals are capable of reaching high levels of flintknapping competence has proved difficult to answer. Callahan's experience with teaching knapping suggests we cannot all become great knappers (1979:38). This is also the position I am trying to argue. John Whittaker suggests:

> Flintknapping requires no unusual strength or artistic abilities to learn the basics. Anyone with normal intelligence and hand-eye coordination can make ordinary stone tools with a little practice. In most stone-age societies, knapping was probably a skill everyone had. (Whittaker 1994:2)

While I would agree that basic knapping was a competence which all adult members of the stone age population would have to learn, there is also evidence for knappers of extraordinary ability in prehistory as well as today. What characteristics separated remarkable knappers from basic knappers? One way to answer this question is to compare qualities possessed by the best contemporary knappers with those who considered themselves poor knappers (Table 2). Fewer of the excellent knappers than the worst knappers play an instrument or often play chess. However, more of them consider themselves artistic and able to draw three-dimensional objects, and they gener-

ally have more patience than the poorest knappers. It seems to me that two qualities are of importance: an aesthetic sense and the motor skills necessary to translate the design into a finished product in flint. Perhaps the competitive urge is also important for spurring the knapper to perfect his or her skills.

In the archaeological record there are many examples of typologically similar artifacts with differences of quality which, I have argued, could well be due to differences in knapper ability. Since being able to make ordinary tools was crucial for survival, most group members had to be trained in the techniques necesary to make everyday items. After all, I am not a computer genius, but I know enough about a computer to use it for typing this article and figuring the statistics. However, there are elements of natural aptitude which enabled certain individuals to excel at flintknapping so that they were able to create objects of exceptional size and beauty -- perhaps we could call these the programmers of the stone age. This has ramifications for questions of craft specialization and social power, since the capacity to control the individuals with unusual ability could be one means for a potential aggrandizer to harness surplus for social purposes.

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Table 2. Summary table showing relative values for answers to certain key questions regarding personal characteristics of excellent and poor knappers. In order to gain a more representative sample, skill categories one /two and nine/ten have been combined. Percentages are based on the total number of answers to the question, divided into skill categories. The highest percentage for each answer is shown in boldface type.

	Skill rating one & two (excellent)	Skill rating nine & ten (poor)
Play instrument?	9/28 = 32% yes	11/12 = **50% yes**
Play regularly?	4/9 = 44% yes	6/11 = **55% yes**
Play chess?	1/27 = 4% yes	7/22 = **32% yes**
Artistic?	26/27 = **96% yes**	13/22 = 59% yes
Draw 3-D?	22/27 = **81% yes**	10/10 = 50% yes
Patience?	21/28 = **75% yes**	10/22 = 45% yes.

APPENDIX 1

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S-223 50 Lund
Sweden

Your name and address:

_____

_____

_____

_____

In connection with a study on craft specialization in prehistory, I am interested in finding out if there is an element of natural talent or inclination which influences who takes up flintknapping. If you consider yourself a flintknapper, (and if I have not already reached you by direct mail), I would like to include your response in this survey. Please mail the completed form to me at the above address by March 15. Thank you!.

Flintknapper survey

All answers will be kept confidential!

1. Yr. of birth_____ 2.Are you **righthanded** or **lefthanded? R / L 3.** Sex **M/F**

4. Your profession_____

5. Your hobbies_____

_____

6. Do you play a musical instrument? **Y / N**

If "yes", which instrument? _____

7. How long have you played?_____years.

8. Do you play regularly? **Y / N**

9. How many times per week? _____

10. Do you often play chess? **Y / N**

11. Are you active in some sport? **Y / N** If so,which? _____

_____

12. Are you artistic? **Y / N**

13. What medium do you prefer? _____

_____

14. Do you find it easy to draw three dimensional objects? **Y / N**

15. How much patience do you have? **O Lots O Normal O Very little**

16. How long have you been knapping? _____years or _____months.

17. On a scale of 1-10, how would you rate yourself as a knapper (don't be modest !) (1=excellent, 10=poor)?:_____

18. How did you learn to knap?

O Trial and error on my own.

O Trial and error with a group.

O By reading articles and trying things out.

O Learned from an experienced knapper.

O Other _____

19. What is your favorite raw material? _____

_____

20. Could you please estimate how frequently you knap at present:

O almost every day for _____**hours**

O a few times a week for _____**hours**

O a few times a month for _____**hours**

O my knapping episodes are sporadic

21. Do you often participate in knap-ins or organized knapping meetings? **Y / N**

22. Is there anything else you would like to add which you think might be relevant?

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