Some remarks about the inter-relations between Archaeology and Natural Sciences.

G. Clark

The work of this symposium and of its predecessors exemplifies the modern trend towards interdisciplinary research as a way of bringing increasingly specialized interests and fields of study to bear on particular topics. On the one hand we have the possibility, so well exemplified in the present case by the group excavating in Rijckholt, of combining the special knowledge of amateurs with the often more theoretical knowledge of professional archaeologists. On the other there is the possibility of bringing specialized natural science to bear on the solution of human problems. I would only like to stress that cooperation between specialists must be genuine, that is to say that specialist must maintain their integrity.

Here in the Netherlands you have a fine example in the Biological-Archaeological Institute at Groningen of what I mean by genuine creative cooperation, as distinct from the bogus cooperation which exists when an archaeologist seeks to justify preconceived ideas by the selective use of scientific data.

The author of a recent work at the history of molecular biology has recently commented that politeness is the death of scientific converse. What he meant I think was deference, deference to seniority, deference to established views. We have to pursue the insight of our specialisms and in doing so must not be afraid of conflict. If we disagree politely but firmly, who knows, but that in the end, we reach conclusions of a durable kind.

In the present case we find a combination primarily of the Earth Sciences, Physics and Chemistry on the one hand and of various studies focussed on human society on the other. It is perhaps understandable that during its initial stages a series of symposia dedicated to the study of flint should focus on its physical character, on the history of its formation, its mode of occurrence in nature and its properties as a potential source of implements for shaping other materials. A knowledge of such matters is plainly essential if we are to understand correctly the winning, dissemination and utilization of flint by man.

The converse is no less true. If research is to be effective its aims need to be defined and brought into focus. To seek to learn more about flint purely as a substance is of course a perfectly valid aim. I would certainly not subscribe to the view popular with some politicians and nearly all tax-payers that scientific research ought only to be supported to the extent that it can be shown to be directed to the satisfaction of perceived social needs. Research into the nature of flint needs no more extraneous justification than the scientific study of any other phenomenon or for that matter writing poetry, painting pictures or even pursuing archaeology. On the other hand it is surely right in the presence of distinguished archaeologists from several countries to consider what light such studies can be expected to throw on prehistory and in particular on the nature of prehistoric societies. Perhaps I am right to assume that the organizers of this conference invite me to address you in expectation that I would emphasise precisely this.

The information to be won from flint in respect of technology is in several respects more precise than that afforded by the igneous and metamorphosed rocks that were also favoured by early man for axe and adze blades. The fact that flint occurs in seams in the parent chalk called for greater skills and a more complex technology in the process of mining than the quarrying of rocks from surface exposures. Descriptions of the method used in particular localities were offered at the Second Symposium and we look forward to hearing more on this topic in the coming days. Again, the dense texture of flint offers the maximum promise for studying the techniques used in shaping it to form artefacts, the manner in which it was used to shape other materials and not least the nuances by which prehistorians are able to distinguish the products of particular social groups. For a time igneous and metamorphosed rocks appeared to give more specific information about the dissemination of products from extractive centers, since they lent themselves to petrological determination. As we now know thanks to the work of the British Museum team even the advantage conferred by this will not hopefully continue for very much longer. The fact still remains that a large volume of work on the determination of stone-axe blades already exists in the literature so I make no apologies for drawing upon this as an earnest of what we may hope to learn from flint when more definitive results have been obtained and published.

In a brief talk one has to choose between offering a comprehensive but necessarily superficial review or going slightly deeper on a narrower front. I intend on this occasion to emphasise the social rather than the technological or even the purely economic aspects of early man's relationship with flint. In respect of the winning of raw materials the social dimension is guaranteed by the fact that the lead in establishing this symposium was after all taken by a group with direct experience of mining as an organized team activity. To view a site like Grime's Graves as the outcome of group activity of a specialized kind is in itself an education in social archaeology. By the same token every archaeologist knows that the forms into which flint was worked by prehistoric man need to be viewed as expressions of the identity and solidarity of social groups, in other wordds as expressions of ethnicity and occasionally of heirarchy as much as adaptions to economic needs. I propose therefore to concentrate on the dissemination of products. I shall argue that the patterns produced by plotting axe or adze blades made of materials from particular foci of mining or quarrying reflect social as well as

economic forces and, conversely, that the systematic attribution of artefacts to the sources of the materials of which they are made is capable of throwing light on the social life of early man unobtainable by other means and vital to the correct interpretation of archaeological data as a whole.
In going so I shall draw upon primary data from two sources:
a) the British Isles, mainly from the IIIrd millennium B.C.
b) aboriginal Australia dating in past from the ethnographic present or recent past.

One of the most valuable outcomes of being able to trace the sources of raw materials and map the distribution of artefacts made from them is to gain an insight into the dynamics of the communities among which they were disseminated and used. To illustrate this we may begin by considering the information accumulated in Britain since systematic work began in 1936 on the sources and distribution of stone axes made from ingeous and metamorphosed rocks[1]. The evidence for seven provinces of the British Isles is here summarized:

Sources	South-west (1972)	E. Anglia (1972)	Lincs., Notts., Rutland (1973)	Derby, Leics. (1974)	Yorks. (1971)	Scotland (1968)	Ireland (1962)
Cornwall							
I-IV	163	52	16	8	14	-	-
XVI	49	-	1	2	-	-	-
XIX	3	-	-	-	-	-	-
Total	215:68.5%	52:35.6%	17:6.5%	10:8.0%	14:8.6%	-	-
N. Wales							
VII-VIII	31	15	40	26	18	1	2
XII-XIII	2	-	-	-	-	-	-
Total	33:10.5%	15:10.3%	40:15.2%	26:20.8%	18:11.0%	1:1.6%	2:2.9%
Lake District							
VI	52:16.6%	72:49.3%	196:74.5%	84:67.2%	103:63.2%	3:4.9%	1:1.5%
Northumberland							
XVIII	3:1.0%	-	7:2.7%	3:2.4%	26:16.0%	-	-
Antrim							
IX	11:3.5%	7:4.8%	3:1.1%	2:1.6%	2:1.2%	57:93.4%	65:95.6%
TOTALS	310:100.1%	142:100%	262:100%	125:100%	163:100%	61:99.9%	68:100%
Other groups	14	16	15	23	-	-	-

Table showing proportions of axes of igneous and metamorphosed rocks in different parts of Great Britain and Ireland identified from quarries in Cornwall, North Wales, Northumberland, the Lake District and Antrim, N. Ireland.

If the distribution patterns of stone axes had been determined by purely economic factors, one might expect to find the products of each factory concentrated in relatively compact and mutually exclusive territories. What we see in fact is very different. This is not to say that the economic factor was unimportant. The cost of transport, at any rate over land, ensured that axes occurred more densely in areas nearer their sources. Thus axes from Cornish quarries, at present presumed to be submerged by the sea, account for more than two-third of those identified from the south-western counties and around half even for East Anglia, but for very much less further north. Again, axes from the Graig Lwyd quarries in North Wales were common in proximate parts of England, but markedly scarcer in East Anglia and the southwestern counties. Similarly, axes of dolerite from the Whin Sill, situated mainly in Northumberland, are well represented in Yorkshire, less so in the Midlands and only rarely further afield. The fact remains that although in different parts of the country axes originating from one source predominated, small and in some instances quite considerable elements invariably occurred from all but one of the English sources and isolated specimens of the one exeption, Whin Sill, reached as far south as Southampton. In the case of Ireland and Scotland small components were present from North Wales and the English Lake District. Again, although the distribution of axes from the factory of Creag na Caillich near Killin, Perthshire, has yet to be systematically plotted, an example has already been identified as far south as Lincolnshire. The evidence shows decisively that factors other than purely economic ones must have been at work to acount for the distributions established by petrological determinations. To pick out only one of the most evident features the concentration of sacred monuments in the Avebury-Stonehenge region of Wessex attracted stone axes from Cornwall, North Wales, the English Lake District. Northumberland and even Co. Antrim. More generally the evidence of the axes brings home the truth that whatever the regional variations of culture existing in Neolithic Britain the province as a whole was in fact knit together by an intricate pattern of interchange, a network held together rather than sundered by the sea.
The ethnographic evidence strongly confirms that the patterns of dissemination of stone axe blades from known sources was in large measure determined by social rather than purely economic factors[2]. It will be convenient to turn for examples to the results of sytematic work on the petrological determination of the sources of stone axes caried out by R.A. BINNS and ISABEL McBRYDE in the New England province of New South Wales and in Victoria, Australia.

In neither case can the patterns of distribution be explained convincingly in economic terms. Thus in the case of northern New South Wales[3] axes of Group 2B from quarries in the Baldwin formation are concentrated mainly on the tableland. Whereas they expanded west along the Darling river to the Paroo between 500/600 km. to the west, they failed to penetrate the much nearer coastal zone to the east. By contrast axes of Groups 4 and 7 were concentrated in the northern half of this same coastal zone. In the case of Victoria[4] the evidence from distribution is even clearer and in this case is confirmed by ethnographic observations. Thus although axes from the Mount William and Mount Carmel quarries were evidently carried over considerable territories it was noted that they failed to reach either the extreme north-west or, despite its proximity to the sources, the district of Gippsland in the south-east. Since Gippsland in particular had relatively high potential and was in fact relatively densely inhabited, the absence of Mount William axes can hardly been due to economic causes. Ethnographic studies show that the Gippsland aborigines belonged to a language group (Kurnai) quite distinct from that (Kulin) spoken by the people in whose territory the axe factories were situated. Again, studies of other forms of social interaction show that the axe blades were being redistributed within a well defined social territory. In this connection Dr. McBRYDE recalled the Nillipédji quarries of Arnhem Land studied by D.F. THOMSON[5]. These produced a material that was esteemed at a technical level for fabricating effective spearheads, but even more for the prestige value that made it desirable as a medium of exchange and thus a potent agent in generating obligation and debt. Even in societies restricted to a lithic technology and a mode of subsistence resting on various forms of catching and foraging the dynamic factor behind the widespread dissemination of products from localized sources related to prestige as much as to utility. From this it follows that the patterns of distribution ought to reflect the intensity and extent of social interaction and offer clues to social structure and relations. The extenive movement of artefacts of stone and doubtless of flint[6] is only a particular instance of what became even more sharply apparent as societies acquired a more vertical, hierarchical structure, namely that prestige came to attach to materials and artefacts by virtue of their exotic origin[7]. It is not difficult to appreciate why control of traffic in exotic resources should have become so important in the process of acquiring and safeguarding power, whether political as during later prehistoric times or, as seems more likely in Neolithic Britain, sacred. The progress of the British Museum team in defining the movement of axes made of flint from specified mining areas is all the more keenly awaited and will need to be closely studied in relation to the patterns already established by plotting axes made from igneous and metamorphosed rocks.

REFERENCES

1. For identification of the sources of stone axes from Neolithic Britain, see:
1st to 5th Reports of the Sub-Committee of the South-western Group of Museums and Art Galleries on the Petrological Identification of Stone Axes in PPS *VII (1941), 50-72; XIII (1947), 47-59; XVII (1951), 99-158; XXVIII (1962), 209-66; and XXXVIII (1972), 235-75.*
*Reports for other regions of England include those for Yorkshire (*PPS *XXXVII, 16-37), East Anglia (*PPS *XXXVIII, 108-57), Lincs., Rutland and Notts. (*PPS *XXXIX, 219-55) and Derby and Leicester (*PPS *XL, 59-78). For Ireland see E.M. Jope* 'Ulster J. Arch. *15, 31-60 and 16, 31-36 and for Scotland, P.R. Ritchie,* (Studies in Ancient Europe *ed. J.M. Coles and D.D.A. Simpson, 1968, 117-36.*

2. G. CLARK, 'Traffic in Stone Axe and Adze Blades', The Economic History Review, *XVIII (1965), 1-28.*

3. 'Preliminary Report on the Petrological Study of Ground-edge artefacts from North-eastern New South Wales, Australia', PPS *XXXV (1969), 229-35;* A Petrological Analysis of Ground-edge Artefacts from Northern New South Wales, *Australian Inst. of Aboriginal Studies, Canberra, 1972.*

4. I. McBRYDE & A. WATCHMAN, 'The distribution of greenstone axes in South-eastern Australia; a preliminary report', Mankind, *X (1976), 163-74.*
I. McBRYDE, WIL-IM-EE MOOR-RING: or, where do axes come from?', Mankind *XI (1978), 354-82.*

5. D.F. THOMSON, Economic Structure and the Ceremonial Exchange Cycle in Arnhem Land. *Melbourne, 1949.*

6. G. de G. SIEVEKING, P. BUSH, J. FERGUSON, P.T. CRADDOCK, M.J. HUGHES and M.R. COWELL show in 'Prehistoric Flint Mines and their identification as sources of raw material', Archaeometry, *14 (1972), 151-175, that under certain conditions flint can be linked with its source.*

7. S. FRANKENSTEIN and M.J. ROWLANDS cite a number of useful references in their article 'The internal structure and regional context of Early Iron Age Society in south-west Germany', Bull. London Univ. Inst. of Archaeology, 15 (1978), 73-112.

Prof. Dr. G. Clark
Cambridge University