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Bonfire of the Enquiries. Pottery Firing Temperatures in Archaeology: What For?

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In this paper serious doubt is cast on the possibility of using firing temperature identifications in technological interpretations of pottery. The comparison of thermometric data for different types of firing structures reveals a large overlap precluding any attempt at technological differentiation on the sole basis of temperatures. Moreover, results from an ethno-thermometric approach of open firings in Cameroon indicate that a thermic characterization of this type of firing is also impossible, due to the considerable variations in temperature in the same firing and even on the same pot. The heating rate and the time of exposure to temperatures are proposed as an alternative because they appear to be the only parameters permitting technological inferences.

Keywords: FIRING TEMPERATURES, FIRING TECHNIQUES, ETHNO-THERMOMETRY, FUEL, HEATING RATE, TIME OF EXPOSURE TO TEMPERATURES, CAMEROON.

Introduction

The identification of pottery firing temperatures has become a standard feature in archaeometric research programs. Since the pioneering work of Shepard (1936) and Matson (1939), identification techniques have been multiplied, refined and the notion of "initial firing temperature" has become as genuine as decoration or morphology.

Unfortunately, within this field of research, identification techniques have been the main focus of interest (see Rice, 1987: 426–435 for a critical review), at the expense of the archaeological utilization of results.

The real problem is to define clearly the full significance of these firing temperatures in archaeological reasoning.

A brief review of the archaeometric analyses containing this kind of information shows how poorly they have been exploited: in most cases, the identified temperatures are not included in any archaeological reasoning, but merely quoted as supplementary technological information (Goodyear, 1971; Morariu *et al.*, 1977; Perinet & Courtois, 1983; Edwards & Segnit, 1984; Kaiser, 1989; Kaiser & Lucius, 1989; Rigby *et al.*, 1989).

Sometimes the archaeometric approach goes beyond the mere identification of firing temperatures and considers such parameters as firing atmosphere or heating rate.

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Although, this has led to the identification of possibly two technological trends within one area (Maniatis & Tite, 1981), only a few inferences were made on the methods used by the artisans to control these parameters.

Also, firing procedures in pottery, metallurgy and glass making are extremely variable, sometimes influencing one another. Controlling these procedures determines not only the possibility of producing artefacts, but also that of generating the innovations needed to improve the quality of the products. Therefore, our capacity for recognizing these procedures through the artefacts is a prerequisite of any interpretation, without which we cannot decide whether the thermometric characteristics observed in pottery are the result of coincidence or of a deliberate choice.

Does the identification of firing temperatures permit us to identify firing procedures? In other words, do these different procedures (characterized by specific structures, atmospheres and fuels) differ from one another in temperatures? To answer this question, two kinds of data can be processed: the thermometric measurements recorded during experiments, and those recorded in the field during ethno-archaeological studies, which I choose to call ethno-thermometric data.

Without denying the importance of the experimental approach, I prefer to use ethno-archaeological data because they reflect a traditional skill which might be expected to be much closer to prehistoric reality than any experimental approximation.

I propose to evaluate briefly the impact of the ethno-thermometric data available for five firing procedures, and to present in detail those on the open firing, collected during recent fieldwork in Cameroon (Gosselain, 1991).

Comparison of the Ethno-Thermometric Data

The data from the firing procedures are presented in Table 1. In order to facilitate comparisons, the temperature range of each of these procedures are brought together in Figure 1.

It is immediately apparent that the temperatures reached do not allow differentiation of firing techniques. None of the temperature ranges can be singled out, and between 600 °C and 900 °C, all data overlap, although this range comprises more than two thirds of the data in each case.

In fact, there are only a few temperatures below 500 °C for open firing and only a few above 900 °C for updraft kiln firing. This comparison seems to indicate that temperatures reached are independent of firing techniques, at least for those discussed here.

Fuels used (the heterogeneity of which does not permit any detailed comparison) do not seem to influence the temperatures either. However, the data on their exact nature, quantity and arrangement is too scanty to assess this in detail.

The aspect of thermometric variation within the firing structure is frequently mentioned, yet is rarely measured in the field. Most of the measurements were taken with only one pyrometer (situated into the heart of the fire in most cases) and it is unclear to what extent these recorded temperatures are representative for the entire firing. There are some vague indications, but only for open firing and updraft kiln firing (Lauer, 1974; Irwin, 1977; Rye, 1981; Mpika, 1986; Sheehy, 1988; Nicholson & Patterson, 1989) where two or three probes were used. In the first case, the amplitude of the variation of temperatures runs from 100 °C to 500 °C, in the second case, from 5 °C to 350 °C. Apparently, temperatures are relatively more homogeneous in updraft kiln firing, but here also the data overlap partially, especially when the mean values of these variations are calculated: 240 °C for open firing and 180 °C for updraft kiln firing.

Considering the data on the time needed to reach maximum temperature in Table 1, it is clear that the heating rate is by far the most specific parameter for each of the firing

Table 1. Ethno-Thermometric data available for five kinds of firing

Temperature (°C)	Time (min) to max t°	Fuel	Preheating	No. thermocouples	No. firings	Country	Author
Open firing							
790–880	21	Palmfronds	–	1	2	Nigeria	Nicklin (1981)
875	34	Logs (Guttiferae and compositeae)	–	1	1	Congo	Pinçon (1984)
775–825	11	Logs (annonaceae and moracae)	+	2	1	Congo	Mpika (1986)
850	20	Logs + bark	+	1	1	Zaïre	Kanimba & Bellomo (1990)
670	28	Cow dung	+	1	1	Namibia	Woods (1984)
770	12	Dung chips + juniper wood	+	1	1	North America	Shepard (1957)
830–890	14	Dung chips + cottonwood	+	1	2	North America	Shepard (1957)
940	60	Dung slabs	+	1	1	North America	Shepard (1957)
715	17	Dung chips + coarse grass	?	1	1	Guatemala	Shepard (1957)
620–920	9	Coconut fronds and husks	+	3	3	New Guinea	Irwin (1977)
270–880	8	Sago fronds	–	3	4	New Guinea	Lauer (1974)
560–918	37	Wood	–	3	2	New Guinea	Lauer (1974)
500–755	18	Twigs + dung	+	3	1	Palestine	Rye (1981)
400–905	24	Palmfronds	+	11	6	Cameroon	Gosselain
Open firing with sherds covering the pots							
675–885	56	Sheep dung	+	1	13	North America	Colton (1951)
760–862	63	Sheep dung + coal	+	1	5	North America	Colton (1951)
Pit firing							
856	70	Cowdung + grass + reeds	–	1	1	Namibia	Woods (1984)
615–787	33	Cowdung + goat dung	–	1	4	Sudan	Tobert (1984a)
700–900	20	Cowdung	+	4	7*	Sudan	Tobert (1984b)
Pit firing with sherds covering the pots							
790–880	114	Wood, straw, dung	–	1	4	India	Miller (1985)
Updraft kiln with firebox							
690–855	170	Stems of sorghum millet	–	2	2	Egypt	Nicholson & Patterson (1989)
631–1006	92	Pine	–	2	8	Mexico	Sheehy (1988)
437–844	92	Household garbage, dried grass, cactus, cornstalks, small branches	–	2	11	Mexico	Sheehy (1988)
905	50	—	–	1	1	Mexico	Shepard (1977)
635	297	Wood	–	1	1	Mexico	Shepard (1977)
850–1030	500	Pine and other scrap wood	–	2	1	Pakistan	Rye (1981)
750–1075	211	Rubber tyres	+	3	1	Palestine	Rye (1981)
590–715	690	Rubber, dung dampened with diesel fuel	+	3	1	Palestine	Rye (1981)

If several firings are observed by the same author, or if several thermocouples are used, only maximum and minimum temperatures are mentioned and only the mean value for the time necessary to reach maximum temperatures is given.

*21 firings were recorded by the author. In 14 instances, however, a small knob of clay was fixed at the end of the thermocouple. These data cannot be included in the overall comparison.

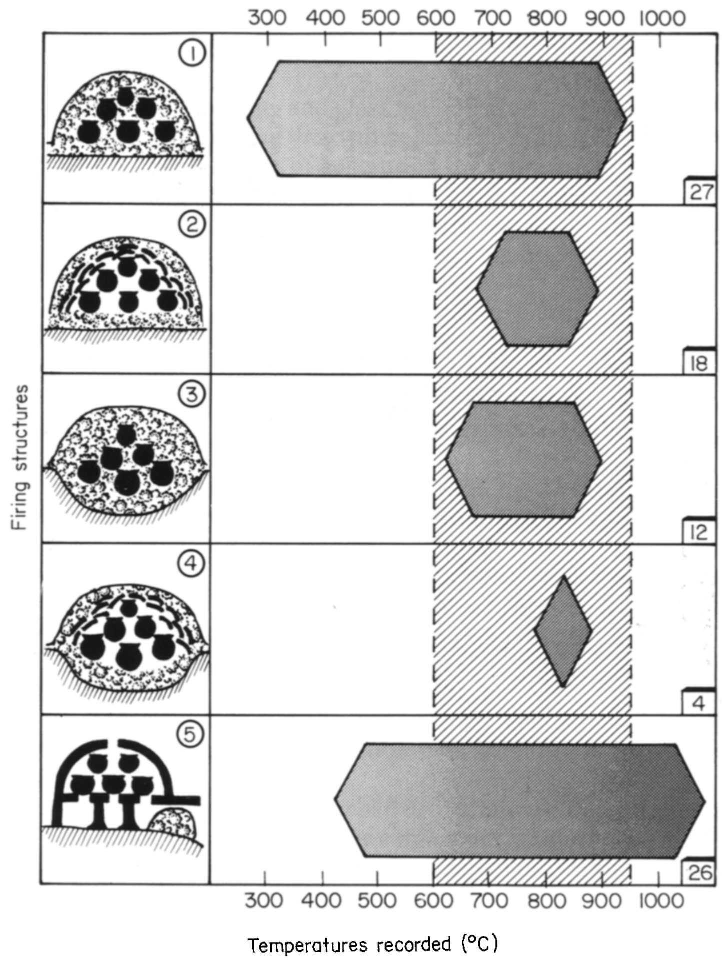

Figure 1. Temperature ranges for the five kinds of firing, based on the ethno-thermometric data given in Table 1. (1) Open firing, (2) open firing with sherds covering the pots, (3) pit firing, (4) pit firing with sherds covering the pots, (5) updraft kiln firing. The shaded area comprises more than two thirds of the data, regardless of the kind of firing. Numbers in the lower part relate to the number of cases.

techniques. On average, 22 min are needed to reach the maximum temperature in open firing, 60 min when a layer of sherds separates the vessels from the fuel, 41 min for pit firing, 114 min for pit firing with sherds and 259 min (4·5 h) for updraft kiln firing.

Apparently, there is an inverse correlation between the heating rate and the presence of a material separating the pots from the fuel (sherds or perforated floors), and to some extent, the enclosure of the firing place (walls of the pit or kiln), as shown in Figure 2.

This observation in itself is not revolutionary but it has two interesting implications: first it might explain, more than the temperatures reached or the thermic homogeneity, the choices and innovations in the field of firing techniques, and secondly it might be our only way to differentiate firing techniques if this heating rate can be identified from the archaeological pottery.

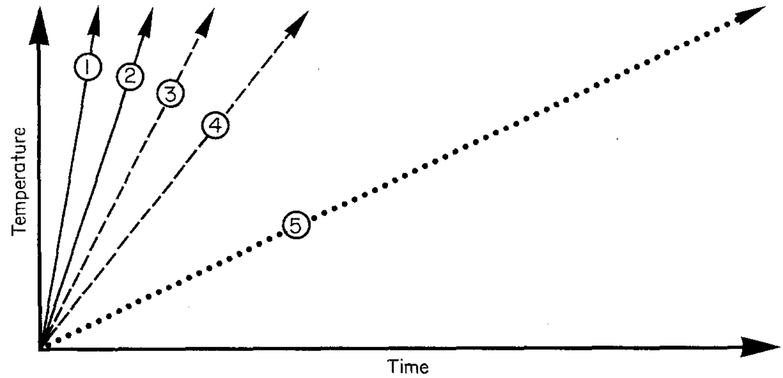

Figure 2. Schematic curves representing the increase of temperature as a function of time for the different kinds of structures: (1) open firing, (2) pit firing, (3) open firing with sherds covering the pots, (4) pit firing with sherds covering the pots, (5) updraft kiln firing.

At the end of this brief evaluation of the available ethno-thermometric data, numerous aspects remain vague, such as thermic variability within the structures, impact of fuels, possibilities of controlling the firing parameters, consequences of the heating rate and relationships between firing techniques and characteristics of the products. In order to clarify some of these problems, I undertook a detailed exploration of firing parameters among traditional artisans. These data, however, apply so far to only one kind of structure, open firing.

Fieldwork

This research was conducted as part of an ethno-archaeometric research program in progress, where pottery is studied from a technological and archaeometrical point of view (Gosselain, 1991). One of the aspects considered being pyrometry, I had the opportunity to study six firings among the Bafia, a Bantu population living 100 km north-east of Yaounde, Cameroon.

Equipment and methodology

Several probes were needed for the kind of research. I chose to use eleven probes (except for two firings in which five and seven probes were used respectively) in order to keep control, recording and set-up manageable out in the field. The probes were thermocouples of the chromel–alumel type, which are quite well adapted for thermometric measurements in structures varying between open firing and updraft kiln, since they can be exposed to temperatures up to 1400 °C. Thermocouples have the advantage of reading the temperature during the entire firing-session, as opposed to pyrometric cones which only read a thermic threshold reached within an indefinite time. The use of thermocouples permits interrelation of temperature and time in a "firing schedule", which is why Nicklin (1981) and Shepard (1957) recommend their use.

My measuring equipment comprised eleven flexible thermocouples, coated with china beads, and connected by compensation wire (copper and copper–nickel) to a multi-way switch of my own fabrication, which itself was connected to a multimeter.

During firing, the junctions between the probes and the compensation wires were kept at a constant temperature (ambient temperature) and every 3 min, each probe was connected via the switch to the multimeter for a rapid reading of the values. In order to avoid incoherent values, I stopped recording some time after the first pot was removed, when the firing structure and the thermocouples became totally disarranged. The thermocouples were put in direct contact with the pots (on the outside or on the inside) before the potters covered them with fuel. The arrangement of the probes was meant to cover the temperatures, as far as possible, for the entire space occupied by the pots. Experience however showed that in order to obtain this result, every pot should have been covered with probes, which would multiply the number of thermocouples by a factor of at least 10. The results from the 11 pyrometers will have to suffice, because it is impossible to handle such elaborate equipment in the field.

Breakage of the probes during the firing was a serious problem. Because they were handled all the time and subjected periodically to thermic stress, they became rather fragile and occasionally snapped, especially during the later part of the study. A more rigid coating should be used in future, in order to make the probes more wear-resistant, but this may complicate handling and transport.

Firings

The data from the six firings are shown in Table 1. Before firing, the pots were pre-heated for *c.* 2 min on a domestic fireplace with a few glowing logs. They were exposed to temperatures ranging from 200 °C to 300 °C, occasionally reaching about 600 °C.

The pots were then put on a bed of palmfronds on the ground, and covered with a layer of fuel, again essentially palmfronds. One potter preferred twigs and mixed them with some palmfronds (BIA.01), two other potters covered the vessels with dry grass before piling up the palmfronds (KIK.01/a–b and KIK.04). Whatever the number of vessels to be fired, they were never piled on top of one another, but were placed on their sides, with the bases frequently turned towards the centre. In only one case (BIA.01) the largest pots were filled with twigs which were immediately set on fire. Next they were put with the other pots and covered with fuel.

When asked about the choice of palmfronds as the main fuel, the potters explained that this material is "strong" and that it would render the pottery "strong", because it burns more quickly, and is less heavy than the wood used in cooking fires.

The firing structures had a general conical shape and attained a height of 1·5–2 m. They were set on fire at the top and were completely aflame within the first 5 min. Fuel was added at least once during the firing when the flames were dying out. The first pot was pulled out in the 15–25 min that follow the initial firing. In four out of the six cases this operation took place after exactly 25 min, the two exceptions were KIK.04 (15 min) and OUF.01 (20 min). Pots were immediately sprinkled with a decoction of *Bridelia ferruginea* bark, giving them a black and shining colour.

According to the potters, pots have to be pulled out as soon as they are as "red as iron" (i.e. when they have reached red heat).

Results

The thermometric data in the temperature diagrams are beyond doubt more complete than any that have been available so far, but comparison of the information has become more complicated (see Figure 3[a–f]). Clearly (1) the curves are extremely variable within the diagrams and also from one diagram to another; (2) the temperatures are completely unstable (except for the temperatures read on the inside of the vessels, the regular rise of which is in sharp contrast); and (3) the moment at which the maximum temperatures are reached fluctuates from half way through the firing to when the first pot is pulled out, or even later.

The problem is evaluation of this variability in the light of a thermometric comparison of the firings. The tremendous variability does not allow all the curves to be assembled in

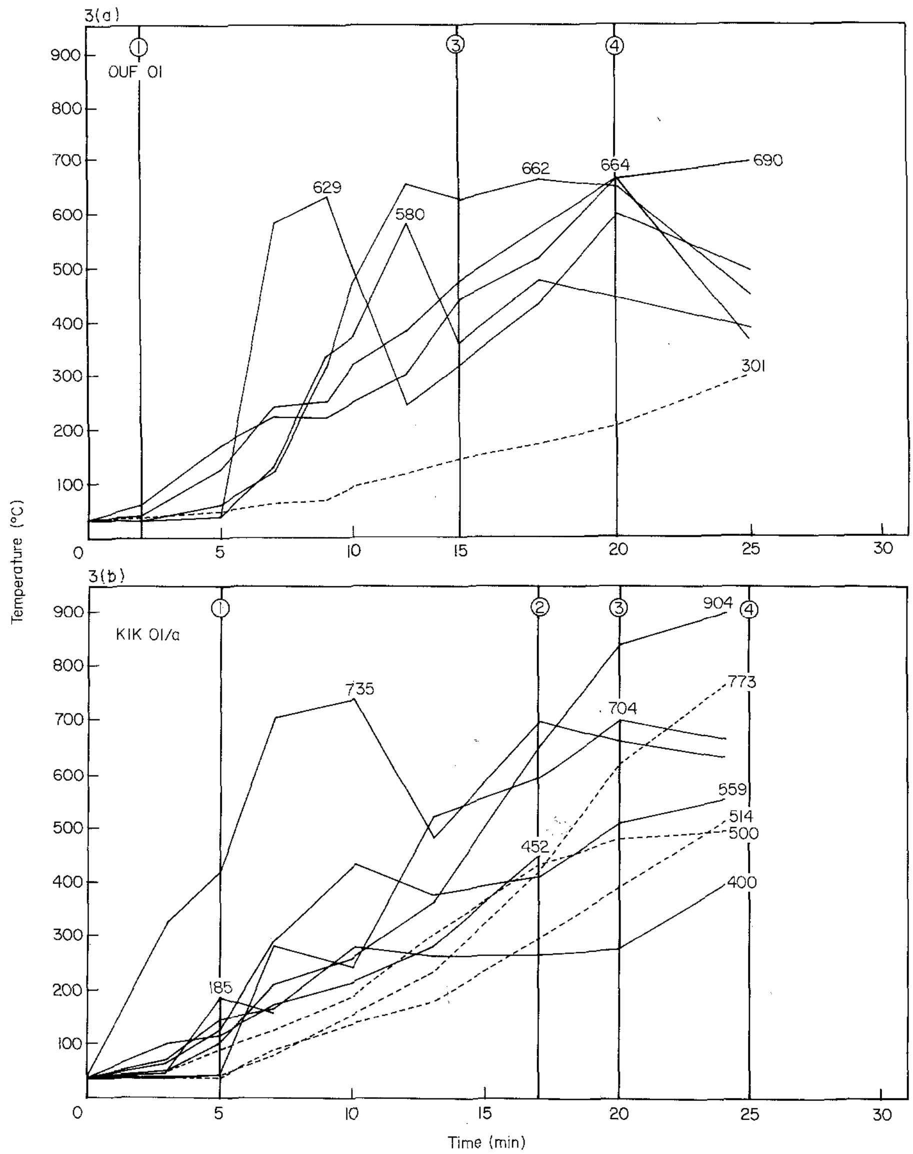

Figure 3. (a–b). Firing schedules of the six Bafia firings. Numbers in the upper part of the diagrams relate to the different stages of firing: (1) the entire structure is aflame, (2) no more flames, (3) fuel is added, (4) first pot is removed. Dotted lines represent probes placed inside the pots.

one diagram. To compare the different firings, an average curve for each firing was calculated, and all six were then displayed in one diagram (Figure 4). The thermic data from the probes on the insides of the pots are left out because the main interest here is the overall rise or increase of temperatures in the firing places.

There is a remarkable overlap between the six curves. We will see below that this pattern of temperature rise as a function of time is the only characteristic common to all firings. In

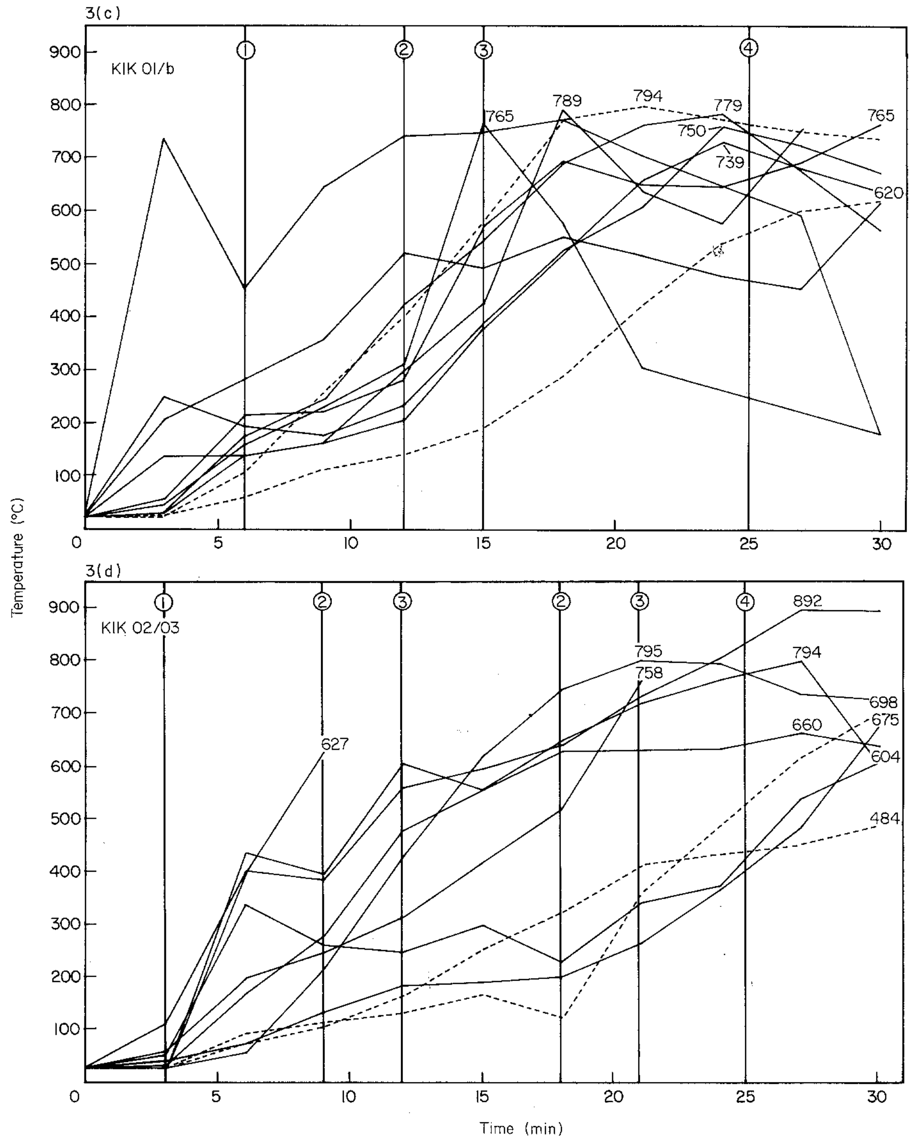

Figure 3 (c–d).

general, temperature first rises slowly, then suddenly accelerates for a few minutes and afterwards continues to rise steadily, until the first pot is removed. On average, maximum temperatures are reached after 24 min.

Only the KIK.04-curve deviates from the general picture, showing a much more abrupt and generally more stable rise of temperature. The choice of fuel might explain this, since for this firing the potter used more grass than for the other firings. Grass might burn more quickly than palmfronds. It is also the firing that took only 15 min and yielded most broken pots (see Table 2). There seems to be a clear relationship between, on the one hand, a quickly burning fuel, causing the temperature to rise more rapidly, and on the other hand, a high thermic stress.

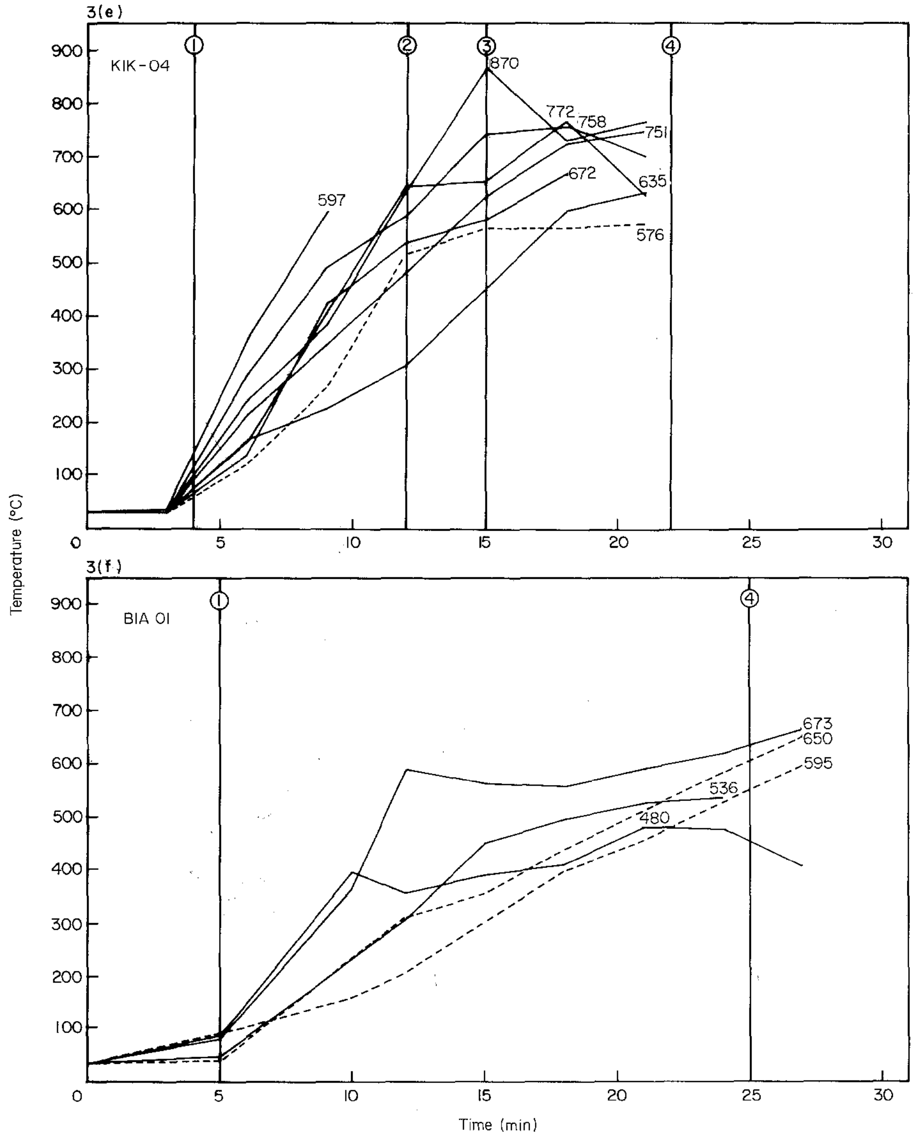

Figure 3 (e–f).

Temperatures reached

The maximum temperature recorded by each probe, in each firing are grouped in intervals of 50 °C (Figure 5). A distinction should be made between temperatures read on the inside (indicated in bold in the figure) and on the outside of the pots. The first group yields much lower temperatures (which is quite apparent in the case of OUF.01), although this cannot be generalized (see for instance BIA.01, KIK.01/a and KIK.01/b).

All temperatures from the outside of the pots lie between 400 °C and 950°C, those from the inside between 300 °C and 800°C.

The use of different fuels is apparently not reflected in the temperatures of the six Bafia firings, perhaps because of similar calorific qualities of the palmfronds and grass.

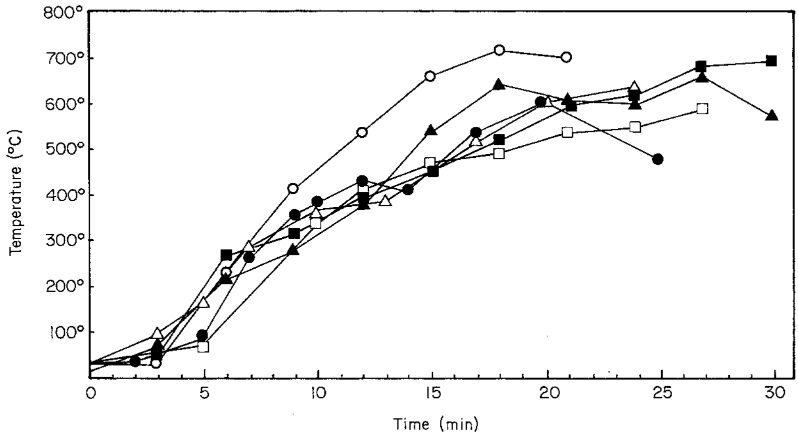

Figure 4. Mean curves of thermic increase calculated for each firing. △ = KIK.01/a, ▲ = KIK.01/b, ○ = KIK.04, ● = OUF.01, □ = BIA.01, ■ = KIK.02/03.

Table 2. General data on the six Bafia firings

Firing	Village	Potter	Fuel	Pots	Broken	No. thermocouples
OUF.01	Goufan I	Ma Ndjama	Palmfronds	24	2	7
KIK.01/a	Kiki	Guibang M–L	Palmfronds + grass	15	—	11
KIK.01/b	Kiki	Guibang M–L	Palmfronds + grass	9	—	11
KIK.02 03	Kiki	Gomoko M Belek A	Palmfronds	25	—	11
KIK.04	Kiki	Kouba M	Palmfronds + grass	16	3	11
BIA.01	Biamo	Makae a Baban S	Twigs + palmfronds	10	—	5

The identification numbers in the first column are those used in the text and figures.

Variations within firings

The distribution of temperatures (of the external probes) is extremely variable when comparing the six firings (Figure 5). The difference between minimum and maximum temperatures varies from 150 °C (OUF.01) to 550 °C (KIK.01/a), with an average difference of 300 °C. These results are an illustration of the enormous range of thermic variation within one single firing. However, this variation cannot be considered characteristic, because it is not seen in all firings. Comparison of KIK.01/a and KIK.01/b is especially relevant: both firings were performed in the same week by the same potter, who used the same arrangement of pots and fuel. Yet, the temperatures are found almost at the extremes of the possible variation.

Variation on the same pot

Again, the variations are unequal among pots and among firings (Figure 6). In general, the differences range from 100 °C to 300 °C, regardless of the size or shape of the pots (the two extreme values were in fact obtained on similar shaped pots).

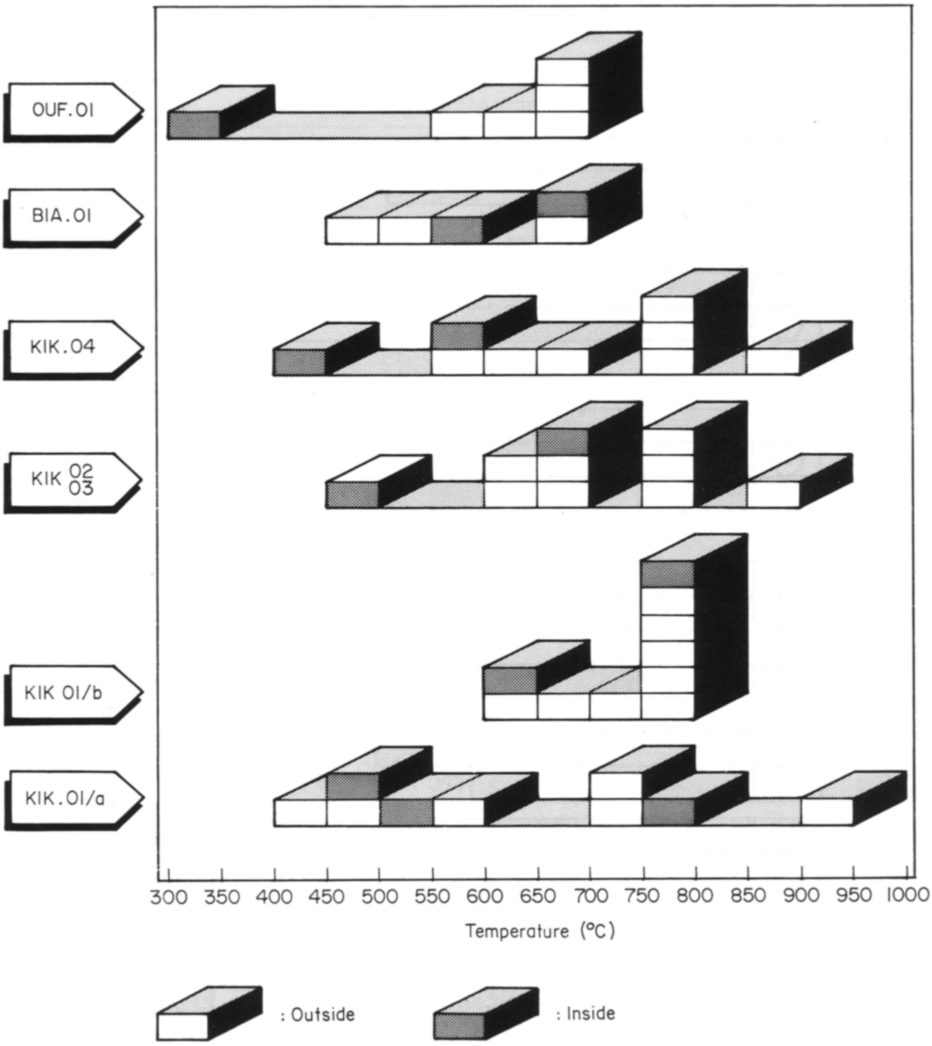

Figure 5. Maximum temperatures recorded by each probe in each firing.

The general assumption that the lowest temperatures would be systematically found on the inside of the pots cannot be maintained (see, for instance, the second pot of KIK.01/a and of KIK.02/03).

If only the temperatures from the outside are considered, the variation runs from 30 °C to 200 °C.

Time of exposure to temperatures

This feature is extremely important, being at the same time related to the heating rate and to the total duration of firing.

The time of exposure of each probe to specific temperature thresholds was calculated, except for the probes on the inside of the pots where the thermic rise is not related only to the firing structure or the fuel, but also to the thermic properties of clays. Probes which had

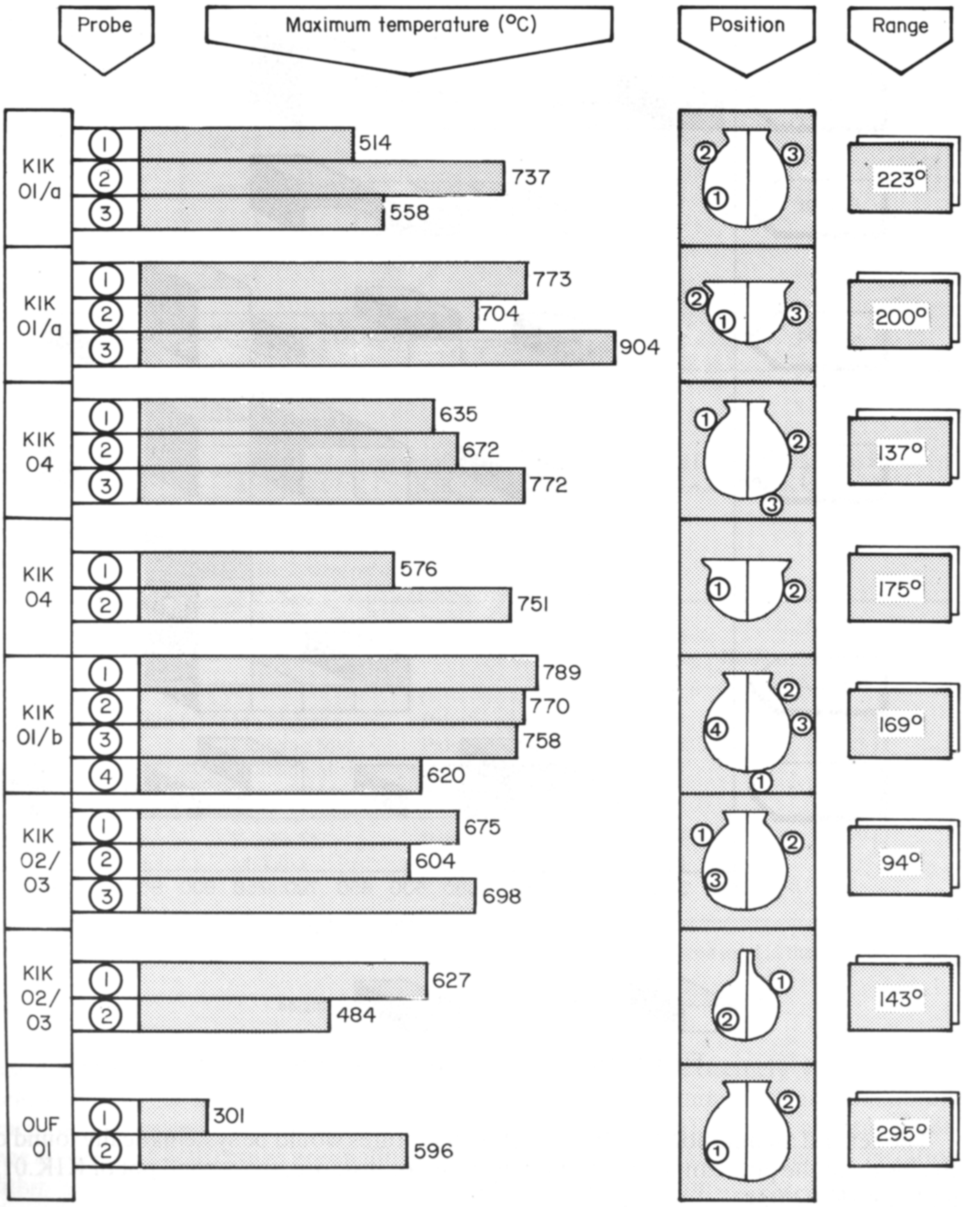

Figure 6. Maximum temperatures reached on the same pot.

snapped in firing were also omitted. The results are clearly a function of the temperatures reached, but there are important differences with regard to the time of exposure (Table 3). The mean values, which are correlated in Figure 7, were again calculated to compare the data more easily.

Generally speaking, as the temperature increases, the time of exposure decreases—which is distinctive for this kind of firing. The decrease is rather regular, except for BIA.01.

Table 3. Time of exposure at different temperature thresholds for each of the Bafia firings

	Time of exposure to temperatures (min)								
Firings	>100 °C	>200 °C	>300 °C	>400 °C	>500 °C	>600 °C	>700 °C	>800 °C	>900 °C
KIK.01/a	17	17	11	11	11	4	2	—	—
	21	21	21	19	15·5	15·5	6	—	—
	19	17	11	7	7	7	4	4	1
	19	14	1	1	—	—	—	—	—
Mean	19	17·2	11·6	9·3	7·5	5·3	2·4	0·8	0·2
KIK.01/b	27	27	27	27	22·5	21	15	—	—
	27	19·5	15	12	12	9	6	—	—
	24	24	15	15	15	12	—	—	—
	27	27	21	18	6	—	—	—	—
	24	18	15	12	12	9	1·5	—	—
	24	24	18	15	15	6	—	—	—
	24	21	18	18	15	12	4·5	—	—
Mean	25·3	22·9	18·4	16·7	13·9	9·8	3·8	—	—
KIK.04	15	12	9	6	3	3	—	—	—
	15	15	12	12	9	6	6	—	—
	15	15	12	9	9	9	6	1·5	—
	15	15	12	9	6	6	3	—	—
	15	12	12	12	9	3	—	—	—
	15	12	12	12	9	9	1·5	—	—
Mean	15	13·5	11·5	10	7·5	6	2·7	0·2	—
OUF.01	18	16	16	15	9·5	9·5	—	—	—
	18	18	13·5	13·5	6	1·5	—	—	—
	18	16	16	6	1·5	—	—	—	—
	20	18	15	7·5	4·5	1·5	—	—	—
	20	18	13	11	8	5	—	—	—
Mean	18·8	17·2	14·7	10·5	5·9	3·5	—	—	—
BIA.01	17	17	15	12	6	—	—	—	—
	17	17	17	9	—	—	—	—	—
	17	17	17	15	15	3	—	—	—
Mean	17	17	16·3	12	7	1	—	—	—
KIK.02/03	21	12	6	3	1	1	—	—	—
	24	24	24	19·5	18	13·5	—	—	—
	21	21	18	18	15	15	12	—	—
	24	24	10·5	4	4	1	—	—	—
	27	24	24	18	18	12	9	6	—
	24	21	18	18	15	10·5	7·5	—	—
Mean	24	21	16·7	13·4	11·8	8·8	4·7	1	—

Only data from thermocouples placed at the outside of the pots which did not snap during firing are utilized.

Here the time of exposure remains constant until temperatures above 300 °C are reached, before the curve finally proceeds steadily, but the time of exposure decreases more rapidly than in the other firings.

The time-span of the entire firing does not seem to interfere. Average exposure-time variability is of the order of 10 min for temperatures below 700 °C. Beyond this limit the

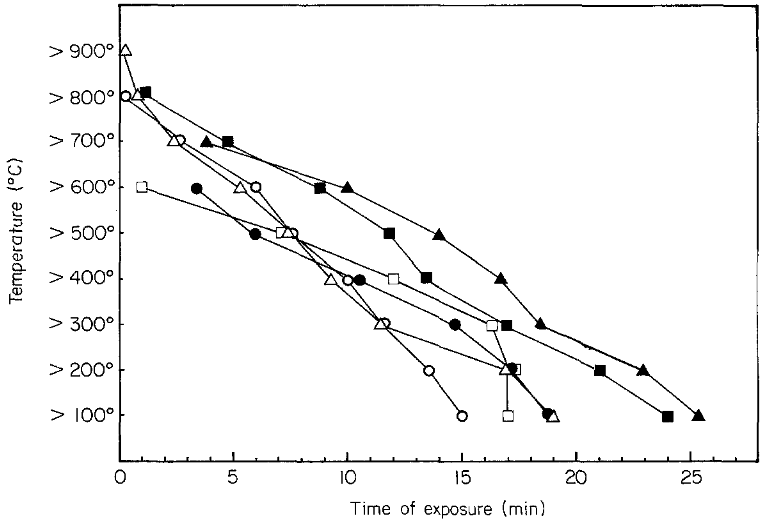

Figure 7. Mean time of exposure to temperatures in each firing. △ = KIK.01/a, ▲ = KIK.01/b, ○ = KIK.04, ● = OUF.01, □ = BIA.01, ■ = KIK.02/03.

data are less frequent and also more clustered. From 800 °C onwards, the average time of exposure equals or is less than 1 min. One may object that this result is, to a large extent, due to the low number of data for this group of temperatures, which is precisely what I want to point out. Instead of considering only the minimum and maximum temperatures, and instead of assuming, as I initially did, that the Bafia fire their pottery between 400 °C and 950 °C, it is safer to consider that in general the firing temperatures remain below 800 °C and, to some extent, below 700 °C.

Discussion and Conclusions

A precise thermometric definition of the Bafia firings appears almost impossible, because (1) the temperatures reached are very variable and are distributed over a large range (550 °C); and (2) the thermic variability within the same firing, or the range between the minimum and the maximum temperature, is as large, ranging from 150–550 °C. The choice of fuel is not reflected in the temperatures either.

Although a precise control of temperatures is impossible, the potters are quite able to reach or exceed the minimum threshold of 500 °C (only 13% of all measurements are situated below this temperature). Even if the temperatures recorded among the Bafia seem to be slightly more clustered (three quarters lie between 600 °C and 800 °C), these results corroborate those of the ethno-thermometric data for the open firing. Nevertheless they have far-reaching consequences because this themometric variability can no longer be explained by specific regional features, such as the arrangement of the structure or the nature of the fuel, both being practically similar in the present comparison. Moreover, the two extreme values of the thermometric variation come from the same potter.

It also became clear that a pot may be subjected to important thermic variations, up to 300 °C, including the inside and the outside of the pot, and up to 200 °C if only the outside of the pot is considered. In other words, identification of a firing temperature from a sherd or a part of a vessel cannot be considered as representative for the entire pot, let alone for the entire firing.

The heating rate and the time of exposure to temperatures appear to be the only suitable parameters for comparing Bafia firings. As we can see, the potters seem to control these parameters to some extent, since they select a fast burning fuel and remove the pots as soon as they reach red heat, some 20–25 min after having set fire to the structure. These criteria allow them to repeat both parameters with minor variations, as shown in Figures 4 and 7.

The question remains why the potters favour a rapid heating rate since it leads to a high thermic stress on the pots due to the sudden evaporation of the water still present in the clay. Usually, this sudden increase of temperature is considered inconvenient because it often causes high firing loss and renders preheating of the pots necessary, especially in the tropics where humid conditions complicate the drying process (Arnold, 1985: 211–212). Moreover, as Gibson & Woods (1989) have shown, only coarse pottery can be fired under these conditions because, as opposed to fine pottery, it allows the steam to escape.

Although the Bafia potters produce coarse pottery and systematically use preheating, it is difficult to understand why they select so consistently a fuel that enhances this pattern of heating rate. One reason could be to gain some control over temperatures: in combining the moment of removing the pots with the heating rate, the potters could avoid reaching, or especially maintaining, certain thresholds of temperatures at which some properties of the clay may start to alter.

This kind of control would be particularly welcome if, for instance, calcareous clays were used, in which the decomposition of $CaCO_3$ to CaO has to be avoided (a process starting at temperatures near 600–700 °C and increasing at higher temperatures) (Rye, 1976). However, the preliminary analyses of the Bafia clays indicate that these do not contain any calcium or other elements that could cause severe physical or chemical alterations if certain thresholds of temperatures were attained. Also, laboratory tests of firings show that these clays easily support temperatures of 800–1000 °C without any major modifications (Impedovo, 1991). Although there seems to be a certain control over heating rate and time of exposure to temperatures and although these features are characteristic of the Bafia firings, the underlying reasons are difficult to explain, except in economic terms, since this only demands a weak investment of time and energy.

To resume the initial idea of this article—the possibility of identifying firing techniques from archaeological pottery—we have seen that identification of the firing temperatures does not permit any technological inferences, because of the large range of possible temperatures for each procedure and their overlap within the interval of 600 °C to 900 °C. In the case of open firing, this situation is explained by internal thermic variation, but this may also be true for other techniques, as the few data available for thermic variation within updraft kiln firing seem to indicate.

The only parameters allowing a technological differentiation are the heating rate and, by extension, the time of exposure to temperatures. If their identification on archaeological pottery is possible, this may lead for the first time to the possibility of identifying prehistoric firing techniques. Therefore, if the pyrotechnological approach to pottery is to be meaningful, we have to turn our efforts to a clear identification of these two parameters. At the same time, an ethno-thermometric approach as presented for the Bafia firing, should be applied to the other firing techniques. This is needed in order to define the specific features of these parameters and in order to understand the reasons that motivate the artisans into choosing a particular firing technique.

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