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# Technical details about traditional sudanese «DOKAS» (baking plates of clay) with glossy black surfaces

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## Introduction:

Plates or flat dishes for baking of bread belong to the most ancient items of hand-made pottery. In Europe they were found in neolithic sites of the Michelsberg and Chassey cultures (2500 B. C.). Their outer and inner surfaces have the same reddish colour (Davidsen 1974). In the Nile valley baking plates have existed since the eldest dynastical period. A small sculpture from the Old Kingdom shows an Egyptian baker working with such a plate placed on three plates of Nile mud (Währen 1963, fig. 4). In archaeological pottery collections of the Northern Sudan baking plates have been present since Meroitic times. They belong to the hand-made ware assumed to be modelled by women since times immemorial until the present. In X-Group sites (ca. 350—550 A. C.) baking plates occur sporadically, but they are fairly common in sites from Christian Nubia and from later periods. The majority of the specimens have a glossy black finish on the inner surface, but there are also red ones at all times (Adams 1962 and pers. communications of the author).

Baking plates or «dokas» (Sudanese Arabic) are still made by Sudanese pottery women. The specimens now known in the Central Sudan from the markets of Kassala or El Obeid or from small pottery centres in the Gezira Province between the Rahad and the Blue Nile are red on both sides. Red dokas are not made from the same clay mix as a water jar, they require a special mineral temper to counteract porosity and to increase resistance to heat. This material can be sometimes only obtained by grounding old plates into powder (c. f. also Robertson and Al Abbas Mohammed 1976). The other technical alternative is to apply

a specific surface treatment. In remote villages of the Blue Nile Province close to the Ethiopian border and in Southern Darfur dokas are provided with a black burnish resembling the finish of the excavated specimens. The present paper is dealing with pottery techniques, the identification of the raw-materials for the slip and comparative studies on contemporary doka potsherds with burnish and a specimen from the Christian Nubian period.

## Materials and Methods

Information from the Sudanese pottery women and samples of their materials and potsherds were collected in connection with a current research project on traditional water purification in rural areas.

*Gozo*: village in the Blue Nile Province near Qeissan, at the Ethiopian border. The population belongs to the Farunga branch of the Berta tribe.

*Kafiya Kingi, Songo and Umm Bushera*: villages in Southern Darfur in the area of the intermittent stream «Bahr el Arab». The pottery women from Kafiya Kingi and Songo were from the Binga tribe, the woman from Umm Bushera belonged to the Kara. The territories of both tribes extend to Bahr el Ghazal Province.

The archaeological potsherd belongs to a doka (height: 4,9 cm, diam.: 33,7 cm) excavated by Prof. Adams on the Nile island Mainarti in 1961/62 (Christian Nubian domestic pottery, Khartoum National Museum obj. No. 17324, Field 6/K 3/137). This sample was kindly provided to us by the Deputy Director in General of the Museum, Mr. Akasha Mohammed Ali.

The mineralogical composition of the materials used for the black burnish and the glossy surface layer of the potsherds were analysed by means of X-ray diffractometry using a PHILIPS diffractometer (Cu—K $\alpha$  with graphite monochromator). This investigation was carried out by Dr. Heinrich Rösch, Federal Institute for Geosciences and Natural Resources, Hannover (Western Germany). I should like to express my most sincere thanks for his valuable collaboration.

- Taf. 20  
Fig. 40: *Doka of dish-shape. Berta-pottery from Gozo (Blue Nile Province).*
- Fig. 41: *Doka of plate-shape with four «ears». Binga-pottery from Kafiya Kingi (Southern Darfur).*
- Fig. 42: *Water jar with graphite-slip on mouth and shoulder parts and rubbed after firing with leaves from the Habil-tree (left). Binga-pottery from Songo (Southern Darfur).*
- Fig. 43: *Dokas of plate-shape without black burnish. Dago-pottery sold in the market of El Obeid (The dark spots on the plate to the right are due to partial reducing firing).*

## Results

*A. Composition of the clay mix:* The clay used in Gozo was blackish and brought from a far-off bed of an intermittent stream. People call this type of soil in Sudanese Arabic «bā dōba» and consider it as a fertile soil for cotton plantation. The brown-grey pottery clay in Songo was also taken from a Wadi, but in Kafiya Kingi and Umm Bushera, where fluvial clay was not available it was substituted by the earth from termite hills. The same type of raw material is also known in other Berta villages as well as in other parts of the Sudan and Africa in general (Crowfoot 1925, David and David-Hennig 1971, Drost 1967). The composition of earth from termite hills may undergo variations and probably depends on the available soils in a certain region. In a sample from Bubaiya-Diresa (60—70 km south of Nyala) — analysed by Dr. Rösch for the sake of its properties as a water coagulant — we found the main component to be quartz and an additional component of kaolinite.

The clay or its substitute is mixed with powdered potsherds and pounded dry savannah-grass in proportions which differ due to the experience of the pottery woman and her clay. Earth from termite hills was tempered in both Provinces with a greater amount of powdered potsherds (1:2 or 1:3 in volumes) than fluvial clay (1:4) and the amount of added grass was less for earth from termite hills, probably because it already contains organic matter. The pottery women of the indicated tribes prepare the same type of clay-mix for all types of ware, no matter whether they are going to shape porous or heat-resistant vessels, but the first type is left without any further treatment.

*B. Types of burnish and their application:* After forming the doka with the hands, a beaterstone and a segment from a calabash (Gozo) or a cow's rib (Darfur) it is left to dry for 2—4 days. Then the pottery woman from Gozo crushes a blue-blackish stone, brought from a Wadi close to the Ethiopian border, mixes the powder with some water and rubs this slip with her fingers on the inner surface of the doka. After slight drying she starts to polish the surface carefully with a smooth pebble. Firing has to take place after a further day of drying.

The pottery women in Southern Darfur use similar methods, but have to obtain their materials from friends or relatives in Bahr el Ghazal Province and instead of water they mix the stone powder with different types of fat (Table 1). The local names for the mineral materials depend on the most numerous tribe in a village and not necessarily on the ethnic origin of the pottery woman.

In Gozo burnish is only applied to dokas, but in Darfur it is also used for the inner surface of cooking pots and as

decoration on mouth and shoulder parts of jars for transport and storage of water.

*C. Firing and after-treatment:* In the Northern and Central Sudan the main fuel for firing is animal dung. This material is scarce in poor mountain villages of the Berta. There a small pit is filled with wood from the Terter-tree (*Sterculia setigera*) and the dish-like doka is turned upside down and carefully covered with firing material. Firing for ½—1 hour is sufficient. In Southern Darfur cattle have been almost exterminated by the tsetse-fly in the mentioned villages and thus the firing material consists also of wood (Darot tree [*Terminalia* sp.] and various brushwood). For firing the doka plates are leaned against other vessels with the inner surface to the outside. Firing is maintained for 1½—2 hours.

In Songo the hot ware is rubbed after firing with leaves from the Habil-tree (*Combretum cordofanum*), called «Sona» by the Binga. This results in dull blackish-grey surfaces, contrasting nicely with the glossy black finish (Fig. 42). In Kafiya Kingi and Umm Bushera the hot ware is carefully turned for 5—10 min. with wooden sticks on a heap of pounded dry grass. After brushing away the grass the surface looks also blackish-grey. Sometimes the hot vessels are also rubbed with handfuls of dry grass for the same purpose.

The doka from Gozo shown in Fig. 40 had been already in use for some time, but retained a shiny blue-black surface, whereas the doka from Kafiya Kingi (Fig. 41) appears black on its upper side. The ware from Umm Bushera was also black, but had a brownish tint.

*D. Ethnological role of the doka in the mentioned regions:* The pottery women from the Blue Nile Province and Southern Darfur make dokas only on special order. Although they sell them at a low price of 15—25 Piaster, baking of flat bread is not yet known in every household. Even if a doka is available it is usually only in use at feasts. For ordinary meals the millet is consumed as porridge. In bigger communities as e.g. Songo some wealthier families bake flat bread on iron plates. At present such plates are sold for 5—7 L. S.

In Gozo and the villages of Southern Darfur the baking plates of clay are called «dokas», none of the tribal languages has got a special term for them. This Arabic name in turn might be a derivation from the Nubian «dejo» in combination with the demonstrative pronoun «ka» (dejo-ka = this baking plate). It is obvious that also the techniques of doka-production were imported and reached these remote villages probably by Nubian caravan traders and refugees from the Northern Sudan during the time of the Egyptian-Ottoman occupation. In Abu Shenina, a village half-way between Damazin and Qeissan lives e.g. a pottery woman from the Danagla of 60—70 years. She

learned her craft from her grandmother, who came as a child to this village. Although the majority of the Danagla and Mahas in Nubia itself are now baking flat bread on iron plates («säg»), she still manufactures traditional dokas with a black-grey shiny burnish on the inner surface. Thus ware made by Nubian women in exile has certainly affected Berta pottery in the area. However the doka was imported to the south only as a tool. Non-Nubian ethnic groups do not know of any magic uses of the clay baking plate or its contemporary iron substitute (Jahn 1979).

*E. Identification of the ingredients causing the glossy black surfaces:* X-ray analysis of the mineral materials revealed two different staining ingredients: graphite and haematite (Table 2). Graphite occurring in a mixture with quartz as main component can not be easily detected by X-ray diffractometry. For this reason all samples were also carefully investigated under the microscope, whereby «Nëni» was found to have a «high» graphite content.

To identify the raw materials for the burnish from the investigation of potsherds is far more complicated. On a potsherd from Umm Bushera ware traces of haematite could be detected in the burnish. Kafiya Kingi ware treated with Nëni showed a thin black cover on a sticky brown layer resembling colophonium. After removal and repeated X-ray test the layer was found to consist of a roentgen-amorphous component (organic material) perhaps combined with traces of graphite.

The glossy black surface on the doka potsherd from the Christian Nubian period was due to a soft top layer of organic carbon resembling the burnish obtained with Nëni. There were no detectable amounts of graphite.

### Discussion

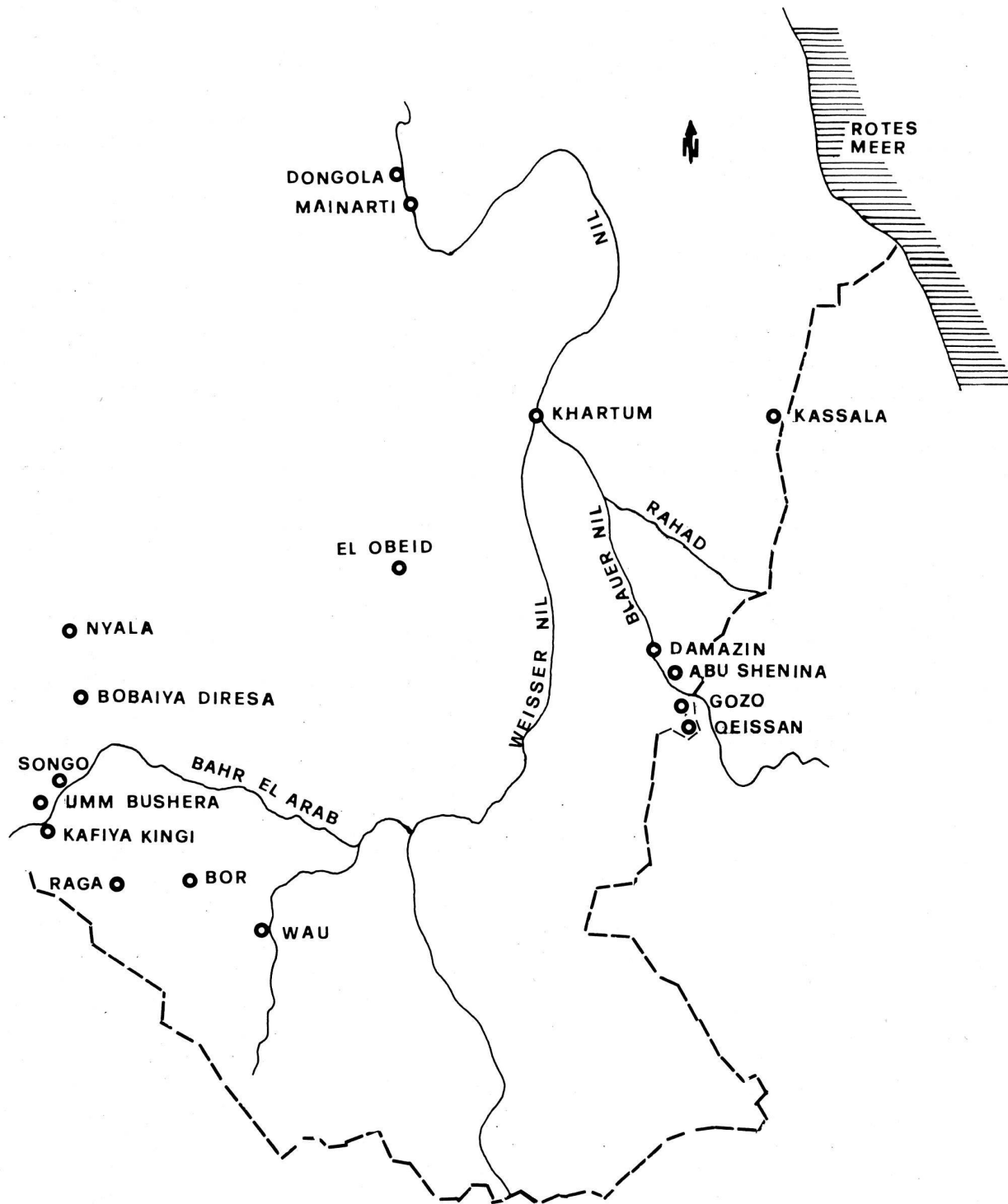
The essential staining ingredient for the black burnish of dokas from contemporary manufacture is obviously graphite. The fact that the Qalfuru-sample from Umm Bushera contained haematite can not be taken as a proof that this material is another technical alternative. The pottery woman believed that she was working with the same «stone» as the other women in this area. Thus it might have been by chance that she got the wrong material. On the other hand it is known from Nubian pottery in Upper Egypt that a haematite slip prepared with water and a little olive oil yields a red burnish after firing with animal dung; at fiercer heat however (obtained by adding chopped straw) the colour turns to black (Randall-MacIver 1905). Besides graphite treatment is traditional also in the pottery of other tribes in Bahr el Ghazal Province. The Ndogo, Golo and Jur rub their vessels after firing both with grass and on certain parts with a black min-

eral powder obtained from a friable stone. The surface appears much blacker than after treatment with grass and has a remarkable lustre (Crowfoot 1925). Grabham found that this black mineral material consisted of a schist containing 23,9 % graphite (Table 1).

The burnish from Kafiya Kingi and Songo appeared as pure black whereas the doka surface from Gozo had a bright bluish tint. This display of colour might be due to traces of an unknown component in Dididang or to textural surface arrangement of platy mica crystals.

In Africa graphite slips are mainly carried out for the sake of decoration. Highly appreciated black ware polished with graphite and fat as vehicle has been also described from tribes in neighbouring countries: the Baya in Cameroon and the Bunyoro in Uganda. The Bunyoro manufactured graphitized ware only for their king (Drost 1967). According to the beliefs of the Sudanese pottery women the graphite burnish of dokas has a functional role. They claim that «kisra» (flat bread) does not stick to baking plates of this type and that they minimize the consumption of oil or fat to be rubbed on the doka before spreading dough on it. In addition to an anti-sticking effect the temperature resistance and thermal conductivity of graphite seem to be useful properties for baking ware. In Austria and Bavaria (18th—19th century) «eysern hevenwerch» (iron ware), ceramics made from a mixture of clay and graphite, obtained great fame. It was mainly used for crucibles (Bauer 1976) yet sometimes also for baking forms (e.g. forms for Easter pastry with figurative stamps from Kärnten, Meyer-Heisig 1955). In addition graphite was also used for surface treatment (0,5—1 mm top layer, Stieber 1967). It is not known whether this method was adopted due to shortage of graphite or as an imitation of true clay-graphite ware. According to scientific tests on potsherds of different types of Austrian graphitized pottery a thin graphite-containing surface layer (Engobeschicht) can not compensate for the valuable properties of ware made of a clay-graphite mixture (Duma and Ravasz 1976).

The glossy black inner surface of the doka from Christian Nubia was also due to a carbon layer. On account of the difficulties in demonstrating graphite in contemporary potsherds the possibility that graphite was also in use in Nubia — where schists are available — can perhaps not be ruled out. In villages of Macedonia, Serbia and Montenegro hand-made clay pans for baking bread are rubbed and polished with diluted dung or soot (Filipović 1951). A further type of carbon treatment before firing consists of closing the fine pores with tarry compounds. This method has been used by the women of Jutland (Denmark) who were curing or smoking their ware with soot from hether. Among their vessels were also



waffle «irons», dough-nut pans and cake forms (Steensberg 1939).

The question of whether surface layers of graphite or organic carbon on clay vessels for baking have mainly an aesthetic or also functional value should be settled by comparative experiments.

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Table 1

## MATERIALS FOR BLACK FINISH FROM BAHR EL GHAZAL PROVINCE AND THEIR VEHICLES

Pottery Center	Name of mineral material	Tribal language	Place of origin in Bahr el Ghazal Province	Vehicle for surface treatment
Kafiya Kingi	Nēni or Mēj	Kreish, Ndogo	Menamba, between Raga and Boro	animal fat
Songo	Qalfuru	Binga	Kata in Raga district	oil from Lulu-tree ( <i>Butyrospermum niloticum</i> ) or melted butter
Umm Bushera	Qalfuru	Binga	Boro	animal fat or oil
Wau-area Crowfoot 1925, Notes from the Geological Survey, Khartoum	Liki	Jur(?)*	Peili, Khour Leira near Wau	none: dry powder

\* not recognized by Golo- or Ndogo-speakers in Khartoum

Table 2

## X-RAY ANALYSIS OF SAMPLES USED FOR BLACK BURNISH (according to Dr. Heinrich Rösch, Hannover)

Type of material	Main component	Additional components	Traces
Dididang (Gozo)	Mica	Graphite	—
Nēni (Kafiya Kingi)	Quartz	Graphite	Anhydrite
Qalfuru (Songo)	Quartz	Graphite, Anhydrite	Muscovite-Illite, Feldspar, Siderite
Qalfuru (Umm Bushera)	Haematite	Quartz	