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## Iron Smelting in Wollega, Ethiopia

By Temesgen Burka

**Abstract:** The author is a graduate student affiliated with Addis Ababa University and the University of Bergen, who is currently concentrating on ethnoarchaeological studies in Ethiopia. He has carried out ethnographic field work on iron smelting traditions in West Ethiopia among the Oromo. Mr. Burka has also worked on reconstructing iron smelting techniques and traditions that had a long heritage in that region but declined from regular use over four decades ago. In this field report, he describes his direct observations of methods and traditions of ore mining and treatment, charcoal making, clay extraction, tuyere making, furnace construction, and smelting. This ethnoarchaeological study should provide highly valuable data for other researchers to use in formulating ethnographic analogies for use in archaeological investigations of iron production activities at other sites in Africa and the Americas.

### *Introduction*

This paper presents my observations of iron smelting procedures at Walagee, in the district of Abee-Dongoroo in Wollega, Ethiopia. I carried out ethnographic work among members of the iron working community at Walagee in three separate trips. I will present my observations of the process of iron working recorded in two of those trips. The third trip was concerned with discussing the social place of the old smelters. The themes that are included in this description are extraction and processing of iron ore (*gordana Sibiilaa* in Afaan Oromo language), tuyeres preparation (*buudaa*, *kololii*, and *madabii*), charcoal making (*cilaattii*), furnace preparation (*boolla buufaa*), and finally, smelting activities.

### *Smelting Reconstruction: First Round*

#### *Mining and Preparation of Iron Ore (Gordana Sibiilaa)*

In the first round of ethnographic work that I carried out in July 2005, we were taken to the old mining site at a locality called Faallee. Hence, the ore is locally called *Gordana Faallee*, or "Faallee's ore." We were led by *Obbo Moosisaa Gaaggaa*, one of the former owners of the mining sites at Faallee and a participant in smelting activities in the past. Members of the "forgers" who volunteered to demonstrate smelting activities also accompanied us. Descendants of "old smelters" of Malkee only helped in reconstructing the story, to which the new smelters and I listened carefully. I was later informed that old smelters used to complain that people are confusing them with the forgers (called the *tumtuu*). It was probably because the old smelters were afraid that they might be called forgers that they refused to participate in the demonstration activities. They were also too old to physically participate or organize labor. The positive part was that the forgers had many live memories of iron smelting activities as it was orally passed down in their society. Accordingly, I had to accept members of the forgers who volunteered to demonstrate based on the story they listened to as well as the help received by an individual who had participated in smelting in the early 1960s.

The former ore mining site is now covered by bushes and coffee plants. We were told to take care while walking in the bush and to avoid stepping on pits that were not visible because some of the old mining pits have collapsed and others had become covered with bushes as well as coffee plants. *Obbo* Moosisaa led us to one of the old mining pits, at which he knew there existed left-over deposits of ore from earlier mining. The pit belonged to the known smelter *Obbo* Wayyeessaa Bokoree. He asked the forgers to clear the bush and the top soil and they did this. Under the top soil, there lies a subsoil that is heavier in texture and consistency, but as red in color as the top soil. He told us the ore was mined from the bottom of the pit about 20 meters deep. He said that this ore is not different from what can be mined anew in the area, although some of the forgers doubted that claim (click on the images below to see photographs by the author of these and other reconstruction activities).



The new smelters then carried a sack of the ore to the river nearby, called Hagmsa Faallee, where cleaning of ore took place in the past. Before washing took place, the new smelters cut bark of an acacia tree and spread it near the edge of the stream as a surface upon which the cleaning would take place. One of the old smelters, *Obbo* Nagaash Fayyisaa, also participated in this process. Then washing was undertaken. As they continued to add water to the ore and the lighter impurities washed down, the color of the ore gradually changed from red to black. Since it was rainy season, the river in which they were washing did not have very clean water. As a result, the ore was not adequately cleaned from the other matrices. The washing was not thorough, because the participants also complained that they were tired. Then the ore was taken to the forgers' village and was weighed the next morning to be 17 kilograms. The ore was put aside for the smelting day.

### Making Tuyeres

In this discussion, I will mainly focus on the clay tuyeres known as *madabii* or *qunxurroo*. Two tuyeres made of clay are needed for the smelting. Another eight tuyeres are made from horn and iron sheets. Since the horn (*buudaa*) and iron (*kololii* or *mundoo*) tuyeres used for forging and smelting purposes were similar both in terms of size and preparation, there was no problem for every forger to own such tuyeres and maintain them at their cottages. I asked the smelter when he would prepare the other two clay tuyeres, and he said that he could do so when he prepared the bellows. He said these tuyeres do not need drying or much technique for preparing them and he makes them only for the new bag bellows. The *buudaa* and *kololii* tuyeres are permanently attached to a bag bellows. Unlike the *madabii* ones, the horn and iron tuyeres do not have direct contact with the fire, and once they were made they could be reused for different projects likely over a span of years. The *buudaa* tuyere is cut and prepared from the horn of cattle and inserted into the bag bellows through the mouth to protrude through the only opening at the bottom of the bag left for this purpose. The iron tuyere is inserted from inside the bag to protrude through the

opening of the horn, sealing it tightly so that the air should not leak out. Leather string attached to the bag is used to wrap around the horn and the edge of the bag to prevent air from escaping. Preparation of the *buudaa* tuyere did not take much time since it needs no special attention.

Darbush Kumsaa, a man of about late thirties in age, volunteered to demonstrate the smelting and assumed the place of master smelter. He also oversaw the production of the tuyeres. Clay (*suphee*) was obtained from a location that was about a ten-minute walk from Darbush's house and about five minutes from his forging (smelting) station. Early in the morning, Darbush led us to Laga Suphee (the Clay River), where his father, the master forger of the village, used to mine for clay to make his tuyeres. An individual named Kabaa Mijjanaa, in the hamlet of Jawaj, corroborated this information and reported that his father, an old smelter, used to extract clay for *madabii* making from this same river. Darbush and his elder brother, Korentii, mined the clay soil after cleaning it from dirt and top soil until they found a coarse and masticated sample.



Then the clay soil was taken back to the masoo village. Although only two *madabii* tuyeres were needed, they decided to make four so that they could use the rest as a reserve supply. They undertook a division of labor for making the tuyeres. They said that pounding the clay was to increase its elasticity (*walqabachisa*). The process is known as *tumuu*, for beating or pounding. After they were satisfied that the clay was softened, they divided the clay soil among themselves to make the tuyeres. They made the tuyeres on the same day that the clay was extracted from the Clay River. I inquired as to whether this practice was undertaken in the past. I wanted to know Darbush's view. Otherwise, I had already been informed by old smelters that it took some days to prepare the clay, and that other materials, such as straw of teff, clay sherds, and sometimes slags, were added to temper it. Darbush told me that he had learned a lot about tuyere making from his father and that his father used to add some of these other materials to temper the clay. However, Darbush usually prepared the clay on the same day it was extracted. He said that his father used tuyeres made this way for over a year. Darbush added that one could wait for the tuyeres to dry on their own without having to expose them to direct sunlight or fire.

Each of the tuyeres was later pierced with a shaped wooden stick to make a tube. The tuyeres were about 70 cm tall; on the *hudduu*, or bottom end, they were about 34 cm wide and they narrowed in width down to the *afaan*, or mouth end. The clay tuyeres were left under the shed of Darbush's house for gradual drying for some time. After two days, Darbush brought the clay tuyeres near the fire at his forging place. Before he put them near the fire, he rubbed them first with dry soil and cold ash and then with hot ash. He then put them a little distance from the forging hearth. Afterwards, he began to fire them on his forging fire and then in a smelting pit furnace prepared under the same hut. Darbush also prepared the *kololii* tuyeres from iron sheet in his forging station.

One day before the smelting day, the participants discovered that two out of four of the clay tuyeres were cracked and non-functional. On the same day, one of Darbush's assistants stepped accidentally on one of the two remaining tuyeres and broke it beyond repair. We were all disappointed by these developments, since it was impossible to make another one under the circumstances. I asked Darbush whether we should carry out the smelting project using a single tuyere and bag. He told me that it might take us over a month to make another clay tuyere due to the heavy summer weather that was fast approaching. It was then decided to carry out the smelting demonstration using just one *madabii* tuyere.



### Bellows (*qalqala buufaa*) Making

In the Walagee area, both smelters and forgers used bag bellows. Making the bag bellows, called *qalqala buufaa*, is a process known as *makkaluu*. The bag bellows are made of goat skin. Each forger has an extra bag prepared or tanned for making bellows. In this case, Darbush did not need to prepare a new bag out of goat skin. He decided to use the bags he had reserved for forging. Therefore, there was no fresh goat skin prepared for the smelting. He made (*makkaluu*) two bags for this smelting, since the bags he was using for forging were old and leaking air. By using two stick slats, he sewed the mouth (*afaan qalqalaa*) with a cotton thread for opening and closing the diaphragm. He left one aperture at the bottom through which the *buudaa* tuyere would protrude. The *buudaa* tuyere is inserted through the *afaan qalqalaa* so that the thicker part is left inside the bellows, closing the gaps tightly. Darbush cut the horn to an estimated length and inserted it into the new bellows. The two are permanently attached to each other.

### Furnace Making (*Boolla buufaa*)

It is the responsibility of a master smelter to prepare the furnace, the tuyeres, and bellows. *Obbo* Darbush and his assistants, guided by *Obbo* Nagash, prepared the furnace near the forging hearth. A new hut for smelting was not constructed, because it was a rainy season and it was not possible to find grass for building the thatched roof for a new hut. In addition to the story collected from old participants, one of the participants of old smelting practices helped in the preparation of the furnace. The furnace was prepared in the forging hut of *Obbo* Darbush. It was dug into the ground in an inclined position of about one meter deep.

Once the soil was cleaned, the master put in stalks of grass and wood and set fire to it. Then the fire was used for firing the clay tuyeres. Firing the inside was also meant to dry and harden it so that loose soil from the furnace wall would not affect the smelting. There was no additional treatment made on the furnace.

The furnace was prepared only one day before the smelting. According to *Obbo* Nagaash, the furnace should have been lined with clay soil. Nevertheless, Darbush did not seem to



listen to Nagaash or the advice received from other participants particularly with regard to treatment of the furnace. Darbush's assistants sided with him in these arguments, because he had already proved himself a master forger like his father. He is known to make bush knives that are regarded as the best in the district.

### Charcoal Making

At present, charcoal is prepared in two different ways. The old way is to cut live trees and burn them in a pit that is covered with leaves and soil after quenching the burn pile with water. This mechanism is particularly used for when charcoal is needed for smelting and household use. This system is no more in use these days. Though charcoal is in high demand in the town, there is no one working on charcoal production in Walagee, because it is considered to be "dirty work." Therefore, it is a second type of charcoal production that is evident, particularly in forging areas. For forging purpose, charcoal is prepared in an open space on the ground in heaps where a fire is set and after the material is half burned it is quenched with water.

The only similarity between the traditional system of charcoal preparation in a pit with the surface preparation method is that after burning the material for a certain time, the workers quench it with water. Individuals who bring their tools to the forging place for repairing their tools either bring bundles of charcoal from their homes or prepare charcoal near the forging site, as wood is available in nearby farming fields. According to them, the difference between preparing in a pit and open space is that charcoal prepared in the pit burns gradually and gives heat for a long time, while charcoal prepared on the surface is used for shorter time periods.



However, the charcoal maker *Obbo* Rabbirraa used the traditional mechanism of preparing it since this charcoal was meant for smelting, not forging. As in past practices, the charcoal for this reconstruction of smelting methods was prepared from three selected tree species. These plants are in *Afaan Oromo* called *Hambaltaa* or *Biiroo* (*Entada abyssinica*) of the Mimosoideae family, *Hudduu Fardaa* (*Trena orientalis*) of the Ulmaceae family, and *Baddeessaa* (*Syzygium guineense*) of the Myrtaceae family.

Old smelters classified the tree species under two types. For them, *Hambaltaa* and *Hudduu Fardaa* produce a saliva-like (*gorora*) substance when burned and their burning helps to consolidate bloom fragments. For forging the bloom (which is still used by the forgers), they told us that they used the *Baddeessa* tree because that fuel tends to melt the bloom and any other scrap iron. *Obbo* Rabbirraa prepared the charcoal according to the information given to us by participants of old smelting practices of the *Malkee* group. He went down the stream of *Laga Suphee* in the farm field of *Obbo* Darbush, where he cut *Hambaltaa* and *Hudduu Fardaa* trees into regular-sized pieces. These trees were half dried since they were

cut down previously as part of slash and burn farming. The master and his assistants participated in the charcoal making as part of offering labor to Rabbirraa. Then a pit was prepared where the sliced wood was heaped and fire was set. After it was half burned, water was fetched from the stream and poured onto the material. Then they collected leaves and covered all over the half-burned wood. The last procedure was to bury the material with soil. They inspected it closely to see whether there was a hole to allow smoke to escape. After they were sure it was all set, they left the material to gradually burn and cool down. For this first smelting, 60 kilograms of charcoal was used to smelt 12 kilograms of ore.

### First Round of Smelting

On the day of smelting (July 14, 2005) the preparation and arrangement of the bellows and tuyeres, a process called *camaduu*, was begun at 10:20 in the morning. In this case, at 10:50 a fire was lit in the pit. To start it they used fire from the hearth and charcoal. More and more charcoal was added while the blowing was taking place. Once the person who measures and adds charcoal (called the *leccaqtuu*) was satisfied with the procedure, the participants began to add the ore. This role was given to *Obbo* Nagaash Fayyisaa because of his previous experience. Simultaneously, the master sacrificed a cock, praying for the help from the spirits (*ayyaana*) of his ancestors and the village. *Obbo* Darbush, who was now taking the place of master smelter, supervised each activity. Smelting activity, i.e. the blowing of the bellows, was carried out by using only one long, clay tuyere and two bag bellows.



The arrangement of the *madabii* tuyere did not seem proper, and *Obbo* Darbush instructed the blowers to stop pumping from time to time so he could inspect the progress. After three to four hours of pumping of the bellows, the blowers began to complain that they could not push air through the tuyere. *Obbo* Darbush stopped the blowing and pulled the *madabii* tuyere back a little, which *Obbo* Nagaash said was wrong. Instead, said Nagaash, the master would do better to use a long stick to open up the tip of the tuyere, which he believed was clogged with slag, and he insisted that the bellows chargers should work strongly and without interruption. A heated dialogue was held between the smelters. The new smelter boasted that he would know better than would the old, and he continued the process for about five hours.

At 3:11 that afternoon, the master told the *leccaqtuu* to add his final charcoal and ore. At 4:00, the *leccaqtuu* added more charcoal, and blowing continued up to 4:26, when the master announced that the smelting was over. When I asked the *leccaqtuu* what he felt about the outcome, he said that he doubted whether we would see tangible results of the smelting. The smelted material was then left for cooling until the next day. The next morning every one of us accompanied the master to see the result of the smelting. However,

it was found to be unsuccessful and resulted in material that was not very well consolidated.

*Obbo Darbush*, like any of us, was disappointed by the result of the work. Every participant offered one or another reason for the outcome. The smelters said that the reasons were mainly two: that due to wet weather the *madabii* tuyeres could not dry properly, and this resulted in three of them breaking and only one in use for the the smelting. Secondly, the blowing was not strong enough to attain the necessary heat. I later found out that the blowers may have conspired and did not fully cooperate with the master, claiming that he did not pay them well. In addition, some blowers blamed the poor results on the quality of the ore, claiming that *Obbo Moosisaa* might have cheated on them by giving them ore left over from past mining. The master then said that if he were given a second chance he would organize a better smelting activity. The second round of smelting was planned to take place after the rainy summer season was over, which meant after mid-September.

### *Smelting Reconstruction: Second Round*

I made a second trip to Walagee in the month of September 2005 to observe another round of smelting reconstruction efforts. Preparations for conducting a second round of smelting began on September 16. Smelting was planned to take place as soon as the clay tuyeres were ready.

*Obbo Darbush* organized this voluntary demonstration of traditional smelting practices in accordance with his promise to carry out another attempt after the first smelt proved unsuccessful. In this second round of smelting, a number of modifications were made. When we again talked to the participants of the old smelting, they insisted that the smelters should take some additional measures in preparing for the smelt. These improvements in the second round included treatment of the ore, *madabii* making, and changes in the depth and internal treatment of the furnace.

According to *Obbo Moosisaa*, the ore should have been washed until it becomes shining black. As I noted earlier, in the first round the cleaning or washing of the ore was not sufficiently thorough to make it charcoal black. Therefore, in the second round the ore was well prepared in that washing took place two times in cleaner water than during the first round in July, when it was washed only once in the unclear water of the flooding river.

In this second round modifications were also made to the preparations of the *madabii* tuyeres. I did not observe those preparations first-hand, because I had to travel to a nearby town at the time. However, *Darbush* described these preparations to me later. As occurred in the first round of smelting reconstruction, the clay was obtained from the area of the Clay River, Laga Suphee. The pounding of the clay and efforts to keep the clay fresh as it was transported from the river were undertaken in a manner very similar to the methods used in the first round of *madabii* making. However, during this second round the smelter added some additional materials to the clay soil. For strengthening the clay, he added



pottery fragments and straw of teff. In addition, this time the length of the tuyere was increased to an average of 1.07 meters.

Then, under better weather conditions than in the earlier attempt, the tuyeres were left under the shed of the house to gradually dry for 13 days. After that, the tuyeres were brought near the fire, because even after this passage of time the *madabii* tuyeres were not fully dry due to the humidity of the extended rainy season. *Obbo* Darbush began to fire them two days before the day of smelting. In this second round, only one tuyere was cracked, but not beyond repair.

Some changes were also made on the preparation of the pit furnace. The second round smelting was carried out in the furnace used for the first round smelting, but with some modifications. In the first round smelting, the depth of the furnace was about 80 cm, to allow 70 cm *madabii* tuyeres. For the second round smelting, the depth was increased to about 120 cm so that it would allow the average length of 107 cm *madabii* tuyeres. This modification on the pit furnace, in terms of depth in particular, was made to follow the traditional line as conveyed to us by participants in the old smelting practices. The other modification made on the pit furnace involved lining the inside walls. In this second round, the master lined the furnace with clay soil. However, three days before the day of smelting heavy rain mixed with ice fell and partly destroyed the lining. It was not possible to reline it since drying of the wall would take longer time than the next three days. To tackle this problem *Obbo* Darbush devised a new technique. He inserted the upper part of a broken pot into the bottom of the furnace, so that the bloom would form on it and the cracking of the walls would not affect this formation. Before he inserted the broken pot, however, he fired the tuyeres inside the furnace for two days, which also helped to dry up the furnace walls.

The day of the second round smelting was purposefully made on Tuesday. Tuesday is called *guyyaa guutuu*, for "full day" or "lucky day." Smelting was begun early in the morning. From about 5:30, Darbush went from house to house to awaken participants. Then at 6:00, every participant was summoned near the smelting hut, *godoo bufaa*. Then at 6:12, a fire was lit and the bellowing began. At an average of about 25 minutes, the participants added charcoal and ore in alternation and under a continuous and more organized bellowing than the first round. Unlike the first round, in this round of smelting they used two *madabii* tuyeres and four bag bellows. In this second round of smelting, the other new element was the use of rubber from a car tire for making part of the bellows.

Six blowers were hired for the second round smelting. All blowers belonged to the *tumtuu* caste. Some of them were already working with the master as assistants in forging activities. Because they complained about the payment *Obbo* Darbush had paid in the first round, I handled the negotiation of their wages in the second round. Smelting in this round took seven hours to finish, consuming 90 kilograms of charcoal carried in three sacks, to smelt 10 kilograms of ore. This was a little bit different from the first round. In the first round, smelting took five hours, using 60 kilograms of charcoal carried in one sack, to smelt 12 kilograms of ore.

**In the second round, *Obbo* Darbush announced the end of blowing and smelting after 13 intervals of adding ore and charcoal and about an hour of blowing without adding any more ore. By that time, the color of the fire and the sound of blowing had changed; these changes were used as signs for stopping the blowing. On the next morning, *Obbo* Darbush and his assistant took out what looked like a block of black material. Darbush's older brother, *Obbo* Bookaa Kumsaa, inspected the material and told us that it was a successful smelt. However, *Obbo* Darbush was not able to make tools out of the *dilalii*, because he never learned how to make tools out of the locally smelted iron. Generally, the reconstruction of the smelting practices was accomplished through a trial and error process based on the information conveyed by the old smelters.**