The building of a down-draft furnace at Molkwo (Mandara Mountains, Northern Cameroon) in 1989:
description of a particularly sophisticated pattern of furnace

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In this paper, we describe a process that took place during 1989 in the eastern piedmont of the Mandara Mountains of North Cameroon, a densely settled area in which the inhabitants have developed an intensive form of agriculture. Since the onset of the nineteenth century, travelers have mentioned this region as an iron production area. They described the Mandara Mountains as a smelting centre that supplies iron to the Bornu and Mandara states.
Concerning the iron metallurgy, the Mandara Mountains are famous for their use of down draft furnaces into which air is introduced down a long vertical tuyère. Iron production ceased in the 1950s due to the availability of metal from Europe. During the fifties and following decades, some authors have still observed a few smelting sessions among the Mafa, the Sukur and the Marghi peoples.
Since then, smelting sessions have been reenacted. The most famous is Dokwaza’s smelting process that Nicholas David and al. have described and filmed. This one concerns the Mafa area.
Christian Seignobos, a French geographer, recorded two smelting sessions: one in the Plata area, and another at Mawasl. Both of them concerned the eastern piedmont from which no other information was at that time available.
Christian Seignobos had planned a third smelting session with a blacksmith of Molkwo but in the event was not available to record the process and asked to Thierry Otto and myself to be present at this smelt on his behalf. The whole process took place between the end of 1989 and the beginning of the following year.
In the late 19th century, Molkwo was one of the main iron production centers in the northeastern piedmont.
Therefore, the process that we describe comes from the heart of the metallurgical industry.
In fifteen minutes, we can concentrate on only one part of the “chaîne opératoire”. We have chosen to focus on the building of the furnace because this sophisticated sequence is especially deserving of detailed description.
First, we have to introduce the main actors. The smelt proceeded under the direction of Adjalbay, a Molkwo blacksmith then seventy years old and now deceased. Adjalbay had two assistants, Tamuaka and Adukay.
The description starts with the building of the furnace. Before this, Adjalbay and his assistants did many walks to gather a variety of plants. Other tasks are also undertaken to retrieve the three different clays used in the frame of the building.
Adjalbay has decided to site the furnace at the foot of a little granite outcrop that is located north of the massif of Molkwo, close to his own home.
The place chosen is a granitic sandy zone located between rocks. The first job is to dig the granite sand in order to create a step in the form of an arc of a circle.
At the foot of this step, Adjalbay and Tamuaka erect a structure which has the shape of a truncated cone and that includes two openings. They build this up by superimposing many rows of clay lumps. This, the body of the furnace is built in two different phases separated by a period of drying. The lower part was built with the local sandy clay, the upper part with a mixture including both the granitic sand and a grey clay.
On each side of the furnace, Adjalbay and Tamuaka build a drystone wall that joins the furnace to the nearest rock. On both sides, a large flat stone is placed in such a way that it juts out of the wall. Below each flat stone, a hole is visible between the stones.
Adukay plasters the stone walls with the clay mixture. He introduces the mouth of a broken pot into the charge hole and fixes it in place with clay.
Then, he plasters the front of the furnace with clay. The front wall is finally covered and Adukay smoothes the whole surface with a stone.
Adjalbay decorates the front wall by pressing the fresh mud with his finger. A cylindrical appendage is modeled and fixed on the front wall, between the openings. According to Adjalbay, this element is the navel (mamay) of the furnace.
Adukay sets several flat stones behind the furnace. These enclose a space behind the furnace.
This area is then filled up with granitic sand and stones to create a platform.
A shield of clay is built over the front wall and three clay spikes are formed on its top. An undetermined stalk is implanted in each of them.
Several flat stones are settled over the furnace. These reduce the diameter of the chimney.
He plasters the stones with clay. On either side of the chimney hole, a bar is built over the clay layer. These two parallel bars will carry the bellows assembly. A large rock is set into the platform. It will be used as seat by the bellow operators.
Adjalbay inserts a dry flower into each spike on the furnace shield, and he coils a piece of veld grape (*Cissus quadrangularis*) around it.
Adukay makes a new clay mixture that includes:
- The already used preparation that included granitic sand and grey clay
- A maceration of stem wood of *Cissus populnea*
- A small quantity of powdered dry plants.
With this mixture, Adjalbay makes a model furnace and places it close to the bottom of the real furnace, on the right side.
Adjalbay digs a little hole in the floor of the furnace shaft. Inside it, he buries:
- a piece of quartz,
- the stalk of a plant named *merzla*,
- a piece of veld grape
- a handful of powdered dry plants.

Then he fills up the hole with a white clay mixed with the rest of the powdered plants.
Next he puts other stalks of *merzla* on the flat stones which go through the front wall and inside the aeration holes. Moreover, a segment of veld grape is set on each flat stone.
Adjalbay and Tamuaka apply the macerated juice of *Cissus populnea* on the inside face of the furnace. Then, white clay and more of the juice are added to the clay mixture.
Adjalbay and Tamuaka apply this mixture inside the furnace. Once again, the juice of *Cissus populnea* is applied inside of the furnace. A quantity of juice and powdered dry plants is added to the previous clay mixture.
The new layer is thicker. It generates a slope which leads towards the opening of the furnace.
Then, Tamuaka applies the juice of Cissus populnea inside. The inside face is carefully smoothed with a handful of fibers of the same plant, which are the residue of the maceration process. He treats the outer surface of the furnace in the area of the charge hole in the same manner.
A new mixture is obtained by mixing the juice of *Cissus populnea* and a red clay usually used by potters. Adjalbay applies this colored mixture with his fingers on the front wall. With this, he draws several large red bands. At the same time, Adukay applies the colored mixture on the support of the bellows system.
A bag of stripped heads of sorghum is placed inside the furnace. The door is closed with stones and the charge hole and the chimney with the fibers of *Cissus populnea*. 
Adjalbay puts some heads of sorghum in front of the small furnace. He presents a burning sorghum stalk to the front of this model. Then, introducing the same stalk through the door, he lights the stripped heads of sorghum contained in the furnace.
We have today not enough time to fully describe the manufacture of the elements that constitute the bellows system: the tuyère and the bellows assembly. These elements have been constructed at Adjalbay’s home.
For the same reason, we will not describe the setting of these elements on the furnace at the beginning of the smelt. We just mention here the building of a thin wall that closes the shaft opening.
Our description is detailed enough to show that the furnace made by Adjalbay and his assistants looks very similar to the one built at Mawasl for the smelting session reenacted for Christian Seignobos. At first glance, only the size looks very different: the furnace of Mawasl is much taller than the furnace built at Molkwo.

Indeed, both furnaces show the same elements:
- a navel located between the charge hole and the front door,
- a model of furnace,
- three spikes on the top of the shield.

Additional elements are also similar:
- in both cases, the wall closing the furnace shaft is pierced according to a scale pattern fringed with six holes,
- the tuyère and the bellows assembly are also similar.

These numerous similarities suggest that the two furnaces belong to the same type. This is not astonishing, considering that the massifs of Mawasl and of Molkwo are closely located and are occupied by related populations.
Nevertheless, the sketch drawn by Christian Seignobos (1991) does not show an empty space around the furnace. None of other down draft furnaces described shows this space. However, according to N. David (pers. comm.), the small furnace built by a Plata smelter in 1989 shows the same structure as Adjalbay’s furnace; and this structure may be common in the case of “batch” furnaces built to allow multiple short smelting sessions that only produce blooms 4 or 5 kg in size (vs. e.g., the big furnace of Mawasl).

But what is the real function of this space? We may think that it contributes to isolate the furnace, like a vacuum bottle. Therefore, the purpose of this sophisticated structure might be to minimize charcoal consumption in a highly populated area, in which wood is very precious.
The furnace of Molkwo shows a complex structure which exemplifies the structural diversity of down-draft furnaces. Unfortunately, it is doubtful whether such a degree of complexity would be well understood in an archaeological context.