## Short historical aspects of the wire drawing

Metallic music strings from iron, copper or silver wire were already in use since the 14th century in Europe. Brass and golden wires were added until the 18th century. Only after 1834 there were also the high sounded steel strings.

The early strings did not have such a high tensile strength as it is possible with today's materials. This is conditional on variations in the alloy through different ores and in the soilings trough dross, and even through the later adaption through forging.

The wire was drawed on handlreels in the always same direction, so that the structure of the wire could not tear open despite soilings.

In the modern wire production the material first will be rolled. In the rough draw the diametre will be reduced from 12 to 3 mm, in the medium draw there is a further reduction to 1 mm to come to the fine draw for bringing the wire to very thin diametres. On drawing the wires through a conical drawtool, the several cristals will be stretched and moved mutually. At the same time they are turning with their sliding directions in to the deformation direction. Turn, rigidity and adjustment of the cristallic structure are in close connection with the material direction. Through rationalizing the production process like through big cross section decreasing of the wire and draw stones with big draw angels, the material direction will be more inhomogen again.

So it is very interesting to see how people manufactured a good product under the observing of some rules in former times. On the other hand we know that there cannot be produced the best quality though enormous technical knowledge because of the cost-pressure today.

## **Osemund iron**

The term Osemund probably comes from the Scandinavien Osemundfurnace. In the course of history the term was used for different iron qualities and to the belonged production procedures.

The iron which was won of the Osemund-furnace was directly forgeable and could be compared with the poorly carbon iron of the furnace. Historians in the 19th century pointed out that this iron was not brittle in spite of the high phosphorus concentration. There were also described procedures how the Osemund iron could be carburised to steel. In the 13th century the continous furnace = "flow"-furnace become more and more common. People had rough high carbon iron and the problem was to decarborize it and to make it forgeable. This was necessary when people wanted to use it the same way how they were used to use the Osemund iron from the previous furnace. The procedure called "Osemundfrischen" should have served to it.

Osemund became more and more to an especially qualitative mould of carbon poor iron because this did not came up automatically through the new "flow"-furnace.

At least the terms Osemund iron rispectively Osemund steel were used for materials that were assembled with sandwich technique. Here the carbon rich and carbon poor deposits were forged and folded together. The silicate inclusions in the poor carbon iron made special effects in the mechanic.

## Phosphorus

As already mentioned there are indications from the 19th century of the relatively high phosphorus concentration in the Osemund iron. Also new analysis in the USA point to this.

On own material analysis at the *"Bundesanstalt für Materialforschung"* we locked that also modern piano strings have got an extremly high phosphorus concentration. Of course this could not be as phosphorus and sulphur are regarded as steel damager which make it brittle. A demand showed that it is not possible to distinguish between surface and core because of the modern fluorescence measuring method.

So the piano string wire only had a phosphated surface for the protection against oxidation. We do not know how the analysis in the USA were made out.

To this point it woud be good to know something about historical wire production. After several drawings the wire had to be softed again by annealing. This was necessary because people hadn't had hard metal or diamants as drawing stone. The so called *"Hol"* was only a little harder as the material which had to be drawn.

After annealing the wire had to be descaled. For this each of the wire drawers of a *"Drahtrolle"* (= means workshop for producing the wire)brought the collected urine from the whole family in a bucket every

morning. The wire was pickled in the urine for descaling. As urine contains much phosphorus it is conceivable that the material adds itselve with this. Especially the urine of children contains much phosphorus and was collected in the children rich families. It is told that the workers took home rape oil, which was used for drawing in the evening, in the same bucket for roasting potatoes.

So it could be asked wether the described slight enrichment with phosphorus is in touch with the production procedure and also why the phosphorus does not do its harmful effect in the Osemund iron. Perhaps the phosphorus concentration was only increased on the the outside layer gets to the inside. But this is probably not in the same way as it phosphorus is distributed in the structure.