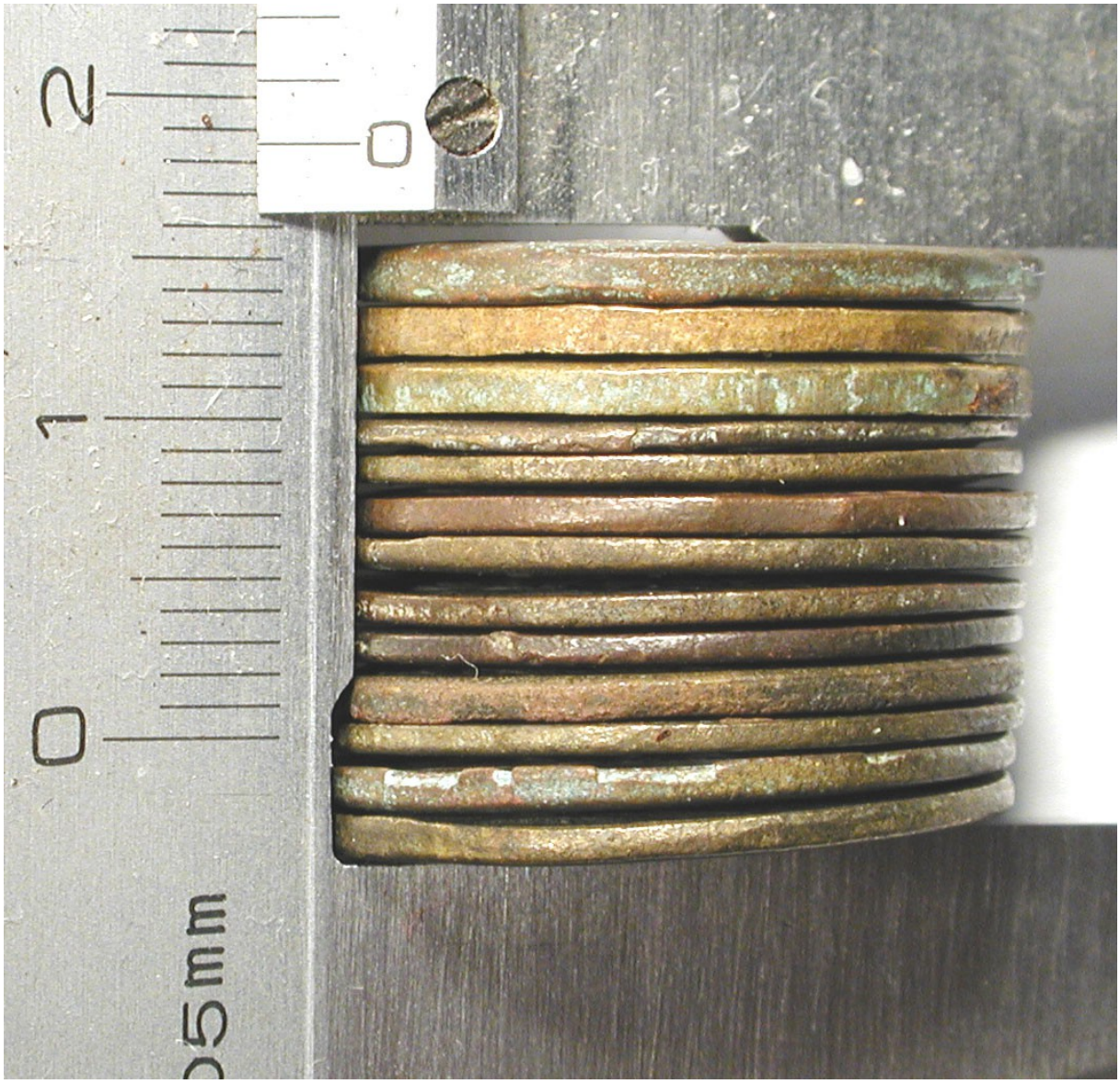
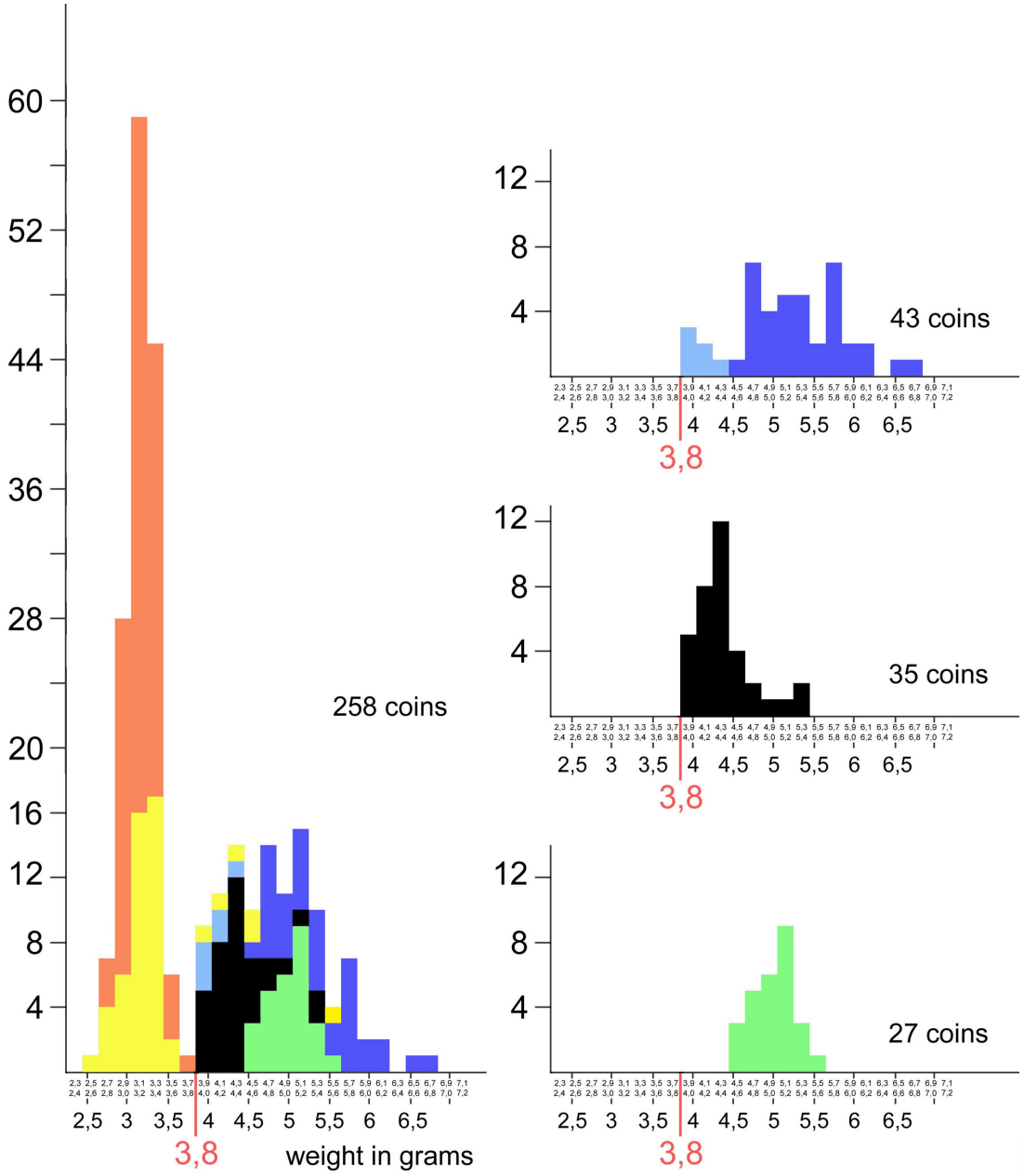
DOA 1916 T, 5 heller part D, thick and thin 5 heller DOA 1916

Everybody who holds a couple of 5 hellers in his hands, will notice some are thinner than others.

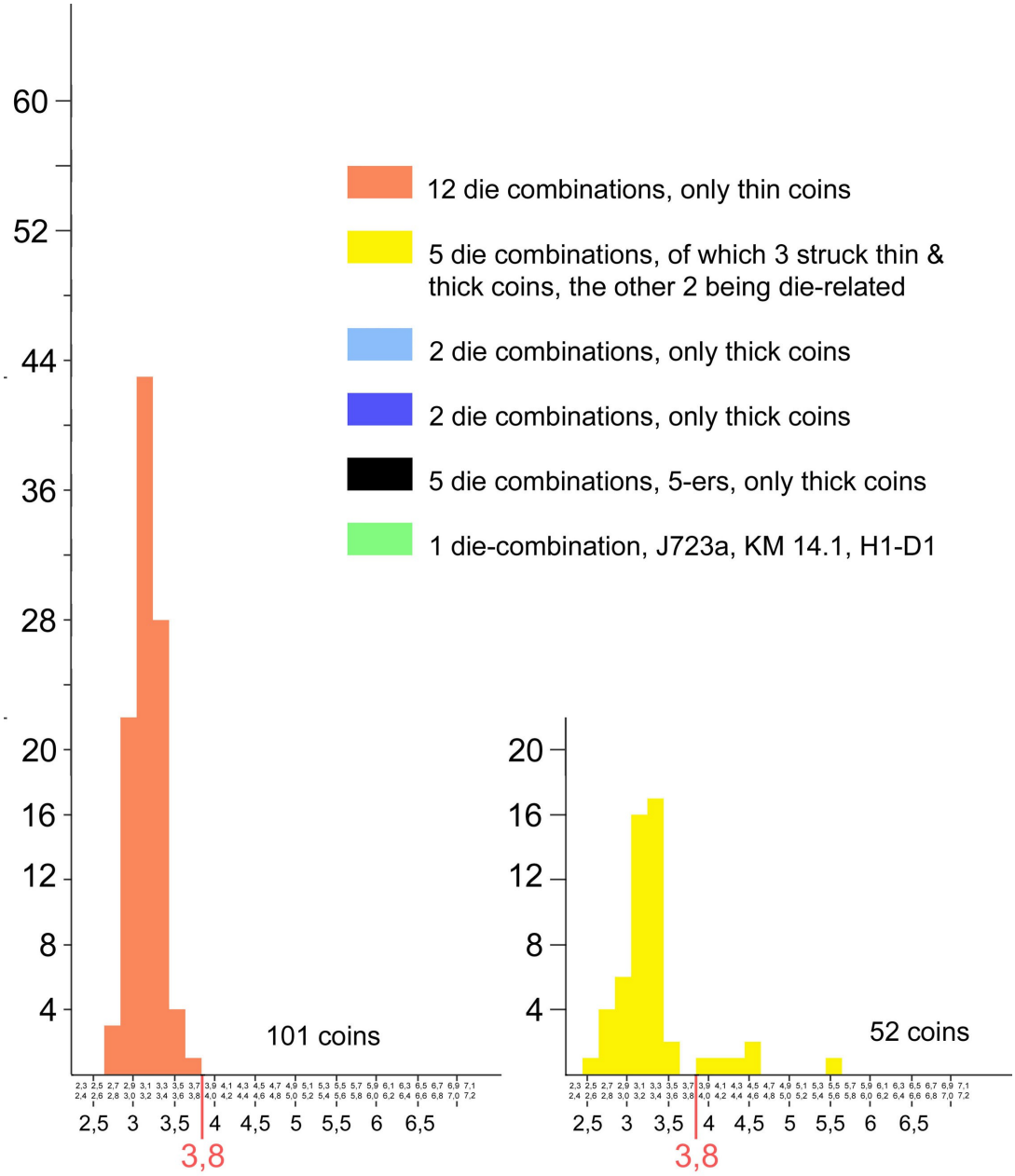


Peter Hammer gives, on page 214 of his book *Metall und Münze*, 15 to 1 as optimal relation between diameter and thickness of a modern coin. For a coin of 23 mm optimal thickness would thus be 1.53 mm.
If the relation between diameter and thickness gets higher then 15 to 1, we get the impression the coins are thin. If the relation gets lower we tend to see them as thick.
A 1.5 mm thick 5 heller has a weight of about 4.3 grams.

Putting known weights of 5 hellers in a graph in 2013 gave following results:



The Arabian Gulf coastal city skyline shows a clear gap between coins with a weight below 3.7 grams and those with a weight above 3.9 grams. Single colours indicate specific groups of die combinations.



Thickness of coins with a weight of 3.3 to 3.5 grams would be about 1.3 mm, measured at highest point. Relation diameter thickness 17.7 to 1. As most of these low weight coins show no upstanding rim, it might be thickness of the sides that hightens the impression of thinness. Where measured this thickness is often less than 1 mm. Relation 23 to 1.

A low value for thickness of coins over 3.9 grams seems to be 1.4 mm. Relation 16.4 to 1. Mostly these coins show at least on one side part of an upstanding rim.
Heavy coins around 5.6 grams would be about 1,9 mm thick. Relation 12.1 to 1.
Thickness of really heavy coins, around 6.6 grams is as yet unknown.

As the distribution of weight of coins with weight over 3.9 grams seems more due to accident then deliberation there seems to be little interest in making further distinctions. All coins over 3,9 grams might be considered thick.
Real hardliners might claim that only those over 6.5 grams are really such.

That the gap between thin and thick 5 hellers is not accidental is confirmed by the decree of 27 May 1916 (112825) which announces the change in weight standards for these coins.
Schumacher (110484) description the 5 heller coins says: circa 5 grams, Φ 22 mm, thick 1,5 mm.

Thickness of a coin is the addition of thickness of the field plus two times thickness of the design. As both are dependent on a complex of factors, like hardness and flexibility of material, striking pressure, depth of design on the dies, size of the dies, loss of material in cleaning the flans, thickness, placement and diameter of the flan etc. it may be clear there will be some spread in the relation between the thickness of a coin and its weight.

Also the zinc content of the material may vary, resulting in small weight differences.
Brass CuZn30 (30% Zinc) > density = 8.55 grams / cm³
Brass CuZn37 (37% Zinc) > density = 8.44 grams / cm³

Looking at the other end of the production of the coins may help to better understand the variety in weights.
No brass cast in Tabora was used for the 5 hellers. Rolling the cast rods to the required thickness must have proved unsuited for these coins. The fact that no Tabora-cast brass was used is confirmed by the lack of casting errors on 5-hellers.

Flans were punched directly from trade stock plates and flattend pipes, or the same rolled to the required thickness. Also scrap metal of the right size may have been used.

A quick survey of diameters of 20-hellers shows diameters between 22.4 and 23.2 mm.
In the table below weight values are given for different thicknesses and punches, weight range is for CuZn37 > CuZn30.
Thickness is what is available on the market today, more archaic thicknesses may have been available in 1916.

Before striking		Flan					
Thickness		Φ22		Φ22,5		Φ28	
inches	mm	cm³	weight gr.	cm³	weight	cm³	weight
0.032	0.81	0.308	2.60 > 2.635	0.322	2.72 > 2.755		
0.040	1.02	0.388	3.275 > 3.32	0.406	3.425 > 3.475		
	1.2	0.456	3.85 > 3.90	0.477	4.025 > 4.08		
0.050	1.27	0.483	4.075 > 4.13	0.505	4.26 > 4.32	0.782	6.60 > 6.69
0.0571	1,45	0.551	4.65 > 4.71	0.576	4,86 > 4,93		
	1.5	0.570	4.81 > 4.875	0.596	5.03 > 5.10	0.923	7.79 > 7.895
0.064	1.63	0.620	5.235 > 5.305	0.694	5.475 > 5.55	1.004	8.48 > 8.595
0.080	2.03	0.772	6.515 > 6.60	0.807	6.815 > 6.905	1.251	10.55 > 10.69
0.090	2.29	0.871	7.35 > 7.445	0.911	7.69 > 7.79	1.411	11.905 > 12.06
0.0937	2.38	0.905	7.64 > 7.74	0.947	7.99 > 8.095	1.466	12.375 > 12.54

While punching a flan, the punch-side of the flan wil get a sharp upstanding rim. To get rid of this the flans were put in a rolling cylinder with sand so they would polish eachother. This will have resulted in some loss of weight. As punches grew older, through wear the upstanding parts would get thicker and less easy to remove. On some coins they survived cleaning and add to the weight. Several different punch-hole combinations may be used.
On punching see: http://steel.com.au
Also the normal production (thickness) tolarances of the material have to be remembered.

Whether the material used is CuZn37 or CuZn30 makes only a small difference of 0.05 to 0.09 grams.

In the Tabora railway workshop punches would be used to make holes for bolts, the punched out parts would be waste. The available punches would be related to the bolts expected to

be used. With Britsch Whitworth bolts, up to 25,4 mm diameter steps between sizes are 1.6 mm, after that 3.2 mm. With modern metrical bolts steps up to 24 mm are 2 mm, after 3 mm. To provide for inaccuracy of punching, the holes would have to be bigger then the bolts.
The table http://www.hug-technik.com/inhalt/ta/schrauben.htm gives at 12 (middle) and 13 (rough) measures for the holes for bolts with diameters mentioned under 1. For a middle range of accuracy holes would have to be 2 to 3 mm bigger than the bolts.
Thus a hole of 22.5 mm would fit Whitworth bolts 3/4" (19 mm) & 13/16" (20.6 mm) as well as 20 mm bolts. Withworth 1" (25,4 mm) would require a hole of 28-28.5 mm, which would also be a rough fitting for a bolt of 24 mm.

Thus the choice of diameter of the flans was restricted by the range of available punches, which would be either at least 1.5 mm bigger or smaller than the one ultimately chosen. A bigger one would have wasted material, a smaller one would make them about the same size as the pre-war copper-nickel 5 hellers. If it was to compensate, in the eye of the users, for the "lesser" material, or for esthetic reasons in relation to the diameter of the large 20 hellers, that the ultimate choice fell on circa 22.5 mm we might never find out.
According to Krenkel at first the 5 heller flans were punches with a handdriven punching machine. Possibly only a restricted range of punches was available for this machine, as it would not have been intented for large holes. From the bulb on the rim of many H1-D1 it is clear they were made using a separate punch.

A combination of circa 22.5 mm with a thickness of the material of 1.5 mm results in a flan of about 5 grams, the weight given by Schumacher. The slightly thicker 1.63 mm would stretch range to 5.5 grams.
Material of 1 mm results in about 3.4 grams, which corresponds to the weight of most thin 5 hellers.
The very heavy coins of about 6.5 to 6.8 grams would be the result of 2 mm thick material.
Coins in the range of 3.9-4.3 grams range could stem from 1.2-1.27 mm.thick materials.

Although some of the wide variation of weights of thick coins can be explained by variations in the thickness of the available materials and size of punches, we need to consider rolling of existing material as explanation of some of the weights.
Thus coins between 5.6 and 6.2 grams could stem from rolling 2 mm thick material, which in itself would have been quite fit for production of 20 heller flans.
Also coins of around 3 and around 4.5 grams need some extra explanation.
One of these explanations might be that, if pipes were flattened by either hammering or rolling the material would get thinner at the same time.

As a large part of the thin 5 heller were struck in August 1916, when production of 20 heller stagnated (see 112889 & 112850), the rolling machine would at that time have been readily available for rolling material for 5 hellers.

Shell cases ?

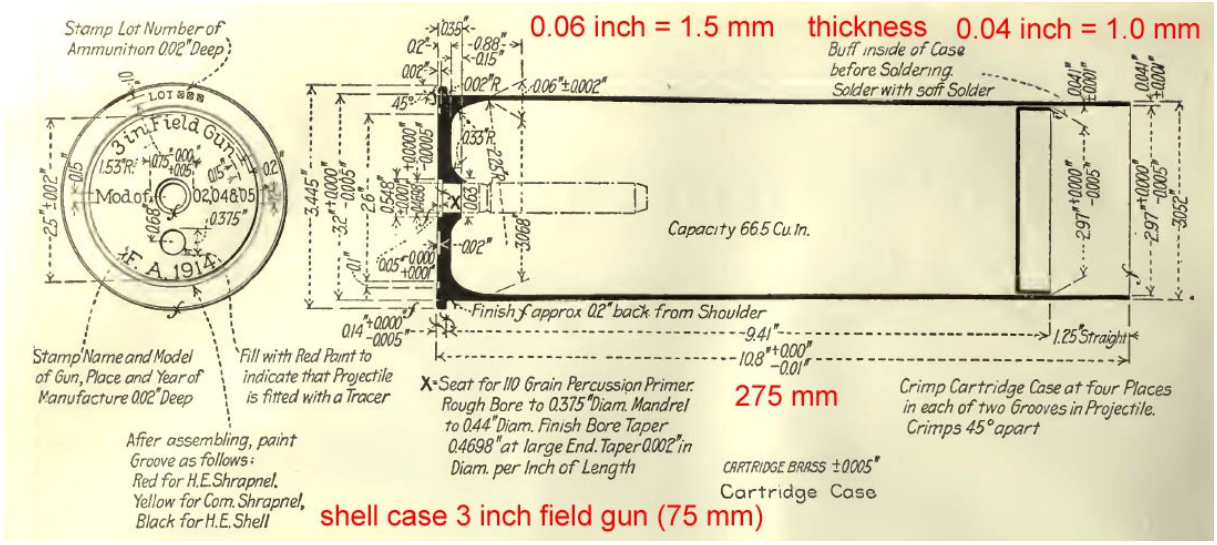
In the *Numismatisches Nachrichtenblatt 3/1976* pages 86-87 rautenberg-1975, a review of a lecture by Rautenberg mentions some of the 5-Heller flans would have been punched directly out of the shell cases of Königsberg 10.5 cm guns. These would be used for striking thin coins.



10.5 cm/40 SK L/40 onboard the german SS Goetzen in 1915 or 1916 in the Bay of Kigoma. This was the Number 6 gun salvaged from the cruiser SMS Königsberg. Note the sliding breech mechanism, typical of Krupp guns of this period. The sailor on the far left is holding a leather ammunition transfer bag.

Geschützmannschaft auf dem deutschen Dampfer Goetzen 1915 oder 1916 auf dem Tanganyika See in der Bucht von Kigoma. Dieses 10,5cm/40 SK L/40 Geschütz stammt von SMS Königsberg.

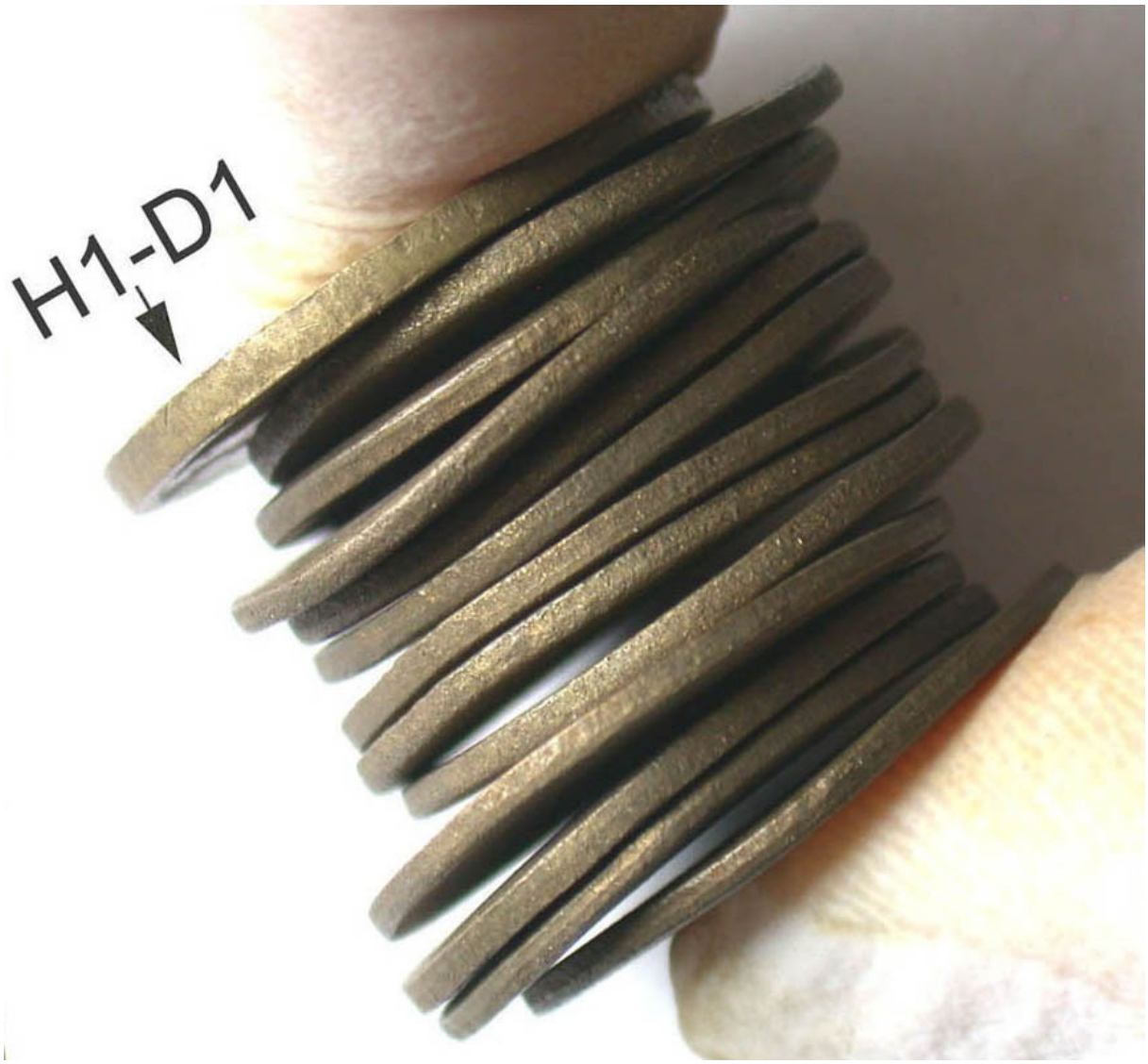
https://commons.wikimedia.org/wiki/Category:10.5_cm/40_SK_L/40_naval_gun?uselang=de



The shell cases of the 10.5 Königsberg guns would have been nearly twice as long as those of in the drawing of a shell case for a 3 inch field gun. In this drawing the sides taper from 1.5 mm at the bottom to 1.0 mm at the top. In a shell case almost twice as long you would expect the thickness at the bottom to be still a little bit more.

If the sides of the 3 inch shell case would have been used to produce flans, a continious series of flan weights would be found, ranging from circa 4.9 to 3.3 grams.
To explain the gap at 3.8 grams, the flan production from Königsberg shell cases would have to have included a rolling to a lesser thickness stage. The reason for this could have been to save on material.

In *DOA 1916 T, extra A, The Royal Museum for Central Africa's collection of 20- & 5-heller coins* thin 5-Heller flans are show that are clearly bent.



This seems to indicate the material they were punched out of was bent also. If thes were no shell cases, it must have been brass pipes.

Conclusions

The 5 hellers were originally intended to be struck on flans 1.5 mm thick, resulting in coins of circa 5 grams. Little care seems to have been taken to maintain this standard, but untill standards were changed no material less than 1.2 mm thick was used. The heaviest coins were struck on planchets 2 mm thick. Ten die-combinations, represented by 105 coins, are not known to have produced thin coins*

Somewhere around end of May 1916 a situation arose that made it necessary to change the standard. A thickness of 1 mm became the new norm. After that very little coins were struck on thicker planchets. In 2013, out of 153 coins, struck by 17 die-combinations, known to have struck thin coins, only 5, struck by 3 die-combinations, weighed over 3.7 grams. In 2017 a thick coin of one other “thin” combination was found.

Standard Catalogue of World Coins > German East Africa KM # 14.1 (Jaeger 723a), oval base of crown, was produced by just one of the ten die-combinations producing thick coins. As KM # 14.2, described as being 1 mm or less thick, is the only other type mentioned, the production of 9 die-combination is not represented in that catalogue.

It would be better to define thick and thin coins by weight then by thickness.

* Existance of two light weight KM # 14.1, Jaeger 723a has been reported, but weight is unknown.