

DOA 1916 T

German East Africa 5 heller 1916 T struck at Tabora a die catalogue

part A - introduction



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A catalogue of die combinations

In DOA 1916, 5 heller, part B 5-heller coins struck by 48 dies, used in 27 normal die combinations (and one mule), are depicted. Cataloging is quite simple: Each individual heller-side die is noted by H followed by a number. Idem the DOA-side. H11-D11 is thus a coin struck by a combination of the dies H11 and D11.

Writing this introduction to 5-hellers I assume that you have read the other introductions, so I do not have to repeat all things said there.

Some general catalogues list two types: one with an oval base of the crown and one with a flat base. Schön's Kleiner Deutscher Münzkatalog (2003) and Michel's Münzen Katalog Deutschland (2002) both list only one type.

KM 14.1 = Jaeger N 723a = oval base. Krause puts extra note: 1.5-2 mm thick.

In Germany this type is called Modifiziertes Stempel = modified die.

KM 14.2 = Jaeger N 723 = flat base. Krause puts extra note: 1 mm thick or less, incorrectly ignoring the existence of thick flat base coins,

From eBay it is clear collectors and dealers use a further subdivision, distinguishing thick and thin coins. This could result in four different types, but no thin oval base coins are known to exist.

Base of crown



Oval base D1

Type 1 flat base (D11A)

Type 2 flat base (D15)

Coins with oval base crown, Jaeger N 723a, KM 14.1 were produced by just one pair of dies, which combination I have named H1-D1.



D2

D4

D8

D10

D11

Type 1 flat base, which I will hereafter refer to as straight base, is found, besides D11A in the upper row, on the five D-dies shown in the second row. Only on D4 the

cross is clearly visible. You might notice the differences in the way the ribbons are attached to the crown.

The five dies in the second row were used simultaneously in the 5-heller machine, as will be explained below. D11A = D11, but possibly used in another machine, as the direction of the die axes of H11-D11 differs from that of H11A-D11A. Lowest weight found for a straight base coin is 3.8 grams.



D3

D5

D6

D7

D6

Type 2 flat base, which I will hereafter refer to as wobbly base, is found on all other D-dies. In the row above are shown the four D-dies with wobbly base for which I have found no thin coins yet.

All thin coins found until now have wobbly base crowns.

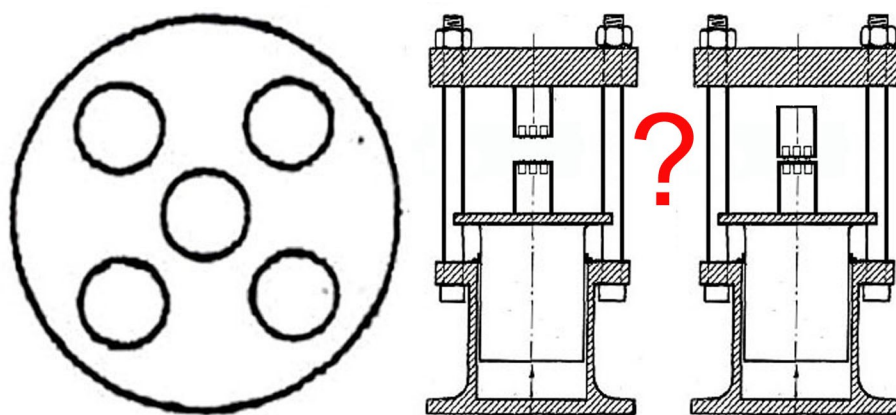
Thick and thin coins # [73725](#)

The known weight range of 5-heller is $2.4 < 6.9$ grams, the heaviest being less than 1 gram lighter than the lightest 20-heller. In earlier editions weight distribution and its implications were discussed in 5 heller parts D and E. In this edition these are integrated this part A as Appendix 1 and 2.

A clear division can be made between thick coins of 3.9 grams or more (H1-D1 > H11-D11) and thin ones of 3.7 grams or less (H13-D12 > H28-D28).

Numismatically interesting is that the decision to change the weight standard can thus be pinpointed in the coinage and in time.

5-heller machine – multiple struck coins



Part of the 5-hellers were struck in a hand-driven press. If this press was not the same as the one used to strike the 15-rupien coins, then it will have been a very similar one.

To counter slowness of the operation five dies were assembled in big blocks of steel as in the drawing left. Thus five coins could be struck at the same time.

As the 15-rupien needed to be pressed three times to get a reasonable result, it would be surprising if five 5-heller coins could be struck in one go, even though the material was possibly considerably softer.

Whereas in striking the 15-rupien coins the upper block was standing free on the lower parts, I think the upper block was attached to the upper part while striking the 5-hellers. Thus the play between the different parts of the machine would easily result in visibly multi-struck coins. This theory would explain why a vast majority of the coins struck on this machine are multi-struck.

Another possibility would be that the lower block would be drawn out, the well struck coins taken away and rest returned to be struck another time.

These five dies have all straight bottomed crowns, which are shown in the second row of crowns supra. I nickname these die combinations used in the 5-heller machine for short '5ers'. In the catalogue part B they are indicated by (5) top right of the page. In Zeno you may find them combined in one picture # [89408](#)

As they produced only thick coins, production by the 5-heller machine must have stopped before that of thin coins started.

During the periods I collected up to 2024 all pictures of 5 hellers I could find on internet I found there 24 H2-D2, 17 H4-D4, 33 H8-D8, 8 H10-D10, 16 H11-D11 and 2 multiple struck coins with straight base that I cannot identify. Not even the 95% confidence intervals of these amounts of coins overlap, so an equal amount of coins struck seems rather unlikely. I can't say more than that I think there is a chance that, striking five coins at a time proving to problematic, after a while less coins at a time were made in one go. H10-D10 might have been a good candidate for dismissal.

Is there any chance 5-heller machine could be the same as the first 15-rupien machine? One clue could be that the 5-heller have about the same diameter as the 15-rupien coins, +/- 22.5 mm. This would mean 15-rupien dies might fit in the same blocks of steel as the 5-heller dies did. Besides the same punch could be transferred to the gold mint (the average 5-heller might be 0.1 or 0.2 mm bigger though. Possibly because it was not struck in a ring like the gold coins.

By the end of April 1916 some 27,800 5-hellers had been produced. As the gold mint started production 15th of April, no more than these could have been produced before that moment if both machines are one and the same.

Based on the amount of coins registered December 2023 the estimated amount of 5ers struck would be 22,000 +/- 4,250.

The ring drawn by Schumacher between the upper and lower block is indispensable if the upper block has to rest on the lower block and if you want to strike the coins three times with a steady die position. It is a cumbersome device though, that will have hindered production, especially if the ring was so tight that the coins might get stuck.

From 5ers that look like single struck, it seems that the starting position was rather

steady. This means that the flans were not put in randomly by hand only. There must have been something to help placing them.

As multiple striking is most seen and most pronounced on the D-side, a shift of up to 1.5 mm being quite normal and taking gravity into account, it may be assumed that that die was the one on top. As displacement of the upper die was big enough to strike sometimes partly outside the flan, a ring higher than the flan might, if it would be hit, hurt the die in the same way as self-strike in the 20-heller machines. No signs of this have been found yet.

As the H-side of the coins also got regularly multiple struck, the flan must have had enough place in the ring to move around quite a bit. One other possibility is that there was no ring at all but that the lower dies were put somewhat lower than the surface of the block.



Some multiple struck 5ers did not only slide, but did also rotate in the process. One explanation might be upstanding pieces on the rim of the flans, which were formed as they were punched from the rods.

Brass

Two different kinds of brass were used for the oval base coins. Of ten H1-D1 coins with known electrical conductivity (EC) a group of six rendered on average 11.9 MS/m ($11.6 > 12.2$). The other four on average 14.4 ($14.2 > 14.6$).

16 5ers rendered on average also 14.4 MS/m ($13.9 > 14.8$).

18 coins from other 'thick-coin combinations' 14.5 ($13.8 > 14.8$, one 15.9)

60 thin coins average at 12.9 MS/m ($11.7 > 14.2$, one 14.8).

Thus there is not only a difference in weight between thick and thin coins, but also in material. Thick high EC coins were struck on stock 'prefab brass', most if not all low EC coins on material directly cut from used shell cases

There are only a few x-ray fluorescence (XRF) tests results available for 5 heller coins. These suggest that the thin coins would contain small amounts of tin and lead, while the thick high EC don't.

Further deliberations on this subject see Appendix 1

Multiple struck dies # [89314](#)



Not to be confused with multiple struck coins are coins struck by multiple struck dies, where all coins struck by these dies show the same elements twice. To make things easy H2 and H10 are 5ers who themselves were apt to produce multiple struck coins.

Oval base crown flans # [73817](#)



One other particularity of oval base coins is that part of them is struck on flans that have a bulb on the rim. As these bulbs are found in different positions and on both sides of the coins, they must be the result of a flaw of the punch. On some flans a second smaller bulb appears next to the first. These bulbs are not found on any coins struck by other dies. It may therefore be assumed that the bulby punch was replaced by a new one while the flans for the oval base coins were made.

Modified die – modifiziertes Stempel # [73799](#)



Top left, middle and bottom right straight base, top right wobbly, bottom left oval base.

If a piece gets broken off the positive die, used to strike the production dies, it cannot return unless it gets engraved directly onto the production die. In 20-heller this was a great aid in sequencing the dies.

In sequencing 5-hellers we have the problem that there are two crown types that cannot be explained as the result of pieces broken off the other as original positive die, nor as re-engravings of that die.

There are three possibilities:

- a. Straight base is the original, five production dies are made before the bottom of the crown breaks away, the oval bottom is engraved directly on 1 production die.
- b. Oval base is the original, one production die before bottom breaks away, straight bottom is engraved directly on five production dies.
- c. Wobbly base is the original, both oval and straight bottom are engraved directly on 1+ 5 production dies.

For all three options long and short stories can be made up.

The fact that I find it hardest to explain why there would be just one oval base crown die, if it is not the original, makes me present the following story as the most plausible.

Oval base production die is made, positive die gets hurt. For 5-heller machine five dies are needed, which of course should be as much as possible the same. As the cross is not seen on four out of five straight base dies, striking is done carefully. Five dies are produced. They do not try to imitate the oval base, but engrave a straight one, because that is easier (that direct engraving on these dies has been done can be seen when you look at the way the ribbons touch the base, but that may also have been prompted by the weakness of the striking of the production dies).

The 5er dies were the first to produce 5-heller coins. When it was decided also to produce 5-hellers on 20-heller machines, the oval base will have been used first, as it was still laying around. That is if H1-D1 oval base coins were produced in Tabora and not in Lulanguru (see below).

After all the multiple struck 5-hellers nobody will have bothered any more about the base of the crown being there or not, let alone engraving it on the dies. Some engraving on the positive die must have been done though to fill gaps between crown and ribbons.

H11A-D11A

Not being able to explain the rotation of a die in the 5-heller machine, I have named the combination of H11-D11 in a position with 3 degrees rotated die axis H11A-D11A. Thus leaving open the possibility that this die combination was afterwards reused in a 20-heller machine. I have found nothing convincing that would indicate later use of other 5er dies on 20-heller machines. In the calculation below I didn't take H11A-D11A into account.

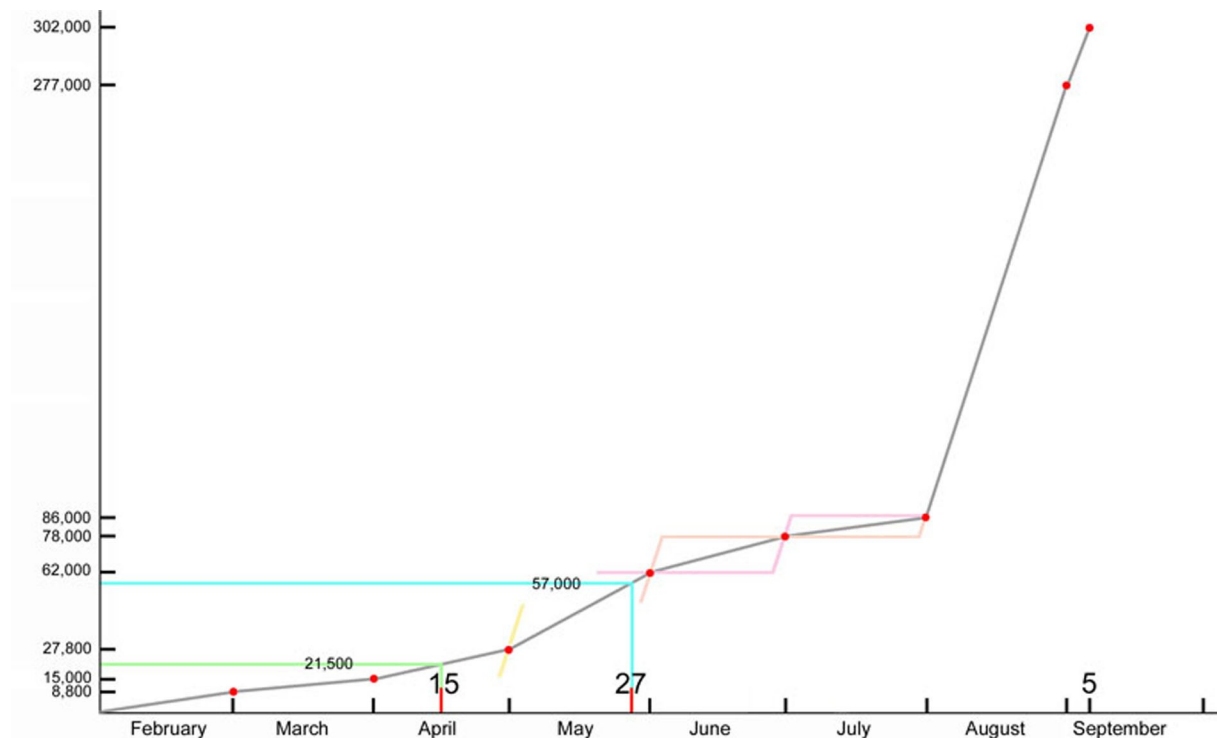
Total production

Monat	Zwanzigheller		Fünfheller		Gesamtsumme
	Stück	Rupien	Stück	Rupien	Rupien
Febr. 1916	74 800	14 960	8 800	440	15 400
März "	148 700	29 740	6 200	310	30 050
April "	214 500	42 900	12 800	640	43 540
Mai "	302 000	60 400	34 200	1 710	62 110
Juni "	362 500	72 500	16 000	800	73 300
Juli "	448 000	89 600	8 000	400	90 000
August "	72 500	14 500	191 000	9 550	24 050
Sept. "	11 700	2 340	25 000	1 250	3 590
bis 5. IX. zusammen	1 634 700	326 940	302 000	15 100	342 040

Schumacher's production details show, after a slow start in February, a small peak in May and then a soaring mountain in August, as production of 20-hellers collapses. As Tabora fell a total of 302,000 5-heller coins had been struck. Schumacher explains the collapse in production of 20-hellers in August by a lack of possibilities to provide the army in the east with coins, because the railway connection had been cut. But that would not explain why so many 5-hellers were

produced. I presume lack of material for 20-hellers may have played a role as well, allowing the 5-hellers more machine-time. Lower overall production might indicate that by half of August one of the machines had broken down.

From the overall production of July it can be deducted that maximum daily production of a machine was more than 7500 coins.



coin production per month according to Schumacher

The decree # [112825](#) of 27 May, published 2 June, did change the weight standard for 5-heller coins, that before had been about 5 grams, to about 3 to 5 grams.

One reason for this decree could be to legalize already struck low weight coins, another to anticipate at a looming shortage of proper material for thick 5-heller coins. Whatever the reason the decree gives a point in time around which the change from thick to thin flans took place.

As production of June might have taken only 2 days and the date of production would not be necessarily the date of counting or registration of the coins, it may be suggested that total of thick coins produced would be between 62,000 and 78,000 coins if after May 27 no more thick coins were struck..

Deducted from 302,000 this would leave between 240,000 and 224,000 thin coins. Parted by 17 coin combinations this would give an average thin-flan die-combination production of 14,118 to 13,176 coins

The second 20-heller machine arrived in the mint beginning of March. As 20-heller production would have had absolute priority over 5-hellers, all 5-hellers struck in February will have been struck by the 5-heller machine. Output of 5-hellers in March was lower than in February and also in April we do not really need 20-heller machines to explain production figures.

If the 5-heller machine = 15 rupien machine, half of April's production would have been little more than a days work for a 20-heller machine.

Earlier it has been mentioned that calculations based on the amount of coins seen on internet renders a mintage of 22,000 (+/- 4,250) 5ers. According to these calculations also 32,000 (+/- 5.000) oval base coins and 49.500 (+/- 6.000) other 'thick-die coins' would have been struck. The total of thick coins would thus have been 103.500 (+/- 7.500). This would put the end of minting thick coins in August.

5 heller struck in Lulanguru ?

Krenkel states in Wirtschaftsdienst that the "kleinen Scheidemünzen" were struck not only in Tabora but also nearby in Lulanguru. I would interpret these to be 5-heller coins.

übergeben, von denen Bestellungen auf das neue Geld eingegangen waren.

Dieser maschinelle Prägeprozeß war im wesentlichen der für die Ausmünzung der 20-Sellerstücke angewendete. Für die Prägung der messingenen 5-Sellerstücke wurde in weitgehendem Maße Handbetrieb mit Handstanzen und Handprägung eingeführt. Die kleinen Scheidemünzen wurden außer in der Münze in Tabora auch in dem benachbarten Lulanguru geprägt.

Die glatt gerandeten Messingmünzen tragen erhöhte Inschriften und Bilder. Das 20-Sellerstück zeigt auf der einen Seite die Kaiserkrone, in der Mitte zwischen zwei vier-

Could Krenkel's statement be correct, or did he make a mistake and did he mean the 15 rupien gold coins? Or did he (as he had left Tabora already in March) misinterpret stories he heard later about minting in Lulanguru, guessing it would be the small denominations that would have been struck there?

If Krenkel is correct he must have been talking from his own experience and production in Lulanguru must have started before he left Tabora in March.

From a logistic and management point of view it seems not logical to mint in two locations, but if you have to produce as much coins as possible and you have a location nearby where there is equipment to do so, why not? There was a press in Lulanguru and this press could also be used to punch the flans out.

Production of 5-heller coins in Lulanguru would explain why the bulb seen on oval-base-coin- flans is not found on other types, as this punch was only used there. Here also oval-base fits in, as in my opinion they were the earliest dies.

If coins produced in Lulanguru were delivered directly to government, they would not figure in production reports of Tabora mint and may thus have escaped Schumacher's attention. If so they don't figure in his production data.

As the gold-mint was Schumacher's direct responsibility he would have noticed if there had been any other minting activity in Lulanguru at the moment his minting was

replaced there. So minting of 5-heller coins there must have stopped before that time.

This could be explained by the fact that the press in Lulanguru was normally used for pressing oil out of peanuts. Peanut harvest season would start in May. If the rate at which 5-heller coins were struck was about the same as that of 15 rupien, it would have made more sense to use the press to produce oil then to strike coins.

Thus there would have been a considerable interval between first and second minting there.

Also shifting and rotation of die position occurs. This might indicated there was no fixed die alignment at the press that struck these coins.



So Krenkel might be correct and oval base 5-hellers could have been struck in Lulanguru.

If so, the total of coins struck would have been 338,000. 5ers 24,500 (+/- 4,500), 'thick-die'coins 55,500 (+/- 6,500), oval base 36,000 (+/- 5,500).

Thus 36,000 in Lulanguru, 80,000 (+/- 8,000) thick and some 222,000 thin coins in Tabora.

If double struck 5ers are overrepresented on internet, these figures much better fit those of Schumacher then those including oval base coin production in Tabora.

Die production details # [199381](#)

Based on 1374 coins found on internet until 2024 an estimated coin production per die combination could be calculated. Red figures are based on the assumption that

H1-D1 was struck in Lulanguru and the other combinations produced 302,000 coins in Tabora.

die combination		H1-D1	H2-D2	H4-D4	H8-D8	H10-D10	H11-D11	5-ers**
number of coins		146	24	17	33	8	16	100
only Tabora		32.090	5.275	3.737	7.253	1.758	3.517	21.980
95% confidence		5.021	2.135	1.801	2.495	1.240	1.748	4.233
H1-D1 Lulanguru		35.906	5.902	4.181	8.116	1.967	3.935	24.593
H3-D3	H5-D5	H6-D6	H7-D7	total***	H13-D12	H13-D13	H14-D15	H15-D15
42	39	44	99	225	4	107	15	21
9.231	8.572	9.671	21.760	49.454	879	23.518	3.297	4.616
2.805	2.706	2.869	4.213	6.030	878	4.367	1.693	1.999
10.329	9.591	10.821	24.347	55.334	984	26.068	3.689	5.164
H15-D16	H17-D17	H18-D18	H19-D19	H20-D20	H21-D21	H22-D22	H22-D23	H23-D23
52	48	102	75	107	34	4	16	109
11.429	10.550	22.419	16.485	23.518	7.473	879	3.517	23.958
3.109	2.992	4.272	3.702	4.367	2.531	878	1.748	4.404
12.788	11.805	25.085	18.936	26.314	8.116	984	3.935	26.560
H24-D24	H25-D25	H25-D26	H28-D28	total****	???		thick or thin dies ??	
49	37	52	38	876	27		'thin coin dies"	
10.770	8.132	11.429	8.352	192.541	5.934		'thick coin dies'	
3.022	2.638	3.109	2.672	7.833	2.262		5ers	
12.296	9.099	12.788	9.345	215.433	6.640		oval base	
Including ** 2, *** 1, **** 6 unidentified coins								

This list may not be as representative as one would like, as what people offer on internet is influenced by their personal interests and their perception of what will bring good money on the market. I think for these reasons H1-D1 and multiple struck coins may be over-represented. That there are so many oval base coins may also be because a hidden treasure has been found.

The lot I once bought has not been taken into account in the calculations. In this lot of 97 coins there were 5 H1-D1, 6 H2-D2, 0 H4-D4, 0 H8-D8, 0 H10-D10 and 4 H11-D11.

In 2024 10 H1-D1, no H2-D2, 3 H4-D4, 5 H8-D8, 1 H10-D10 and zero H11-D11 showed up.

In 2022 only 4 out of total of 100 5-hellers were H1-D1, in 2019 32 out of 190.

The exact numbers may thus not be very reliable, at least they are an indication of the rarity of some combinations.

“Mules”

Mules are coins struck by die combinations that were not intended to be used in that combination. As the 5er dies were intended to strike coins in medal alignment, coins struck by them in an other alignment may be regarded as mules. March 2017 the existence of one such coin could be attested, a combination of H8 and D11 with die axis crossing at 90 degrees # [167370](#)

As five coins were struck at the same time, mules of three other combinations and a coin of the cental dies with turned axis must also have been struck. Please inform me if you ever find such a coin.

Help in identification

Some coins may safeguard their privacy to an extent you might start to despair about ever identifying them. The 5-hellers, being smaller, are even worse than 20-heller. If getting depressed you better send pictures of the coins to info@ptbvhrokerspartij.nl so we can look at them together. If possible send also pictures with die positions (see # [73596](#) and # [91588](#), line is along the bottom of heller). Small pictures are of little avail, so let them be big. If I am not on holiday I will do my best to answer quickly.

Of course, I would also like to get pictures of all coins that would add to the series shown in Zeno, especially for the first and last stages of dies. If I am lucky you find me new dies. If you send me pictures I suppose you will have no objections to them being used in Zeno or this catalogue.

Easyfinders

Easyfinders are intended to make identification easier if a coin shows certain characteristics, but normally just comparing with the pictures in part B will do.

easyfinder circle & filing lines # [73852](#)
easyfinder die position # [77446](#)
easyfinder double struck dies # [89314](#)
easyfinder haircracks & pieces broken off # [77278](#)
easyfinder self-strike # [73578](#)
easyfinder straight bottom crown # [102849](#)
easyfinder strike-out # [73853](#)
overview, H2-D2 – H15-D15 # [89270](#)
overview, H15-D16 – H28-D28 # [89271](#)

4th edition Appendix 1 and 2, 5 heller part B and former parts C, D & E

5 heller part B, die catalogue, shows the die combinations in alphabetical order of the H-side.

Pictures are better if you magnify Adobe Reader to 125% (or more)

Former 5 heller part C has been omitted from later edition of this catalogue. It consisted of a folder with separate pages for each die combinations.

Appendix 1 = former 5 heller part D, Thick and thin 5 heller DOA 1916, see below. It concentrates on the implications of weight distribution and metal properties.

Appendix 2 = former 5 heller part E, weight distribution, see below weights noticed until 2024.

DOA 1916 T, 5 heller part A, appendix 1, thick and thin 5 heller

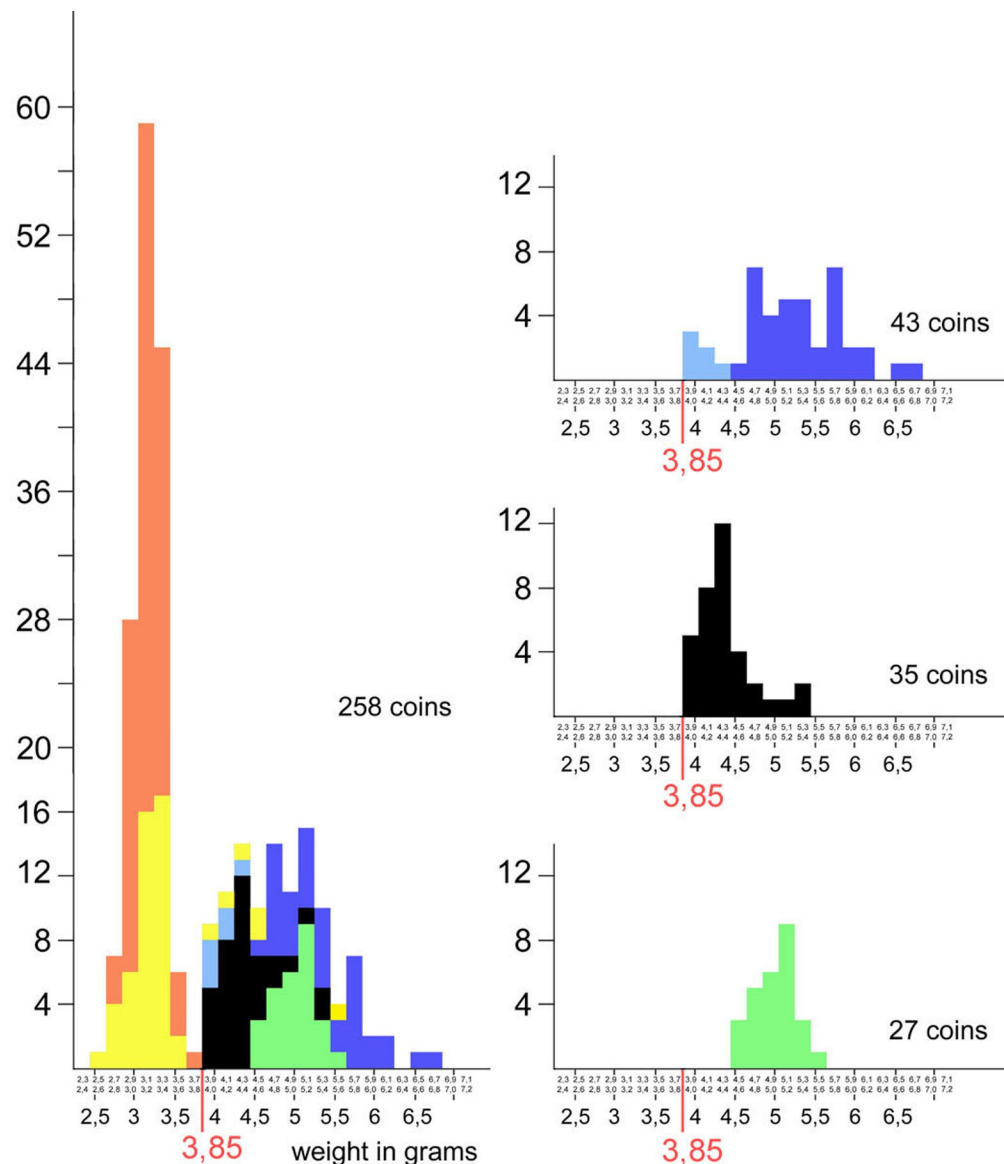
Everybody who holds a couple of 5 hellers in his hands, will notice some are thinner than others.

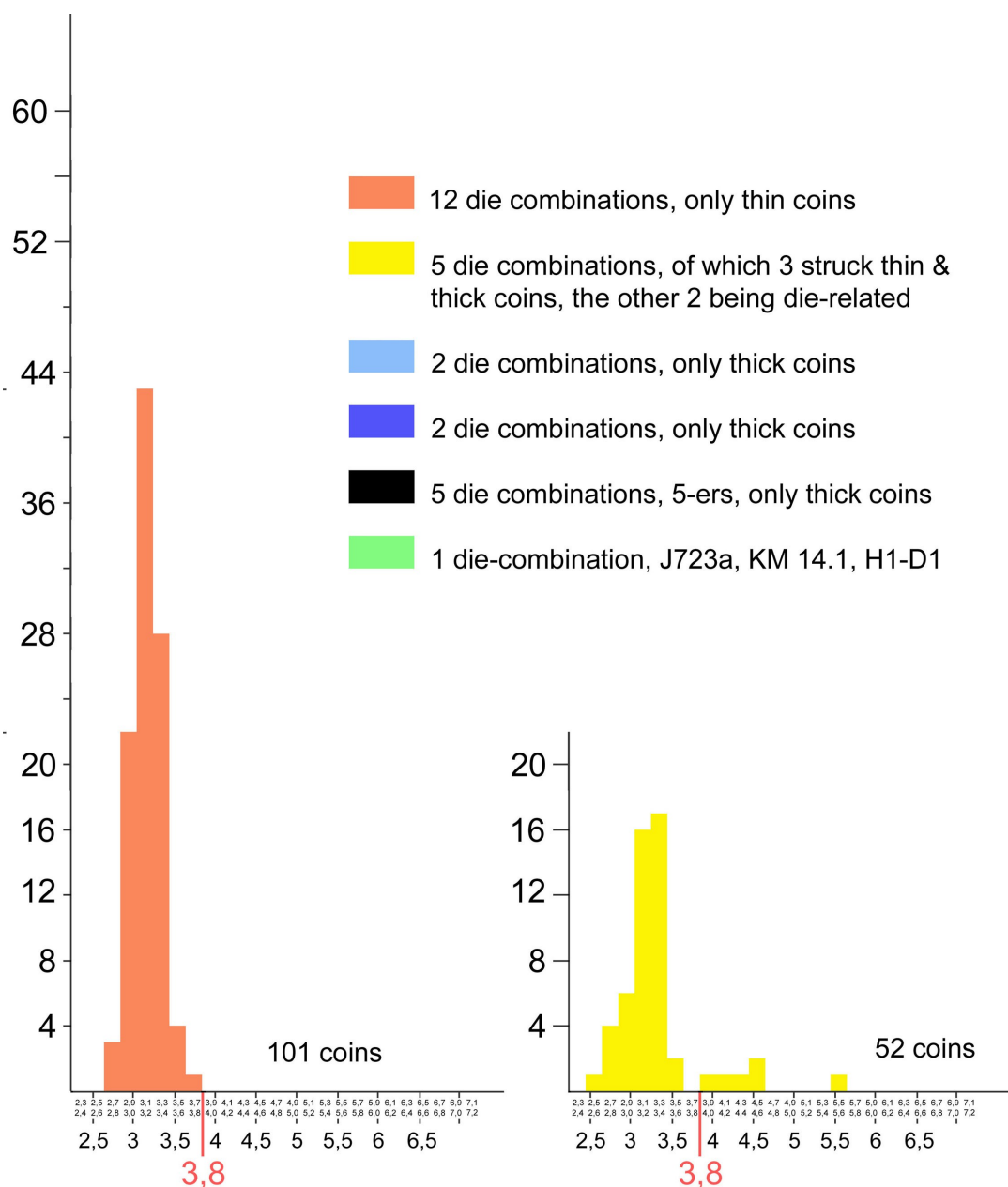


Peter Hammer gives, on page 214 of his book *Metall und Münze*, 15 to 1 as optimal relation between diameter and thickness of a modern coin. For a coin of 23 mm optimal thickness would thus be 1.53 mm.

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:





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		ϕ 22		ϕ 22,5		ϕ 28	
inches	mm	cm ³	weight gr.	cm ³	weight	cm ³	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) tolerances 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 than 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. Whitworth 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 intended 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. In his 1990 article *Das Kriegsnotgeld der deutschen Kolonien* (NNB 2/1990) he specifies shell cases from 3.7 cm navy revolver canons and 5 cm company guns.

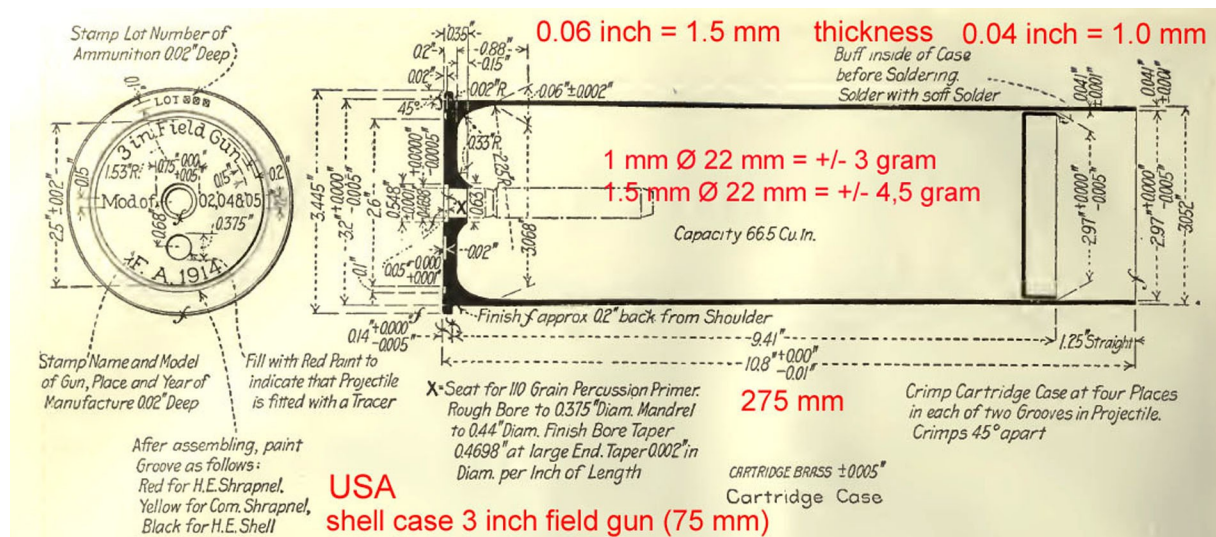


10.5 cm/40 SK L/40 onboard the german SS Goetzen in 1915 or 1916 in the Bay of Kigoma. This was the Number 6 gun salvaged from the cruiser SMS Königsberg. Note the sliding breech mechanism, typical of Krupp guns of this period. The sailor on the far left is holding a leather ammunition transfer bag.

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

A gun salvaged from the [light cruiser Königsberg](#) and mounted on the [gunboat SS Graf von Götzen](#) on [Lake Tanganyika](#)
https://en.wikipedia.org/wiki/10.5_cm_SK_L/40_naval_gun



The shell cases of the 10.5 Königsberg guns would have been nearly twice as long as those in the drawing of a shell case for a 3 inch USA 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 continuous 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.

If no more 10.5 cm cases were available by the time the minting of thin coins started, the smaller 5 and 3.7 cases could explain thinner 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 shown that are clearly bent. [112039](#)

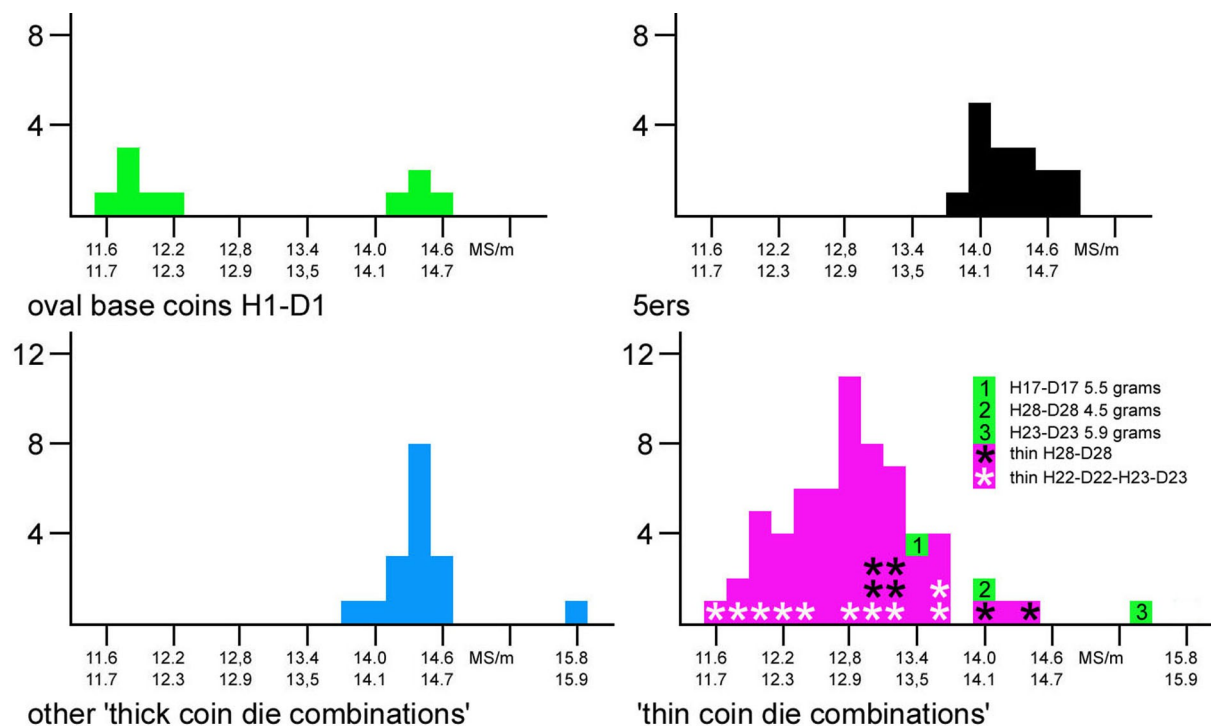


This seems to indicate the material they were punched out of was bent also. If these were no shell cases, it must have been brass pipes.

Different kinds of brass

Electical conductivity (EC) has been measured of 106 coins, 10 H1-D1, 16 5ers, 17 'thick die coins', 60 thin 'thin die coins' and 3 thick 'thin die coins'.

Most coins were tested four times, three times the D-side and once the H-side (see [349218](#)). A spread of the results up to 1 MS/m was quite normal, but on one coin even a difference of 3 MS/m on one side occurred. In the graphs the average of the measurements is shown.



[349221](#)

EC results show standard prefab brass was used to produce most thick coins. Exception are the low EC oval base coins. Their EC resembles that of Tabora brass, produced by smelting scrap brass. Only this material shows many casting errors, which are not found on H1-D1 coins. As thin coins would be struck on material directly obtained from shell cases, it seems plausible low EC H1-D1 were also struck on the thicker parts of them, while the thinner parts were smelted to make Tabora Brass. Possibly this could have been cases from the 10.5 cm Königsberg guns. As these flans would have been slightly bent and of uneven thickness this might have been reason not to use them to strike 5ers.

For the large spread in EC of thin coin I have no explanation, unless loss of EC would be caused by the force of the explosion when firing the guns..

Naval brass?

Only a few coins have been X-ray fluorescence (XRF) analysed. The results suggest thin coins (below 3.9 grams) were struck on another material than the thick coins struck by H11-D1 through H11-D11. A material that corresponds to naval brass.

<https://www.avivametals.com/collections/naval-brass/products/c46400-naval-brass-lead-free> & <https://www.avivametals.com/collections/naval-brass/products/c48200-naval-brass-medium-lead>

Data sheets give EC 16.1 for normal brass against 15.2 for naval brass.

X-ray analyses of some DOA 1916 5 heller coins

* average electrical conductivity, see Zeno.ru 349218							
5 Heller	Weight	EC*	Cu/Zn ratio	Cu	Zn	Sn	Pb
H1-D1 J723a KM 14							
H1-D1-2	5,1	14,5		66,7	32,2		0,03 Ni 0,07, Fe 0,97, As 0,11
5ers							
H2-D2-2	4,3	15,0		73,2	26,5		0,04 Ni 0,07, Fe 0,19
H2-D2-3	4,5	14,5	H-side cleaned	79,1	20,7		0,01 Ni 0,05, Fe 0,04, As 0,01
			D-side cleaned	78,2	21,7		0 Ni 0,05, Fe 0,05, As 0,01
Other thick coin die combinations							
H5-D5-2	4,1	14,6		80,5	19,4		0,02 Ni 0,04, Fe 0,05, As 0,01
Thin coin die combinations, thin coins							
H15-D16-2V	2,6	11,9		66,1	31	0,89	1,26 Ni 0,07, Fe 0,35, As 0,22
H21-D21-1	3,0	14,2		62,2	36,3	0,68	0,33 Ni 0,08, Fe 0,25, As 0,10 Cd 0,015
H22-D22-1	3,3	13,6		62,5	36,1	0,57	0,27 Ni 0,09, Fe 0,34, As 0,13
H24-D24-3	3,1	13,4		61,9	36,8	0,5	0,47 Ni 0,09, Fe 0,20, As 0,05
H28-D28-4	3,3	14,4		63,3	35,4	0,41	0,44 Ni 0,05, Fe 0,44, As 0,11



H1-D1-2



H2-D2-2



H2-D2-3



H5-D5-2



H15-D16-2v



H21-D21-1



H22-D22-1



H24-D24-3



H28-D28-4

[349329](#)

For low EC H1-D1 no results are available. As my presumption is they were early products of the mint, they could hardly contain any tin, as the rest material (of shell cases) would have been used to produce Tabora brass. Tin content over 0.05% is hardly ever found in Tabora brass.

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 until standards were changed no material less than 1.2 mm thick was used. The heaviest coins were struck on planchets 2 mm thick.

Among 218 coins of known weight, struck by the ten die combinations H1-D1 through H11-D11, only 4 coins were found with a weight below 4 grams. 1 H4-D4 (3.9 grams), 1 H5-D5 (3.9), 1 H11-D11 (3.8) and 1 unidentified double struck coin (980n

3.9). These were struck on prefab brass with electric conductivity around 14.5 MS/m, with the exception of part of H1-D1, which were struck on material with a very low EC of around 12 MS/m.

The few XRF tests of high EC coins showed no tin and only minimal traces of lead.

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.

Among 220 coins of known weight, struck by the 17 die combinations H13-D12 through H28-D28, only 9 coins were found with a weight above 3.7 grams. 1 H13-D13 (4.1 grams), 1 H15-D15 (5.0), 2 H17-D17 (5.5, 4.3), 1 H23-D23 (5.9), 1 H25-D25 (3.9), 3 H28-D28 (4.5, 4.4, 4.1) and 1 unidentified double struck coin (3.9 grams).

The few XRF tests showed significant amounts of tin and lead.

More XRF data would be necessary to allow any definite conclusions.

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.

DOA 1916 T, 5 heller part A, appendix 2, weight distribution

January 2024

Die combination *	Coins found September 2010 **	Weight of coins found September 2010	Weight of coins found after September 2010 until March 2013, since March 2017 *****			
H1-D1	28	5,3, 5,3, 5,2, 5,2, 5,1, 5,1, 5,1, 5,0, 4,7, 4,7, 4,7, 4,5, 4,5	6,9, 6,5, 5,6, 5,5, 5,4, 5,4, 5,3, 5,3, 5,3, 5,3, 5,3, 5,3, 5,2, 5,2, 5,2, 5,2, 5,2, 5,1, 5,1, 5,1, 5,1, 5,1, 5,1, 5,1, 5,1, 5,0, 5,0, 4,9, 4,9, 4,9, 4,9, 4,9, 4,9, 4,9, 4,9, 4,8, 4,8, 4,8, 4,8, 4,7, 4,7, 4,7, 4,6, 4,6, 4,6, 4,5, 4,5, 4,4, 4,2, 4,2			
Multiple struck coins occur - 13-32 (without H14-etc. & D25-etc.) 1-1 = 1 single struck coin – 1 multiple struck coin 980x = serial numbers of pictures with unidentified multiple struck coin						
H2-D2	4-9 (3-5)	5,3, 4,5, 4,4, 4,3 4,3, 4,3, 4,0	5,1, 4,7, 4,7, 4,5, 4,5, 4,3, 4,2, 4,0	980m	(0-1)	?
H4-D4	2-4 (1-5)	5,3	5,0, 4,6, 4,4, 4,3, 4,3, 4,0 ,3,9, thick 1,8 mm	980n	0-1 (0-2)	4,1, 3,9
				980p	0-1 (0-1)	4,3
H8-D8	3-10 (3-6)	4,7, 4,5, 4,3, 4,2	4,9, 4,8, 4,4, 4,4, 4,3, 4,2, 4,1, 4,1, 4,1, 4,0, 4,0,	980r	(0-1)	?
H10-D10	2-1 (1-5)	4,8	5,1, 5,0, 4,9	980t	(0-1)	3,94
H11-D11	2-5 (4-2)	4,3, 4,3 , 4,1, 4,1	4,7, 4,4, 4,3, 4,2, 4,0, 3,8	H14-D15-H15-D16	24-1	5,0, 3,5 > 2,4 see self-strike
980	0-1	4,2		D25-H25-D26	16-1	3,5 > 2,8 see strike-out + self-strike
Self-strike occurs 60			Strike-out occurs 49			
H3-D3	8	4,8, 4,0	5,3, 4,9, 4,4, 4,4, 4,4, 4,3	H6-D6	13	6,2, 5,3, 5,2, 5,0, 5,0, 5,0
						6,8, 6,7, 6,7, 6,7, 6,6, 5,4, 5,4, 5,4, 5,2, 5,1, 5,1, 4,8, 4,6, 4,4, 4,4
H5-D5	8	4,2, 4,1, 4,1	4,8, 4,4, 4,3, 4,2, 4,1, 4,1, 3,9	D12-H13-D13 (2-24)	26	3,4, 3,4, 3,3, 3,2, 3,2, 3,2, 3,2, 3,1, 3,1, 3,1, 3,0, 2,9
						4,1, 3,5, 3,5, 3,5, 3,4, 3,3, 3,3, 3,3, 3,3, 3,3, 3,2, 3,1, 3,1, 3,1, 2,8, 2,7, 2,7
H7-D7	27	6,0, 6,0, 5,7, 5,7, 5,7, 5,4, 5,2, 5,1, 5,1, 4,8, 4,8, 4,7, 4,7, 4,7, 4,5	5,9, 5,9, 5,8, 5,7, 5,7, 5,7, 5,7, 5,7, 5,6, 5,5, 5,5, 5,5, 5,5, 5,4, 5,4, 5,4, 5,4, 5,4, 5,3, 5,1, 5,1, 5,1, 4,9, 4,8, 4,8, 4,8, 4,8, 4,8, 4,8, 4,7, 4,7, 4,7, 4,7	H19-D19	4 (+2)	3,2, 3,2, 3,2
						3,5, 3,4, 3,3, 3,3, 3,3, 3,2, 3,2, 3,2, 3,1, 3,1, 3,1, 3,1, 3,0, 2,8
H28-D28 (1 double struck)	17	4,5, 4,1, 3,5, 3,4, 3,3, 3,3, 3,3, 3,3, 3,2, 3,2	4,4, 3,2, 3,2, 3,2, 3,2, 3,2, 3,1, 3,0, 2,9, 2,8, 2,7	990a1, a2 & a3	5	3,4, 3,4, 3,1, 3,0, 2,9
						3,5, 3,1
				990c	1	3,2
						3,0
Strike-out + self-strike occurs 152			Nothing special 10			
H14-D15-H15-D16 (6-6-13)	25	3,5, 3,4, 3,4, 3,4, 3,2, 3,1, 3,0, 2,8, 2,8, 2,6	5,0, 3,5, 3,5, 3,5, 3,5, 3,3, 3,3, 3,3, 3,3, 3,2, 3,2, 3,2, 3,2, 3,2, 3,1, 3,0, 3,0, 3,0, 3,0, 3,0, 2,9, 2,9, 2,8, 2,8, 2,4	H11A-D11A	1	4,8
H17-D17	14	5,5, 4,3, 3,3, 3,3, 3,2, 3,1, 3,0, 3,0, 2,9	3,6, 3,5, 3,4, 3,4, 3,2, 3,0, 2,9, 2,8	H21-D21	3 (+2)	3,5, 3,0
						3,7, 3,2, 3,2, 3,0
H18-D18	30	3,4, 3,3, 3,3, 3,2, 3,2, 3,1, 3,1, 3,1, 2,9	3,5, 3,4, 3,4, 3,4, 3,4, 3,3, 3,3, 3,3, 3,3, 3,3, 3,2, 3,2, 3,2, 3,2, 3,1, 3,0, 3,0	990b	6	?
H20-D20	23	3,4, 3,2, 3,2, 3,2, 3,2, 3,1, 3,0, 3,0, 3,0, 3,0, 3,0	3,5, 3,5, 3,4, 3,4, 3,4, 3,4, 3,4, 3,3, 3,3, 3,3, 3,3, 3,3, 3,2, 3,2, 3,2, 3,2, 3,2, 3,1, 3,1, 3,1, 3,0, 3,0, 2,8, 2,8			
D22-H22-D23-H23 (2+1-2-23)	27	3,4, 3,4, 3,3, 3,3, 3,2, 3,2, 3,2, 3,2, 3,2, 3,2, 3,2, 3,1, 3,0, 3,0, 3,0, 3,0, 2,9	5,9, 3,7, 3,5, 3,4, 3,4, 3,4, 3,4, 3,4, 3,3, 3,3, 3,3, 3,3, 3,2, 3,2, 3,2, 3,2, 3,2, 3,2, 3,2, 3,2, 3,2, 3,1, 3,1, 3,1, 3,1, 3,1, 3,1, 3,0, 3,0, 3,0, 2,7			
H24-D24	16	3,4, 3,3, 3,3, 3,2, 3,1, 3,0, 2,9	3,4, 3,3, 3,3, 3,3, 3,2, 3,1, 3,1, 3,1, 3,0, 3,0, 3,0, 2,9			
D25-H25-D26 (8-9)	17	3,5, 3,3, 3,2, 3,2, 3,1, 3,0, 3,0, 2,9, 2,8	3,9, 3,5, 3,5, 3,4, 3,4, 3,4, 3,4, 3,4, 3,4, 3,3, 3,3, 3,2, 3,2, 3,1, 3,1, 3,0, 3,0, 2,9, 2,7			
Total 316 per September 2010, not including H1-D1 6,9 grams maximum weight found as yet (H1-D1), 2,4 minimum (H15-D16)						

Purple print coins found after September 2010 until March 2013***** Blue print no weight known

* Bold type only coins 3,9 grams and over found Bold type idem, straight bottom crown

Bold type both coins over 3,9 and under 3,7 grams found

3,8 coin weight between 3,9 and 3,7 grams

Regular type, only coins 3.7 grams and under found Between () subdivision for individual die combinations

** Between () first number coins that seem single struck, second number multiple struck coins.

Numbers of coins found after September 2010 are only given for 5ers and for die combinations for which September 2010 less than 5 coins were found, .

***** Between March 2013 and March 2017 only some relevant weights have been added, like the 5,9 grams for a H23-D23 coins, since March 2017 again all weights found were added