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DOA 1916 T

German East Africa 20 heller 1916 T struck at Tabora

A die catalogue

Part A – Introduction



Kees Uitenbroek

In this catalogue 20-Heller coins struck by 154 dies, used in 98 die combinations, are portrayed, plus some coins of uncertain lineage.

Known types



A certain Standard Catalogue of World Coins, normally referred to as Krause, lists three varieties of the H-side, named Reverse A, B and C, and two of the D-side, named Obverse A and B.

As this is a die-catalogue, I have chosen not to talk about obverse and reverse but use H for the heller-side and D for the DOA-side. In designating the main varieties I follow Krause with the exception of using A(C) instead of C. This because HA- and HA(C)-dies were produced by the same positive die.

HA(C): six leaves below heller, four inner leafs above heller at left side, both curved tips of feet of L are complete.
HA: six leaves below heller, three inner leafs above heller at left side, with exception of one die the top of the curved part of the foot of the left L is missing.
HB: two leaves below heller, L's have triangular feet.
DA: Large crown.
DB: Small crown.

The three major H-varieties in combination with two D-varieties, give six types of coins (not taking in account different metals).
Although price differences between HA and HA(C) coins may be huge, most German

catalogues do not list them separately. Schön does not even mention HA(C), so better to keep away from that catalogue selling such coins.

	Krause	Jaeger	Schön
HA(C)-DA	15/15a obv A rev C	724a/b/c	15a/b
HA-DA	15/15a obv A rev A		
HA(C)-DB	15/15a obv B rev C	726a/b/c	17a/b
HA-DB	15/15a obv B rev A		
HB-DA	15/15a obv A rev B	725a/b/c	16a/b
HB-DB	15/15a obv B rev B	727a/b/c	18a/b

Why more types?

Krenkel states HB-DB, Jaeger 727b, KM 15a obv B rev B, was the first type of 20-Heller coins struck in Tabora. These dies were designed and engraved by Wolf.

Working with these coins, it does not take long to realize that HA/A(C)-DA and HB-DB are the “intended” combinations and HA/A(C)-DB and HB-DA the “unintended mules”.
One can imagine that someone running a mint like this would not have felt at ease with only one pair of positive dies at hand to make the production-dies. If anything happened to a positive one, you would be out for the time it takes to cut a new one. So it is no bad idea to get a spare pair ready in advance. Easiest of all, of course, would have been to strike a new pair, using production dies. If they tried, it did not work. Pressure needed might have been too high. Second best would be cutting a new pair. But why so completely different and why use them?



Lack of skill to make an exact copy would be a good reason to change design. Two look-alike types in circulation would make forging very easy, but that does not seem convincing enough in the circumstances and would not explain why they were used.

Looking from another angle you could connect the two main types with the two machines used to strike the coins. Using a different design on each machine would make it very easy to keep count of production of each machine, which would be necessary if workers were paid according to production. This would mean both main types of coins were produced simultaneously.

Or maybe someone simply did not like the first design and initiated the second. The operetta type of crown and unorthodox lettering might have offended the eye to much. This would mean production of one type was stopped, at least temporarily, as production of the other started. Study of the materials used has learned this is what did indeed happen.

0-series

My collection contains 2 HB-DB coins which differ so much from all other coins of this type that they might be considered a type on their own. These two coins were struck by two separate pairs of dies.





Comparing these coins with normal HB-DB, it becomes clear that the dies used to produce these coins must have been struck using positive dies that were not yet finished. This may have been prompted by eagerness to test the process and pressure to get the mint going. As the other HB and DB dies were struck with finished positive dies, these dies must have been the first HB and DB dies struck.

Being produced as part of a trial run, I have designated these coins the Zero-series > HB0-DB0.

A 0-series coin figures on page 204 of a book on fake coins by Weege. In his reasoning that that coin is a cast copy he does not recognize the fact that the coin is struck on a flan that was punched out of a rod of cast material .

Brass, “bronze” and copper

At a certain moment the German Jaeger catalogue introduced bronze as a third material

used for the production of 20-Heller coins, besides the traditonal brass and copper.
This decision was based on research of the electrical conductivity (EC) of these coins by Peter Hammer and Guy Franquinet, published in Münzen & Papiergeld 10/2004 92417
They found a wide range of values for the EC of “red” 20-Heller coins and decided that those with an EC of 50 MS/m and above must be real copper ones and the ones with an EC between 20 and 50 MS/m would be bronze.

Analysis of X-ray fluorescence test results of coins with EC between 20 and 50 MS/m has shown that low their EC is due to either deoxidyzing agents or minimal amounts of arsenic, tin or nickel. No bronze in the usual sense of that word was found. Therewith the new bronze category loses its meaning and should be discarded. See 20 Heller part H for more on this subject.

Whereas it was possible in early days to distinguish copper and brass by eye, after nearly a century of wear and tear this method is not reliable any more. For those who think they could, see 84734. (**warning**! NGC slabbed coins are eye-tested only, see 119172)
The most reliable way to test the composition of 20-Heller coins is to check their density. The density of brass is lower than 8.60 gr/cm3, that of copper higher 8.70 gr/cm3. A simple way to test density is given at http://www.gold-test.de/pruefung.html
Density is equal to weight divided by volume. Volume can be calculated by hanging a coin with a thin thread in a glass of water that is standing on a scale. The volume of the coin is the difference between the weight before and while you hang the coin in the water.
Contrary to what is said on the site, you need a scale at least 0.01 gram accurate to get a reliable result.

Brass produced in Tabora by smelting scrap metal (Tabora-brass) has as a rule a lower EC then brass that didn't pass through the melting pot (prefab-brass), but both can't be separated on a coin to coin basis. All HB1-DB coins are Tabora-brass though and probably all brass HB5c-DB3f, HB5i/HB5j-DB3j and HB5o/HB5p-DB3o are prefab brass.

Copper coins are attested for all HB5-DB3 die combinations and for HA4b-DA10a, HA4d-DB3b and HB5z-DA9c. On the pages which give description of separate die combinations, C indicates that tested copper coins are known for this combination and how many were found in my own original lot. If you have information on tested bronze or copper coins from other combinations, please inform me.

Metrology

Weight ranges from 7.268 through 14.2 grams, with an average of 11.4 grams. Coin diameter ranges from 28.3 through 29.7 mm. More on light weight coins at the end of this introduction.

Die recognition

Each time a positive die was used to strike a production die, the forces involved affected the positive dies a little. The resulting changes, when sudden and substantial, make a main subdivision for each positive die possible. This subdivision is also a subdivision in time as regards the production of the production dies. There is, alas, no guarantee these dies were also used in this production order.

Within each subdivision, recognition depends on characteristics of the production dies themselves. Some of these characteristics may only be apparent when a die is young, while others only appear as the die grows older.
Die position is another source of information, although less reliable since die shifting and rotation did occur during the striking process. The quality of striking by the same pair of

dies may differ considerably from coin to coin, showing details on some that are untraceable on others.

The main subdivisions

HB0 through 5 – 54 dies (HB2i and HB2i/3? counted as seperate dies) 62099



HB0, 2 dies, fat leaves



HB1, 11 dies, slender leaves, upper outer leaf left sharp



HB2, 11 dies, top upper outer leaf left horizontal, second from top outer leaf right sharp



HB3, 6 dies, second from top outer leaf right blunt, third from top outer leaf left unaffected



HB4, 3 dies, third from top outer leaf left affected, top outer leaf left V-form



HB5, 21 dies, top outer leaf left cylindrical

Combinations HB0-DB0, HB1-DB1, HB1-DB2, HB2-DB2, HB3-DB2, HB3-DA, HB4-DB3, HB4-DA, HB5-DB3, HB5-DA

DB0 through 3 – 49 dies 62098



DB0, 2 dies, oval base of crown protrudes



DB1, 11 dies, base of crown recut, outer line at right side of upgoing part of right ribbon straight or indented but at same level as rest of ribbon.



DB2, 18 dies, outer line at right side of upgoing part of right ribbon indented and at a lower level then rest of ribbon, best seen in floodlight.



DB3, 20 dies, outer line at right side of upgoing part of right ribbon partly brooken off, bulb remains.

Combinations HB0-DB0, HB1-DB1, HB1-DB2, HB2-DB2, HB3-DB2, HB4-DB3, HB5-DB3, HA-DB3

HA(C)1 through HA4 – 25 dies 62179 & 84480



HA(C)1, 4 dies, leaf left of top of 2, LL complete



HA2, 3 dies, no leaf left of top of 2, left L incomplete, top of bottom triangle of right E sharp



HA2d, special case, upper part of foot of left L visible at lower level when die is young



HA3, 12 dies, top of bottom triangle of right E blunt



HA4, 4 dies, upper triangle of right E affected



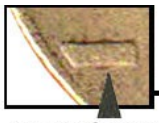
HA4d, special case, upper triangle of right E not affected when die is young

HA2d is a very deep-struck die, as testified by the bridge between upper parts of right L

and E. Therefore, also the remnants of the broken off top of the foot of the left L are visible. This part of the die fills up and on most coins the top is hardly or not visible. That is why no special subcategory has been created for this die. HA4d is really a HA3. The upper triangle of the right E fills up, so later coins seem to be struck by a HA4 (76311). Since these form the majority of the coins this die has been given a H4 listing.

DA1 through 11 – 26 dies 62218 & 62570



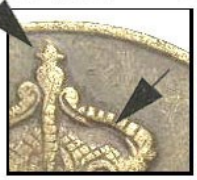

DA1, 2 dies

lower left ornament complete, DA1


DA2, 1 die

lower left ornament incomplete, DA2 > 11

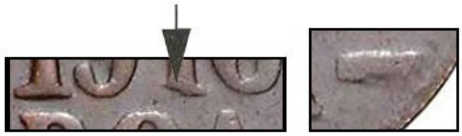

line in top of crown right complete, DA1 & 2


line in top of crown right incomplete, cross complete, DA3, 2 dies


left sidebar of cross shifted upwards, DA4, 1 die

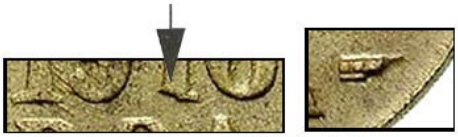

DA1 > 4 & DA5a


left part of bottom of right 1 seems to protrud from trousers, right lower ornament (semi-) complete, DA5b


left part of bottom of right 1 missing, right lower ornament, near complete, DA6, 4 dies


left sidebar of cross missing or vissible at a lower level, DA5 > 11


left part of bottom of right 1 seems to protrud from trousers, right lower ornament “gun-turret”, DA7, 1 die


left part of bottom of right 1 missing, right lower ornament “gun-turret”, DA8, 4 dies

right lower ornament “gun turret”, DA7 > 11


right part of bottom of left 1 seems to protrud from trousers, DA9, 4 dies


right part of bottom of left 1 drops, HA10, 1 die


right part of bottom of left 1 missing, DA11, 3 dies

The sequence of DA5 > 8 is problematic. The “gun turret” right lower ornament would put DA7 after DA6, but the bottoms of right 1’s suggests the opposite.

First in first out

Degeneration of the positive dies makes it possible to sequence production of the production dies for each type. The production dies will not have been made one at a time, but several at one go. These will have been put on a shelf ready to be used as other dies failed. Looking at the die combinations, the amount of dies in stock does not seem to have been very big, since normally early H-dies are used in combination with early D-dies and late H with late D.

For HA(C)1 and HA2 combinations with DA are HA(C)1a-DA1a, HA(C)1b-DA3b, HA(C)1c-DA6d, HA(C)1d-DA2a, HA2a-DA1b, HA2b-DA2a and HA2d-DA4c.

Although some dies may have lingered longer behind new batches, normal shelf-life does not seem to have been very long. The “earliest” know HA-DB combination is HA(C)1c-DB3u, the “earliest” HB-DA is HB3c-DB3a. This might indicate that early HA would be contemporary with late HB2

HA3i-DA9f (see bottom of this introduction) can be dated as the earliest combination to strike coins out of brass sheet metal.
Tested bronze/copper coins are only abundant for HA4b-DA10a and form only a smaller part of the products of HA4d-DB3b and HB5z-DA9c. This might indicate the latest HA are not later then the earliest HB5 and that we have bronze/copper coins with HA or DA thanks to a prolonged shelf-life of these dies.

Die characteristics

Circle and filing lines 62313





To give the die a flat surface you can put the die in a lathe and move a chisel over the surface. If the chisel is not sharp enough and the lathe worn you will not get a smooth surface but a spiral will appear, which I call circle lines. If the lathe is not available or not so much needs to be done, you can also use a file, which will leave filing lines. Circle and filing lines are a kind of fingerprint, different for every die. Only very few young dies do not show any of these lines.

Alas, on most dies circle and filing lines fade fast and normally you will have to content with a few last remnants, if any.

Double struck dies, design position and die diameter 75400 & 68992



Where each double struck coin will differ from the next, coins struck by a double-struck die will all show the same double lines. Most double-struck dies show the first imprint very close to the definite one. The above coin is the exception where the die rotated some 80 degrees in between.

Die diameter is not always easy to measure and may appear to change as dies grow older. The smallest diameter observed is +/- 25.0 mm (coin right), the largest might be well over 28 mm. The design is not always well centred on the die. The difference in position of parts of the design towards the rim can be used to recognize certain dies.

Haircracks, broken-off pieces and bulbs 84895



Haircracks are a numismatist's best friend, even if they are not as easy to discern as the dies that lost pieces.

Bulbs may form where a die has imploded, possibly due to an irregularity in the material. (Lets hope, as there are 2 dies with nearly the same damage at nearly the same place, there is no other (human) cause involved)

Self-strike and strike-out 83931



Self-strike (German: *Lichtenrader Prägung*) I call the imprints left by dies hitting each other without flans in between. Parts of the opposite die are visible on the coins.

Strike-out is the result of horizontal movement of the dies at the moment the coins are struck. One effect, which I call raking, looks like part of the design has been scraped of. Another, which I call splash looks like material was blown away by a strong wind.

Strike-direction (>) is given for the H-side and indicates the direction from which the forces seem to come. So the coin above right has strike-out direction bottom left or >lo.
On the other side the forces would come from the opposite direction, which will be mirrored if you turn the coin. So >lo shows the same effects on the D side as if originating from top left. Strike-out directions distinguished are bottom left = >lo, top left = > lb and bottom right = >ro.

Die position 91588 , 71536 & 70664



A simple way to determine die position is by putting a “post-it” paper on the coin and then turning the coin around. On the H-side the paper has been attached at the bottom of Heller

Comparing the die position of your coin with die positions in one of the easyfinders will give an indication of where to search. The problem is that shifting of die position is quite normal. Rotation though is only seldom seen.

Coin- and medal-alignment

Germans call coin-alignment French-allignment (französischer Prägung), as they used to strike their own coins in medal-alignment and the Frech in coin-alignment. Medal-alignment means that if you drill a hole in a coin at the top of the design on one side, it will also be at the top of the design on the other side. This position is also called 12 o’clock. If you keep a coin in medal-alignment in front of a mirror both sides will show the same orientation.
In coin-alignment (6 o”clock) the hole at the other side will be at the bottom of the design.

Being German, the Tabora mint struck their coins in medal-alingment. It must be by mistake that some extremely rare exceptions exist



The mistake must have been noticed quickly as all other known coins of this die combination (HA(C)1c-DA6a) have normal medal-alignment.



One other, multiple struck, HB-DB coin with coin-alignment is known. Condition of the coins doesn't allow full determitation of the dies.

If anyone would find another 20 heller with coin-alignment, I would be much obliged if some pictures would be send to me.

Easyfinders

Easyfinders are organized around one or more die characteristics of the coins of a subdivision. Comparing characteristics of your coin which those shown in the easyfinders will in most cases lead directly to the dies that produced your coin. If not, you will just have to look at all the coins of its subtype. In the easyfinders a three-digit and a five-digit number are given below each picture.

The three-digit number is a sequence number in the Zeno-titles of the coins, which keeps pictures there (zeno.ru) in the right order. This number also appears at the top of the pages where the die combinations are catalogued separately. The 5 digits number brings you directly to a picture of the coin if you typ this in search at the top of any Zeno page.

Easyfinders	HA(C)1	HA2>4-DA	HA-DB	HB-DA
Circle & filing lines	003 # 70724	003cc # 70549	001 # 63363	002 # 63383
Double struck dies				
Self-strike		003zs # 70723		
Haircracks etc.				
Strike-out		003> # 70874		
Design position				
Die position		003p # 63545		
Total view				

Easyfinders	HB1-DB	HB2-DB	HB3-DB	HB4-DB	HB5-DB
Circle & filing lines	0040cc # 73123	0045cc # 73128		005cc # 70128	
Double struck dies					
Self-strike				005zs # 64074	
Haircracks etc.					
Strike-out	0040> # 73125	0045> # 73129		005> # 70069	
Design position	0040x # 73127	0045x # 73131			
Die position	0040p # 73124	0045p # 73130		005p # 64007	
Total view		0045t2 # 73953	0045t3 # 69165		

These same easyfinders you will already have seen opening this 20-heller map. Easyfinders have not been updated as regularly I would have wished.

Help in identification

Some coins may safeguard their privacy to an extent you might start to despair about ever identifying them. In that case you better send their pictures to 20heller@ptbvhrokerspartij.nl so we can look at them together. If possible send also pictures with die positions. Small pictures are of little avail, so let them be big. If I am not on holidays 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, countermarked and double struck coins. If you send me pictures I suppose you will have no objections to them being used in Zeno or this catalogue.

Countermarked coins 7155

M countermarked on 20-heller first appeared in the 1920s in Germany. The relation with Mozambique is not supported by evidence.
For single M countermarks several different punches are known. See # 72752



Fakes and fabrications

Certainly one day the Chinese will start counterfeiting 20-heller, but they do not seem to have started yet, probably because there are still so many other types that are far easier to copy and sell in bulk.

That does not mean no counterfeiting is going on, but that it is not done on a grand scale. The problem for counterfeiters is that no two 20-heller coins are exactly the same. Thus, it would be highly suspicious if you tried to sell ten exactly the same coins. So counterfeits may be expected to be made on a one-by-one basis.

As copper 20-heller fetch higher prices then brass ones, but cost the same amount of work, it will be copper a counterfeiter goes for.

With a little knowledge of chemistry it is not to difficult to give a brass coin a copper look or even put a thin layer of copper all over the coins surface. A simple test on specific gravity

would reveal such a coin though. Alas, not many auction houses seem to be willing to do any tests at all.

A good galvanoplastic copy would be much harder to detect, if some care has been taken to hide the soldering of the two sides. A mistake in die-direction might give such a coin away. As galvanoplastic copying in not everybody's daily work, 20-heller may have escaped being copied this way. Coppering and galvanoplastic cannot be recognized on pictures if the original is chosen well, as they do not involve changes to the original type.

Some other handy people, who want to make some extra money out of their coins, might use their abilities to change a normal coin into something much rarer. Below are four examples of their workmanship.



Top left HA4b-DA10a-K with complete LL. See 008a # 69051
Top right HB5f-DA10a-K. See 008c # 69054
Bottom HA4d-DB3z-K with complete LL. See 0008b # 69053

All four coins are probably indeed copper. HA4b and HA4d did never exist with complete LL, so the top of the foot of the left L must have been added later. HB5f and DA10a where never used in this combination, so either both sides were soldered together or it is a cast copy, using 2 different coins to make the mould.

Dies in disguise

Besides HA2d and HA4d, where a gradual change can be observed while the dies grow older, other dies may appear in disguise more randomly.
HB3d was observed only once in this form. Full or faint remnants of the top of the leaf may be seen on early HB4a.



HB3d disguised as HB4
1 of 20+ coins



HB4a disguised as HB3 on some early coins, only 1 coin known with full leaf

Light weight coins

In *The Handbook of Tanganyika*, 1930, page 189, it is stated: "Of the twenty-heller coins only the first batch produced from brass sheets to the value of Rs. 4,000 came out light in weight, viz. eight grammes". This would be equivalent to 20,000 coins. The available date make it probable that the 20,000 must be interpretated as the total amount of coins in this first batch, of which some had a weight as low as 8 grams.
Typically HA3i -DA9f and HA4a-DA8a did produce light weight coins of this category.
Eight grams for a 28 mm coin is equivalent to 4.9 grams for a 22 mm coin of the same thickness.
As 5 grams was the set weight for the 22 mm 5-heller coins, this might indicate these first 20-heller coins on trade stock brass were struck after standard weight for 5-heller was changed by decree 112825 of 27 May 1916.

Production data

As explained in 20 heller part I, a rough estimate could be made of the amount of coins struck by each die combination by counting the coins struck by these combinations offered on internet. This resulted in the following figures for the main types.

main type	mintage	+/-	main type	mintage	+/-
HA(C)1-DA	40,000	9,000	HA2-4-DB	93,000	13,000
HA2-4-DA brass	250,000	20,000	HB-DA	125,000	15,000
HA4b-DA10a copper	50,000	10,000	HB-DB brass**	700,000	27,000
HA(C)1-DB	12,000	4,500	HB-DB copper**	365,000	

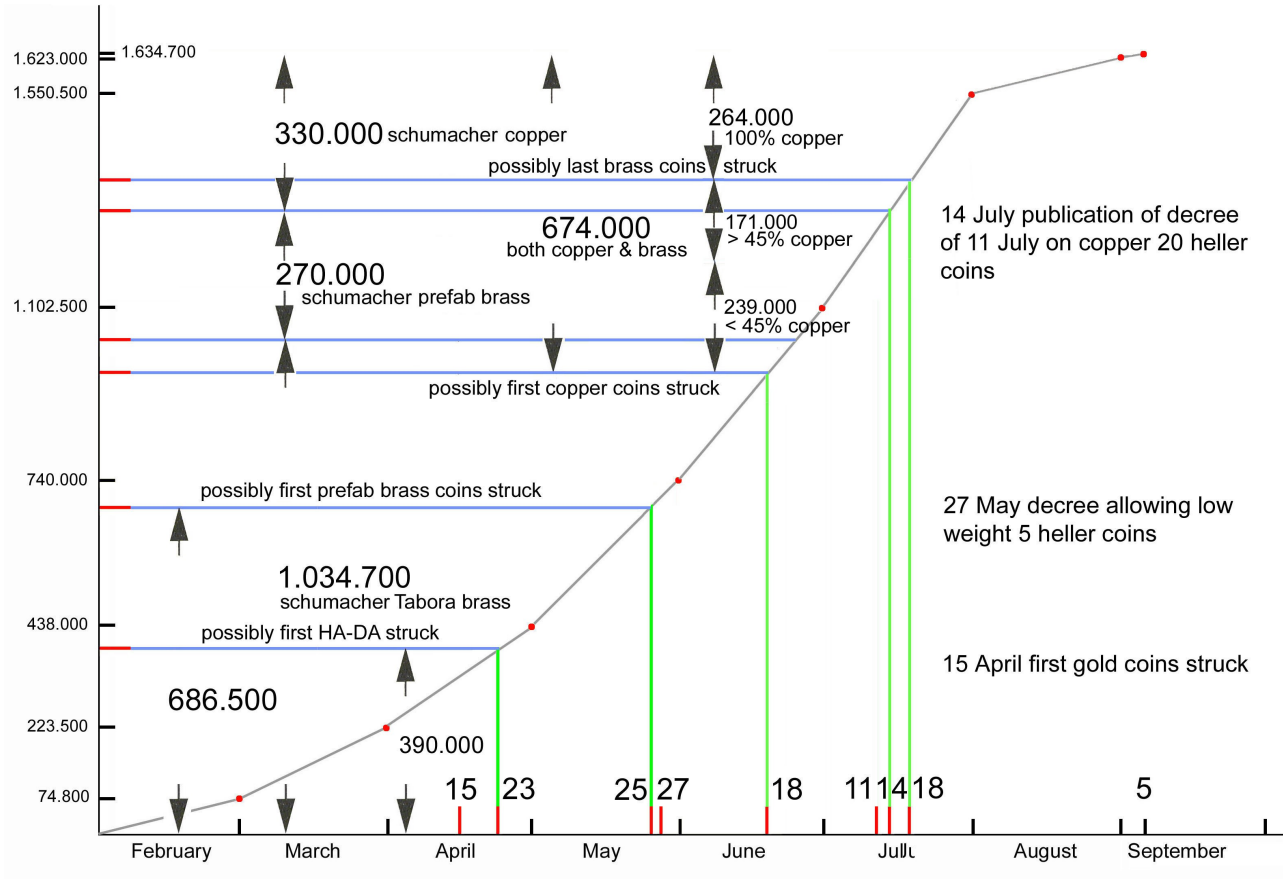
The +/- figures are the (rounded) statistical 95% confidence interval. 95% confidence interval means that the chance is less then 5%, that you would have found as much items as you did, if the real total amount of items was more then this margin higher or lower then the amount you calculated.
** In 20 Heller Part H a possible total of 425,000 has been calculated for the overall mintage for all 4 types of copper 20-Hellller coins. To arrive at 365,000 copper HB-DB

50,000 copper HA-DA and a roughly estimated 10,000 copper HA-DB and HB-DA have been subtracted. 27,000 is the 95% confidence interval of a total mintage of 1,065,000 brass and copper HB-DB coins.

Dating of Tabora-brass, prefab brass & copper

Schumacher gives the following data: prefab brass +/- 270,000, copper +/- 330,000. Leaves +/- 1,030,000 Tabora-brass (emuenzen.de/forum/attachments/praegezahlen). Putting these numbers in a graphical representation of coin production gives an indication of the date before which production in a certain metal must have started. That is 24th of June for prefab brass and 14th of July for copper.

A decree 112676 dated 11th of July, published 14th of July, regulates the striking of copper coins. Schumacher was head of the gold mint. The railway company managed the Heller mint so all Schumacher knew about the production of Heller coins would be from second or third hand. It might be coincidence, but it would not be impossible that Schumacher arrived at 330,000 copper coins calculating the amount of coins struck after the 14th of July.



In total 24 die combinations did strike copper coins. They produced circa 674,000 brass and copper coins, which would give a possible first date for the striking of copper coins around 18th of June.

In 20 heller part H also possible first dates for the striking of prefab-brass coins and HA-DA coins have been deduced from the material properties of the coins. Striking of the first prefab-brass coins, which would have been partly light in weight, around 25th of May does not conflict with the decree of 27th of May lowering the weight of the 5-Heller coins.

Striking of the first 15 Rupien coins on 15th of April and possible striking of the first HA-DA coins around 23rd of April might imply a relation between both, for example that the cutter of the 15 Rupien positive dies was available to cut these also for a new type of 20-Heller, which was then for some reason adopted for production.

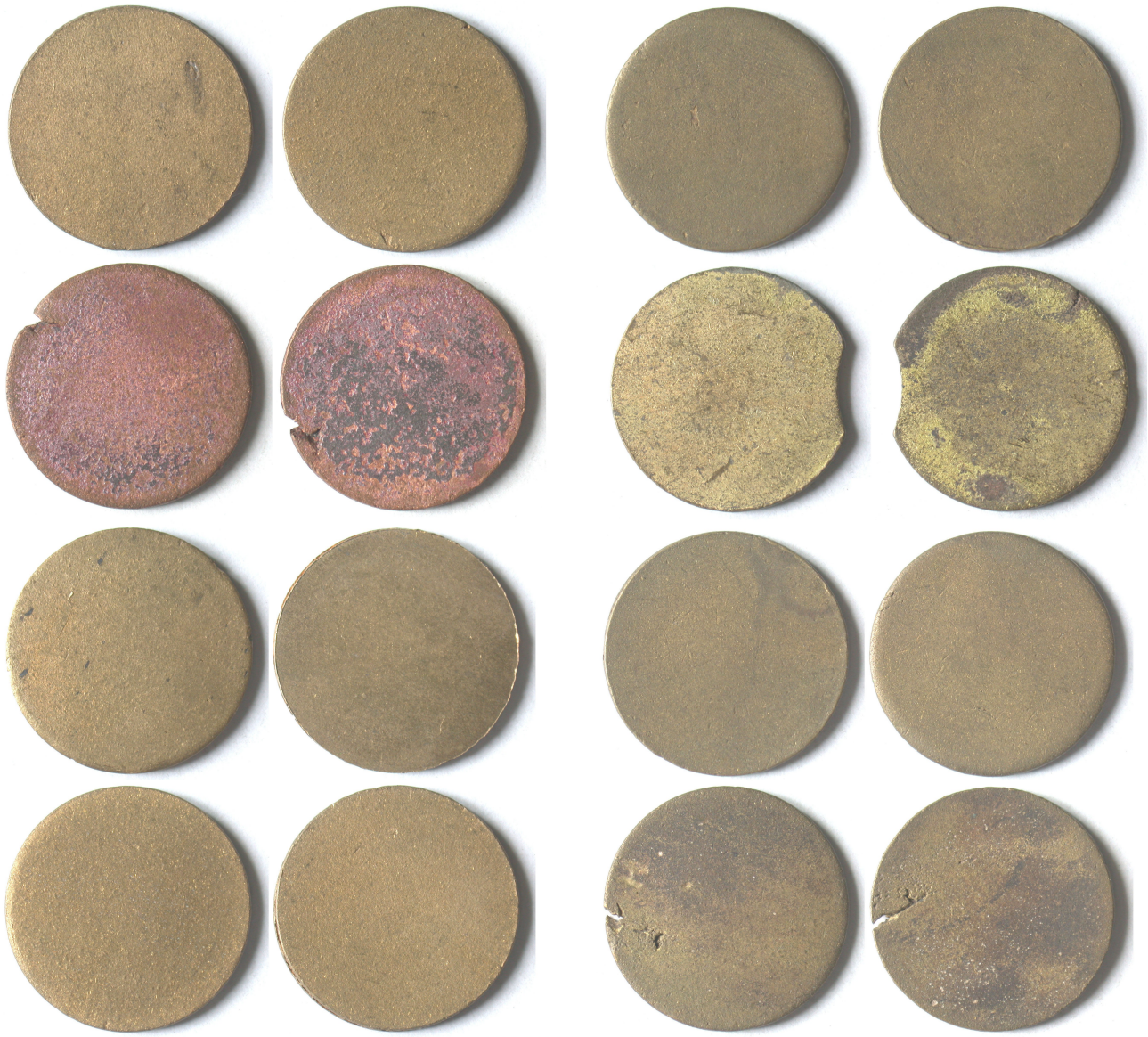
Thus the minting at the Tabora mint can be divided in 3 major periods. Striking of the HB1-2-DB1-2 coins took place in the first 3 months, then for 1 ½ – 2 months mostly HA-DA, HA-DB and HB-DA were struck, after which the HB5-DB3 and HA4b-DA10a were produced in the last 2 - 2 ½ month.

Surviving dies 112594 & 112593



At least one pair of dies has survive into our days.
No coins could be found that were struck by these dies. Probably they were never used because of the crack in the lower parts of both dies. As both top outer leaves of the H-die are sharp, this must be one of the first H-dies struck. On the D-die it can't be seen whether it is D1 or D2.
Perhaps these dies were kept behind with the idea to try to strike new positive dies in case of failure of the existing positive dies.

Flans from the Belgian Royal Museum for Central Africa's collection HO.1927.511 of DOA coins 112043 112447 & 112044





The museum's collection contains 139 flans, at first sight 80 brass and 59 copper/"bronze". This distribution, which doesn't fit the assumption that at the end only copper 20-hellers were struck, and the composition of the rest of the collection, containing a lot of "error" coins, makes me think these flans might have left the mint as regular coins. That is unnoticed amongst their struck compatriots. Like the other "error" coins they would then have been sorted out at a later stage by an observant paymaster.
Also the edges of the flans merit some attention. They clearly show these flans were punched from a piece of metal



These flans are very interesting as they show what we can expect to find on a mint state coin. Dents and buts, discolouration, black spots or even something like the second coin left in the first picture. Comparing this last flan with the forth right in the second picture,

which shows what I would think to be a casting error, I wonder is some of the copper looking flans in this collection are not brass ones in disguise.





Mint state black copper oxide formed during the annealing process





Some coins show parts that look like they have been partly sandblasted, while other parts look freshly struck. The rough parts of the coins must be due to the original roughness of the flans, which survives on weakly struck parts of the coins, since on coins struck by the same dies they show on the same spots. The pattern of scratches and dents is different every time, so it are not the dies that struck them on the coins.

Some analysis of copper coins show aluminium and silicon. This makes me think of the use of sand to heighten the grip of braking trains. It would have been a natural thing for people working in this railway workshop mint to strew sand on the copper plates to give a better grip to the rolling bars. Aluminium and silicon make feldspar, one of the products of volcanic activity, with Kilimanjaro looming in the distance. (For the coin above only

aluminium (0,53%) is mentioned, no zinc, tin or lead was found, uncertain is if it was tested for silicon).

20 Heller part B, C, D, E, F, G & H

20 Heller part B, C, D & E form the proper die catalogue, they show the known die combinations in different orders.
Part B shows the die combinations in Zeno sequence order. In most cases in this part related die combination are found together. This part is not very usefull if you like to determine the die combination of a certain coin.
Part C shows the die combinations in alphabetical order of the H-side. This is the part most usefull if you want to determine the die combination of a certain coin, exept for HA3a-DA combinations.
Part D shows the die combinations in alphabetical order of the D-side, which is only usefull for HA3-DA combinations
Part E shows only HA-DB and HA-DB die combinations,

20 Heller part F has been omitted from the 3rd edition of this catalogue. It consisted of a map with seperate pages for each die combinations.

20 heller Part G has been omitted from the 3rd edition of this catalogue. It consisted of a map of files regarding the problems tackled in part H.

In 20 heller Part H, Tabora-brass, prefab-brass & copper, the question is tackled which materials were used for the 20 Heller coins and what this can learn us about the production sequence of the differen types.

In 20 Heller part I, coin production per die combination, the results are presented of an attempt to calculate production for each seperate die combination. Thus an impression of relative rarety can be obtained.