

A KEY TO THE TARTAR CURRENCY: TOQTA, SARAY AL-MAKHRUSA, 710 H.

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Four years ago I have started to collect coins. It was a strange collection: the coins were issued by one ruler, at one mint and in the same year. The interest, which I had in these coins, grew from the preceding historiography. Since G. A. Fedorov-Davydov started his studies of the Golden Horde currency, a huge amount of the material was accumulated in the scientific literature. This material covered mostly the 14th and the early 15th century, but unlike coins of the 13th century the particular issue of Toqta-Khan was frequently met in the hoards and in the exavations. The said difference led scholars to the conclusion that the monetary system of the Golden Horde survived in the beginning of the 14th c. a monetary reform, which established the standard of Tartar coins for seventy years. This reform, according to Fedorov-Davydov, was aimed at unification of the currency in different regions of the Mongolian state, and the Saray coinage of 710 H. was exactly this reformed issue (Fedorov-Davydov 1960 100–111).

Coinage of Toqta-Khan has been mentioned already in the earliest catalogues of Djuchid coins (Fraehn 1826 №19; Fraehn 1832 №28), although now scholars prefer the work of S. Janina for references (Janina 1954 10). These coins' obverses and reverses kept no secrets. The obverses contained the Arabic inscription, combined with the name of the khan, written in the Uighur script: «**All-mighty Sultan Gias ad-Dunia Toktogu the Just**». The reverses were also entirely standard: «**Struck in Saray al-Makhrusa, in the year 710**».

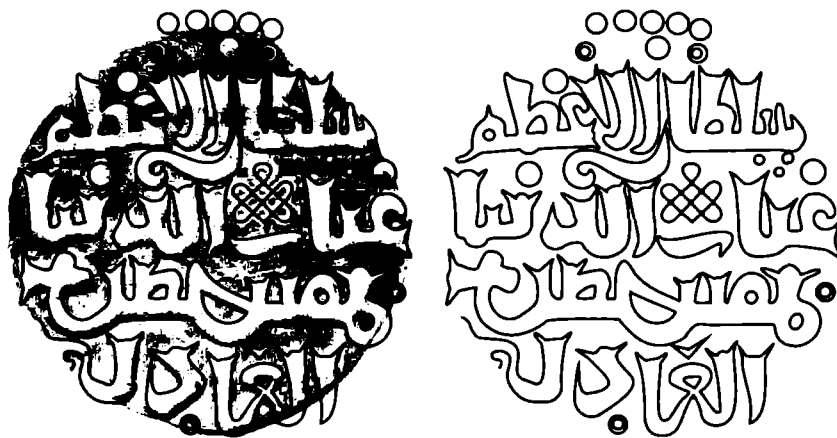


Fig. 1. The digitalized image of a coin and the transparent outline used as the overlay for comparison with the images of other coins.

The medieval technologies used for engraving of dies are not unfamiliar to the numismatists. The set of tools designed for engraving has changed slightly till nowadays. But one has to praise qualification of the engrobverse, who cut dies for the Tartar coins. At times they are almost indistinguishable, and one has to wonder not if the engraver had a firm hand, but that he used some stencil to position the inscriptions. One can hardly attribute these dies by

their fragments if not to resort to the reconstruction of the die and capabilities of digitalization, used in this study.

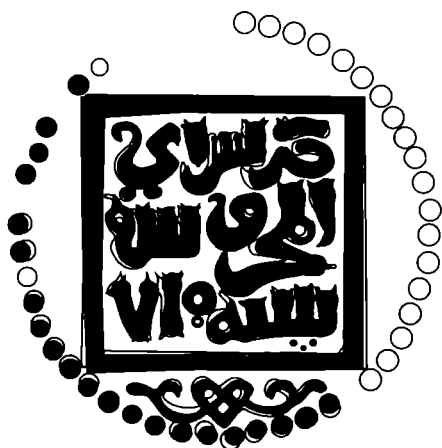


Fig. 2. Sameness of the dies (reverse type 3, dies 20 and 28, engraver «Charlie»)

The first result of the die analysis was the discovery of the fact that the silver coins of Toqta-Khan with the reverse inscription «**Saray al-Makhrusa, 710**» have been struck at several mints during several years. Thus it was not only the capital mint of Saray, where these coins were issued (and even not necessary the capital mint). The coin types and dies, detected in the research, are linked in a single sequence. Thus the material makes it possible to reconstruct almost exact sequence of these dies introduction at the mints (wear of dies was taken into account as well). Characteristic lettering and style of the obverses imply that four engrobverse by turn designed dies for these coins.

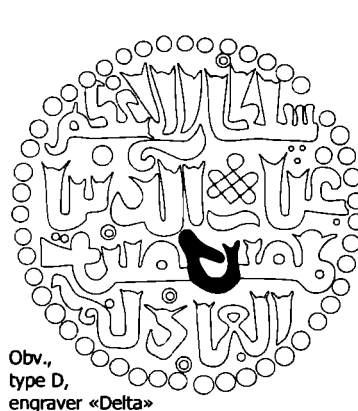
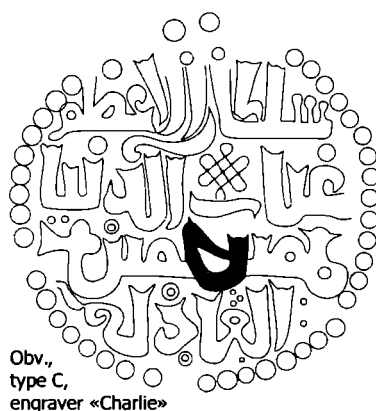
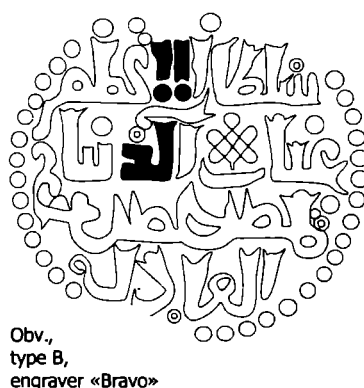
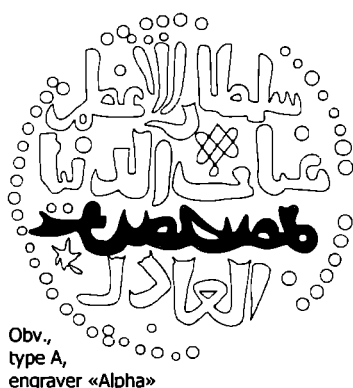


Fig. 3. Coin type «Toqta, Saray al-Makhrusa, 710». Basic attributes of the obverse typology.

This implies that the mint had no engraver among its staff and simultaneously indicates that the Tartar mint was a traveling one, obliged to engage craftsmen at fingertips. Consequently the extremely uniformed coinage of Toqta khan can be subdivided into four varieties, for convenience called «types» below. These types differ by obverses, although they have numerous common reverses.

The type, first by chronology, can be distinguished by the manner master «Alpha» engraved the Uighur name of Toqta — Toktogu. Termination of the letters in this type (as well in the second type) is sharp-pointed, not bisect. The second type is the most easy to detect as master «Bravo» made use of the naskh script together with the kufi script. «Bravo» obverses must be the second type, because exactly «Bravo» reverses were used later with the third type of obverses. Qualification of two engrobverse surpasses that of the craftsmen who made dies when the Golden Horde mint resides in the early 14th c. in Ukek (near modern Saratov). However it is hard to define this qualification as an extraordinary: the letters are not in proportion and even the size of dots, forming the circular cartouche, varies significantly.

Although high skill, taste and predilections of the third and the fourth engraver («Charlie» and «Delta»), who made dies for the dangi of Toqta, were very similar, one clear-cut distinction does exist. The type and the engraver is marked with the second letter «T» in the name of the khan — if it is merged with the precedent letter «K» or not. One could neglect this difference, if the implementation of the third and the fourth type was not determined with the chronological and territorial boundaries, described below.

There are also four variants of reverses to be called «types». The first one was created by «Alpha», the second — by «Bravo» (they can be traced by the form of the last letter in the word «Makhrusa»). We can date the use of these two types grace to the interleaving of the third and the fourth type. It is not easy to say who, «Charlie» or «Delta», has engraved a particular reverse die. But it is not so important, because the difference between the third and the fourth type is not of the decorative nature. Points appear or disappear above figures «one» or «zero» in the date 710 (these specifying the type) according to the chronology of manufacturing.

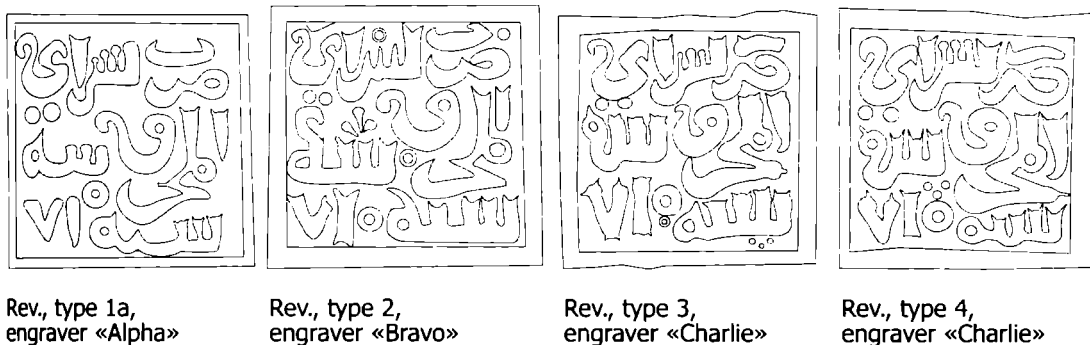


Fig. 4. Coin type «Toqta, Saray al-Makhrusa, 710». Reverse dies typology (central cartouche).

The die-linkage table, drawn below for the obverses and the reverses, demonstrates that the mint masters made interlaces using dies of the third and the fourth type. The sequence of 32 reverses (not counting dies 33–37) splits into seven groups. We can state so that the reverse type has changed six times. We have to remember also that, when Toqta-Khan died in the end of summer 712 H., political unrest come to the Golden Horde. His nephew Uzbek, who seized the throne, started to coin silver with his own name and the date 713 H. (Tizengauzen 1884 174, 197,

322, 384, 437, 514; Tizengauzen 2003 324)¹ During those three complete years which they could strike the dangi with the name of Toqta, autumn followed summer and spring followed winter also six times. The time had one more dimension: six times the ordu of the khan together with the mint had to move on migration from the summer pasture to the winter one and backwards. Thus the chronological definitions of the reverse types are to be seasons «spring-summer» and «autumn-winter». The third reverse type (the third to appear) has to be called a «summer» type and the fourth one — a «winter» type, because the beginning of the 710 year of Hijra coincided with the beginning of summer 1310 AD.

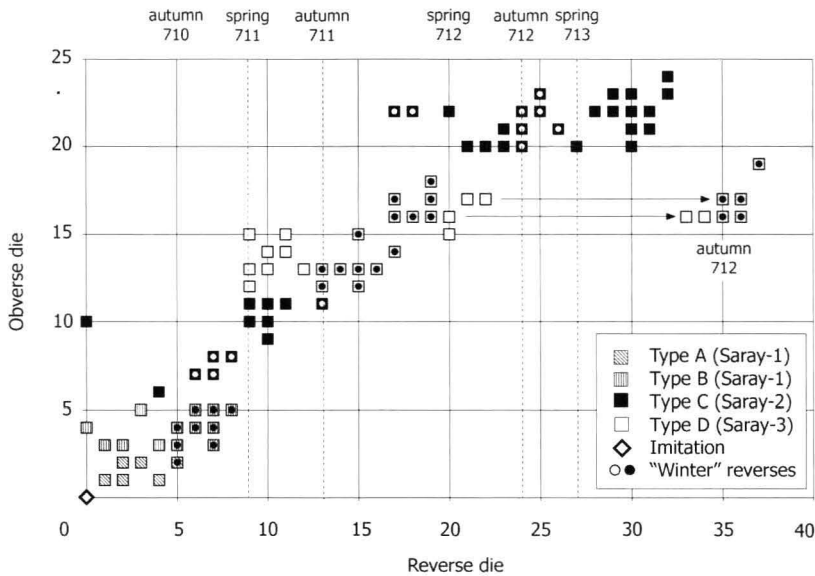


Fig. 5. Coin type «Toqta, Saray al-Makhrusa, 710». Die linkage table and chronology of dies.

Typology, sequence of use and chronology of the types issued with the name of Toqta khan together with recurrence of the obverse-reverse combinations, let us reconstruct an important moment of the financial history of the nomad state. As we can judge by the date, placed on the dangi, the coinage had started not before 710 H., i.e. after 31st May 1310. The mint was located in the ordu of the khan and there is no surprise that after migration in autumn it has appeared in the place, where master «Charlie» lived. The first die engraved by «Charlie» had time to work jointly with the «summer» die of «Alpha»; two more dies were in use together with the «winter» dies, made in the workshop of «Bravo». Mint masters stored up three more dies engraved by «Charlie» and used them only after the spring migration at some new, the third place. The service life of the «Charlie» dies was, naturally, limited, and the mint authorities had to find a new engraver there where the khan moved late in summer 1311 AD. This engraver was «Delta», who preferred to write the Uighur «T» together with «K». The numismatic material let us see that the horde remained at this site till spring 1312 AD, and eight obverses from «Delta» served at the mint for a long.

There is no surprise that in spring 712 H. the Tartar ordu moved on migration again and returned to the place, where it spend autumn 710 - spring 711 H. There is no surprise that the

¹ The medieval Arabic authors were not always able to distinguish two dates: when Toqta died and when Uzbek was enthroned. Consequently some of them tell us about Toqta deceased in January 1313 or 1314. The exact date is contained in the continuation of the Rashid ad-Din chronicle (the continuation was written by an anonym author in times of Shahruh). Toqta died 4 Rabi II of 712 H. (9th August 1312).

mint arrived to the residence of «Charlie» equipped with the reverses of «Delta». They started coinage with his already worn «summer» dies and the obverses of the third type. At last, in autumn 712 H., mint masters took from the chest «winter» dies survived from 711 H.² One can notice one strange thing: the mint, moved with the khan, took with it the reverse dies engraved by «Delta», but none of the obverses³. The mint and the ordu didn't move from this place after Toqta-Khan was dead, and two more seasons «Charlie» engraved dies for coinage. At the same time «Delta» re-engraved two obverses (nos 16–17), produced two new «summer» dies and three more «winter» dies (nos 33–37) and the second mint till spring 712 H., Toqta-Khan already deceased, struck dangi of the type «**Toqta, Saray al-Makhrusa, 710**».

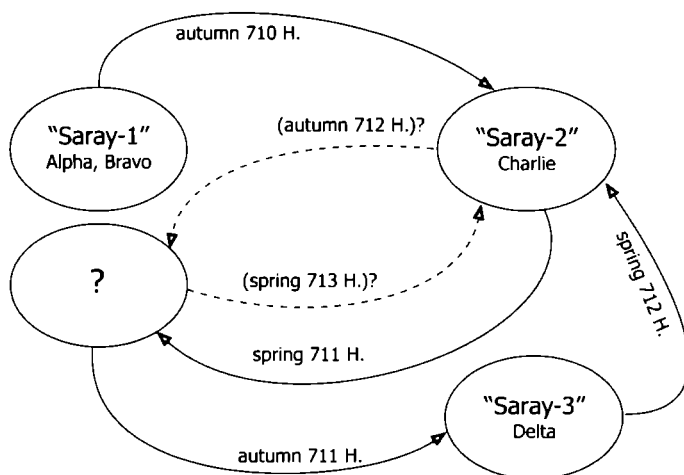


Fig. 6. Migrations of the horde and the mint «Saray al-Makhrusa» in 710–712 H.

The above schedule, making clear that the coins, bearing the date 710 H., were minted in 710–712 H., explains why in the course of the Golden Horde coinage we can observe an intensive production, for example, in the years of 682, 734, 773 or 796 H., and why there is a «pause» in coinage after these years. Everything was simple: like European powers, issuing some anachronic «type immobilisé», the khans of the Golden Horde resorted in the 13th and in the 14th c. to the «serial» coinage. Dies and types linked in a sole chain, their consecutive replacement at the mint give us no chance to state that there was a reform in 710 H., the reform which was a basis for the periodization of the Golden Horde currency. The reform would require an instant expansion of the mint and synchronous employment of the whole of dies dated 710 H. We, however, have instead a prolonged coinage of the unchangeable type up to the appearance of coins with the name of Uzbek-Khan in 713 H.

The number, assigned here to the different types and dies, determines their order of employment at the mint. However one has to find grounds to say that the type «A» dies were first to appear and the type «D» ones were the last. Indeed, the reverse numbering will result with the mirrored figure 5, looking as fine as the original.

One can establish the true sequence not only with the wear of dies. The currency is submitted to the chronological changes, caused by the outflow of coins abroad, into the hoards or the melting pots. In the course of time the number of coins decreases while the number of

² These dies were already worn-out significantly, evidently by this reason there are only two coins of the third type struck with the «winter» dies of 711 H.

³ This is not improbable, however, that obverse no. 21, recorded as «Charlie», was the re-engraved die made earlier by «Delta». The images were not perfect to state it for sure.

dies cannot be changed. Accordingly for every issue the proportion «coins/dies» decreases. This proportion is low for the oldest coins and is the highest for the currently struck coins. This proportion for the year 710 H. is to be under the figure characteristic for the year of 712 H., if the coins came from the same source. This source is the Golden Horde currency after 712 H. The difference between the issues has been frozen in the subsequent currency, and the hoards, buried after 712 H., brought it to us even if the coins were dispersed.

The said proportion «coins/dies» is $71:11=6,45$ in the gathering of the obverse types A, B and C (dies nos 1–11). The similar proportion for the obverse types D and C (dies nos 12–24) is much more higher — $146:13=11,23$ or (if we take into account two re-engraved dies) $146:15=9,73$. Naturally, these confirm that the sequence of dies has been determined above correctly. The significant difference between two proportions attests rapid changes of the currency during the last years of Toqta-Khan; it supposes a high extraction rate. By the beginning of 713 H. those coins struck with the obverse dies nos 1–11 circulated one year and a half more, than the coins produced with the obverse dies nos 12–34. Because of it their number decreased stronger, one and a half time more ($9,73/6,75$). This proportion means that during the said 1,5 years one third of the coins left the circulation⁴. The extraction probability 0,27 (23,6% of coins per year) had to exist in the Golden Horde to make it possible⁵. I've supposed earlier, when analyzing the contents of the hoards that such a rapid flow of silver did exist in Tartar state in the 1310s⁶. The results of the dies analysis make to look at this figure more closely. Besides all, it tells us that the amount of the monetary fund in the Volga region was rather modest.

Roman Reva has published earlier a small hoard of coins minted in Azak (it contained at least 23 coins when it was found). These coins, struck with 16 obverse dies, were anonymous, and he suggested that the name of the khan was omitted because of the political ambiguity of 713 H. By this reason he identified the coins as the issue of some unknown emir of Azak and dated the coinage of these «aspri baricati» by those six months, which passed from the death of Toqta-Khan to the moment Uzbek-Khan took power. We can guess now, who has issued these coins, for there are few possibilities. A sample of 23 coins, struck with 16 dies, designates that there were 56 dies in the whole. With this number the hypothesis of R. Reva suggests that the provincial mint in half a year issued more coins, than the central one in three years. Obviously, we have to reject it. Instead we can only choose who, Toqta or Uzbek, has considered the words «Commander of the Faithful» to be sufficient as designating his splendor⁷. One can also estimate, how much time did it take to issue these coins. Weight of these coins tells us that they were exactly those aspri, mentioned by Pegolotti (Pegolotti 1936 25)⁸, the coins issued by Uzbek-Khan, because it was he who reduced the weight of the baricat⁹. The date of this reform is unclear, although the upper limit may be obtained from the composition of «Pratica della mercatura», ignoring Venetian coins, issued in the reform of 1332 AD.

⁴ The calculation of the extraction rate is explained in: Ponomarev 2007 1008–1026; Ponomarev 2009 30–34.

⁵ Calculation of the extraction rate with help of the die study has an advantage in comparison with the method, based on chronology of the issues. This advantage appears because we know the number of dies. The extraction rate, calculated by chronology, combines in reality two parameters — one, measuring replacement of coins in circulation, and another, measuring changes of the circulation value. The extraction rate, found with help of dies' frequency, doesn't correlate with the latter.

⁶ The chronological structure of five hoards let me calculate earlier that the circulation had been refreshed by 21–22% per year (Ponomarev 2009 52).

⁷ Recently there has appeared on the market similiar coins, dated 704 H.

⁸ The Florentine merchant tells us that the mint of Azak (Tana) struck 202 coins from sommo. They were a little bit under 1 g, for the standard sommo was 60 dirhams, weighting 3,2745 g each, i. e. 196,47 g.

⁹ (Reva 2005 18–23). Weight of the coins published by R. Reva (0,84, 0,86, 0,91, 0,92, 0,93, 0,99, 1,00, 1,01, 1,02, 1,03, 1,04, 1,06, 1,06, 1,07, 1,11 g) is under the standard, equal to ¼ mitkal. At the same time the average weight of the coins, minted in the Crimea under Uzbek in 720 H., and exhibited at www.zeno.ru, is above the figures from Reva's hoard: it reaches 1,076 g.

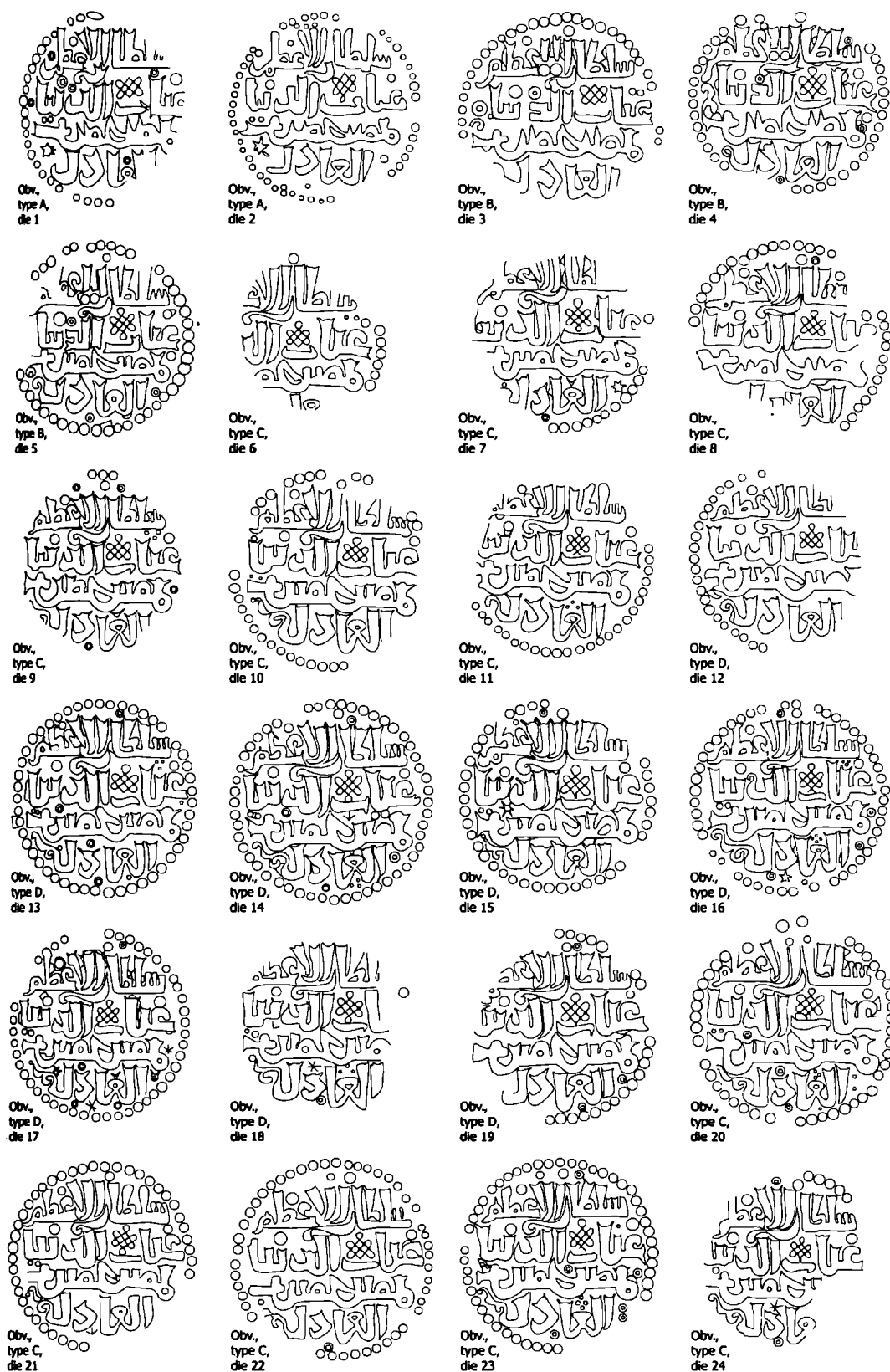


Fig. 7. Coin type «Toqta, Saray al-Makhrusa, 710». Reconstruction of the obverse dies (distinctive defects of the dies are shown)

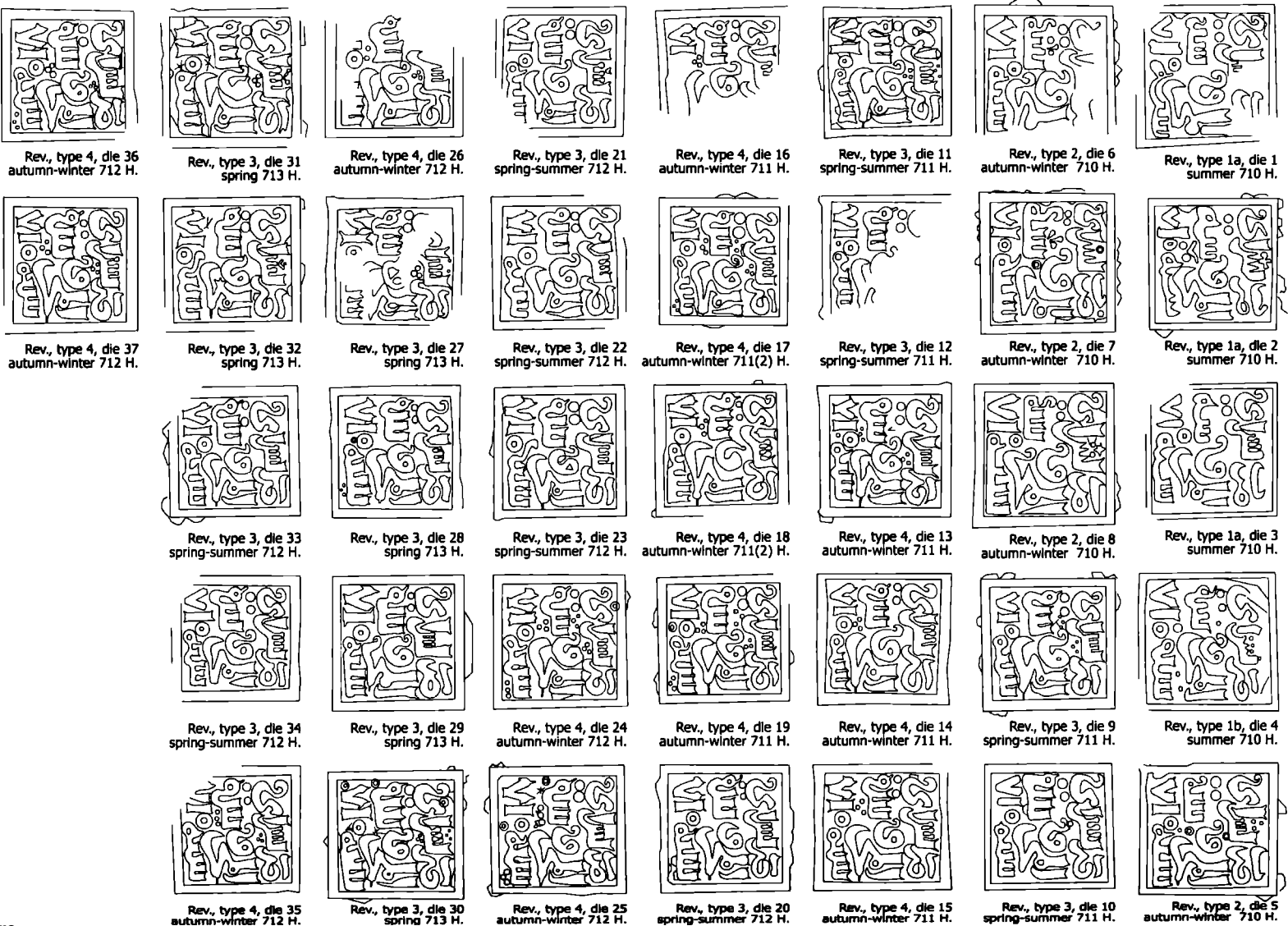


Fig. 8. Coin type «Toqta, Saray al-Makhrusa, 710». Reconstruction of the reverse dies
(central cartouche only; distinctive defects of the dies are shown)

I have calculated the total number of dies, dated 710 H., with the help of the formula, linking the number of coins inspected and the number of dies found. These two parameters happen to depend only from the total number of dies, used to issue the type in question. Unfortunately the research, which explains the formula and its nature, as well the advantages in comparison to the previous methods of estimation, hasn't been published prior to this article.

The most probable figures of the total happened to be 25 obverse dies and 40 reverse dies¹⁰. One can expect for a long time an unknown reverse to be found for we know already 37. The last unrecorded obverse die may be that, which was used to strike the only known imitation of the coin type «**Toqta, Saray al-Makhrusa, 710**», kept in the collection of K. Khromov. If we take into account that two obverse «Delta» dies were re-engraved, it will become evident that $(25+2):3=9$ dies per year were sufficient to refresh and maintain the currency. As we have estimated also the extraction rate (24% per year) we are ready to estimate the amount of the total currency. It seems to be the amount, corresponding to the number of coins struck with $9:0,24=38$ dies. Any of these figures gives no chance to suppose that Toqta-Khan has tried to perform some unification reform. With 27 obverse dies he was not able even to replace old coins, circulating in the capital region, and was, of course, unable to refresh the currency of the Crimea and the neighboring territories. He did in reality the only thing — he changed the eighth time in half a century the foot of coinage of the Mongol coins. His new coin was to be struck by a half dirham, was reckoned as $1/6$ of dinar, and by this reason could obtain the name of «dang», which means the same — «one sixth».

The history of the currency prior to 710 H. also tells us that Toqta-Khan has never mind the reform of monetary system in the Black Sea region with the issue of coins similar to the dang of 710 H. Although E. Oberländer-Târnoveanu hasn't fulfilled the complete die study (it seemed not obligatory in the 1980s) of the coins issued by Toqta, Nogay and Chaka from the Uzum-Bair hoard (Iliescu-Simon 1964 217–228) he composed extremely detailed classification of these *aspri baricati*. I can serve as his lips to say that there are 369 typological subdivisions; hence one can count only above 369 dies in the hoard. The hoard covers period 695–700 H.¹¹ and even imprecise estimation pushes us to the conclusion that the Crimean and Danube mints supplied the market with the amount of silver that took every year 60 dies for manufacturing. It was six time above the needs of the capital region. It is not necessary that the amount of the currency was also six times more, for the circulation could be refreshed with the speed above 24% per year. The proportion of the Crimean coins of Toqta-Khan (minted before 696 H.) in the hoard is equal to 10%. The circulation was renewed in 6 years by 90%, and this figure means that the extraction probability was 0,43 as well that every year one third of the coins left circulation¹². So, one can estimate the value of the Tartar currency around Black Sea by 180 dies' productivity, almost five times more than around Saray. I believe this to be the principal reason, why they never mind unification on the basis of the capital standards.

The unification of the currency could perform Djanibek-Khan in the years around 1343–1347 AD. We are to come to this conclusion after comparing the chronological composition of the Djuchid hoards with the data, contained in the acts of the Genoese colony of Caffa, covering 1343–1347. These documents, preserving the last known mention of *aspri baricati*, also mention

¹⁰ The obverse dies represented with: 1 coin — 3 dies, with 2 coins — 1, 3 — 2, 4 — 2, 5 — 1, 7 — 1, 8 — 1, 9 — 2, 10 — 1, 11 — 1, 12 — 2, 13 — 1, 14 — 1, 15 — 1, 16 — 1, 18 — 1, 19 — 1, 20 — 1. The reverse dies are represented as following: 1 — 6, 2 — 4, 3 — 2, 4 — 4, 5 — 7, 6 — 2, 7 — 3, 9 — 1, 10 — 2, 11 — 3, 13 — 1, 14 — 1, 22 — 1. The method of estimation, developed by W.W. Esty, shows identical figures for the original number of dies — 26 for obverses and 41 for reverses (Esty 2006 359–364).

¹¹ The encyclopedia of an-Nuvejri tells that Chaka died in 700 H. (Tizengauzen 1884 160).

¹² The simplified method for calculation of this parameter see: Ponomarev 2007 1022.

«aspri veteri» and «aspri nuovi»¹³. One can easily guess that the scribe meant by «aspri nuovi» the dangi of Djanibek, the money that started to extrude «aspri veteri» from the circulation. The rate of «aspri veteri» to sommo doesn't differ from the rate of aspri baricati, just because they were the same. However this rate practically coincides with the foot of coinage known from «Pratica della mercatura»: instead of the rate 190 aspri for sommo there was a higher one – 200 «aspri veteri» for sommo. This has occurred because during the reform Djanibek-Khan resorted to the financial trick, well-known in Europe also. He has got rid of the baricat from the overvaluation and the coin has started to circulate by its intrinsic value. The coins were not banned, but as they had the tale no more, their value was identical to the value of raw silver, and their near future was not the future of coins, but that of raw for coins.

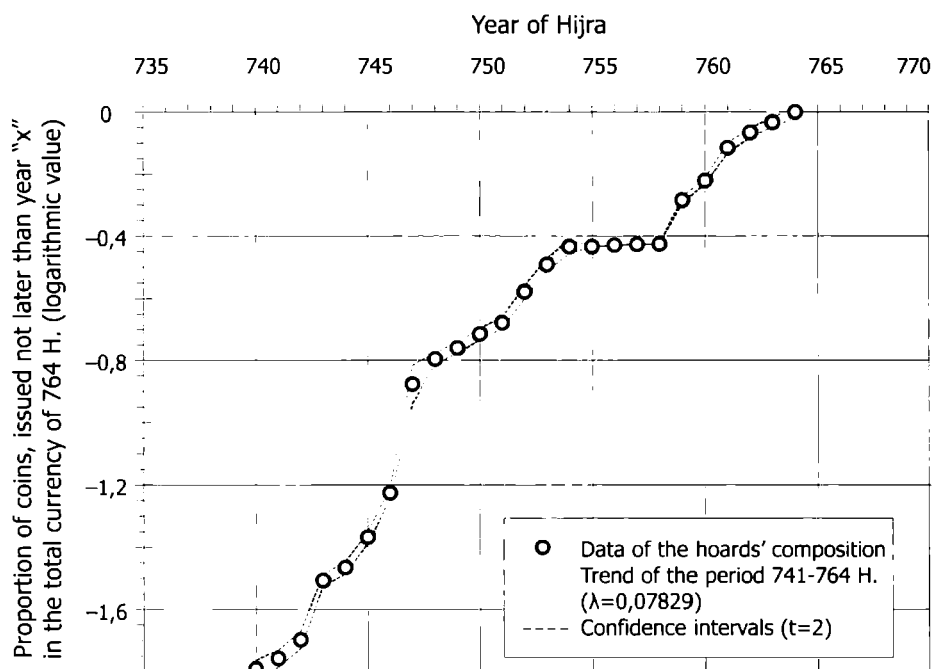


Fig. 9. Chronological composition of the Golden Horde currency in 764 H.

The production of «aspri nuovi» reached its peak in 747–748 H. (24.04.1346–30.03.1348), and the circulation, based on the dang of the Saray type, was not only refreshed, but increased its amount by 27% (fig. 9; for details see Ponomarev 2002 57–59). This increase was stipulated by vanishing of the independent currency zone around the Black Sea and by the end of baricat. The value of this increase specifies the proportion between the currency stocks in the Volga region and in the said area, which existed around 1347 AD, – 4 to 1. These estimations together with those, obtained grace to the die analysis, should be treated as the cardinal characteristics of the economic development. They demonstrate that the proportion, concerning amounts of the currency in two zones, has changed by 20 times from the beginning of the 14th c. The phenomenon does not necessarily indicate the decrease of the Black Sea region economy: it has to assert the rapid monetarization in the Volga region during the first half of the 14th c.

¹³ Balbi-Raiteri 1973 No. 14 (06.01.1344), 28 (13.03.1344), 78 (03.08.1344), 21 (21.03.1344). The year 745 of Hijra started 15 May 1344.

The same process, once upon a time initiated by the European merchants at the Black Sea, by the beginning of the century has reached the limit, determined by the needs of the regional economy. This market could, of course, decrease when the trade crisis of the 1320s burst out. Opposite, the Volga region market has started its growth and expanded, merging the peripheral areas of the state. One more sign of this expansion under Uzbek-Khan was the coinage of copper pulis, alien to the Volga region market during the previous period. Those, who have to seek the grounds of this development, are not the numismatists of the Golden Horde. They are the historians, engaged in Russian medieval history. The said processes could hardly happened without influence of some important events of those time — pacification of Rus' and transition of the tribute collecting into the hands of the Moscow princes.

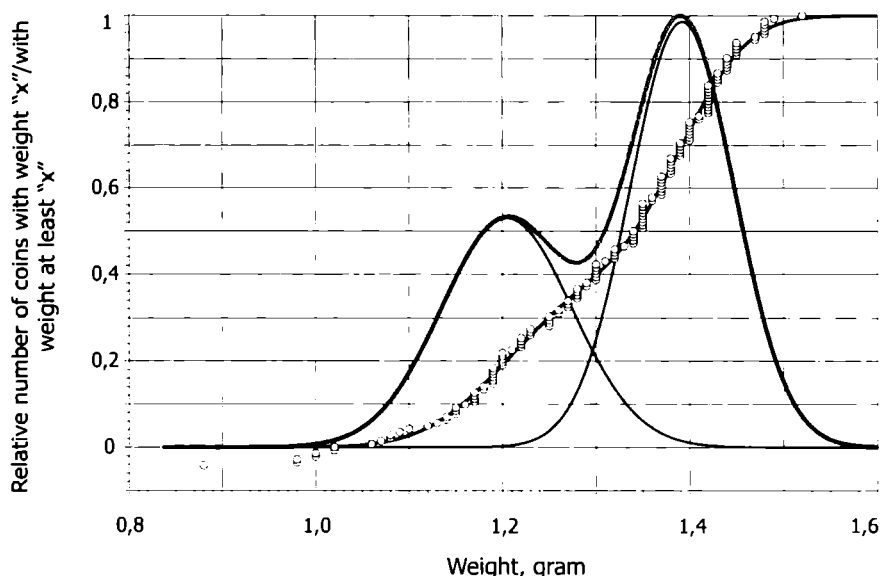


Fig. 10. Distribution of the coins' weights approximated with the sum of two Gaussian laws (Golden Horde, Toqta, Saray al-Makhrusa, 710 H.; 149 specimens from the Selitrennoe hoard of 1973).

Correlation index 0,9989;

1) $M_0=1,392$ g; $\sigma=0,0558$ g; $\mu=0,0060$ g; 85 spec.

2) $M_0=1,205$ g; $\sigma=0,0699$ g; $\mu=0,0092$ g; 56 clipped spec.

The type of the currency, chosen to support circulation in a medieval state, was not the only feature of the monetary policy. The amount of seigniorage, paid by those, who brought silver to the mint, determined competitive ability of the coins, their eligibility for the international transactions, as well a degree, that protected specie from culling. Quite naturally to expect, that these tasks in the unitary state were solved in a similar manner at the different mints. To detect the minimum overvaluation, necessary for the dangi of 710 H., one can use their metrology from the hoard, found in 1973 at the Selitrennoe site, ruins of the former capital Saray (**fig. 10**; Fedorov-Davydov 1980 58). These coins have circulated for many decades; many of them have been clipped, but nevertheless the current distribution of weights preserved standard deviation of the original distribution, submitted to the Gaussian law. In the fresh coinage the value of the standard deviation corresponds to one third of remedy, so we can estimate that the maximum of the latter was in 710 H. $\pm 0,16$ r ($\pm 10\%$). The Volga region coins were protected from culling if the mint, called «Saray al-Makhrusa», took for coinage as many

as the mint in Azak, about 6% of silver (Pegolotti 1936 25)¹⁴. To determine the rate of the dang coins to the baricat coins one should know their alloy. We haven't any documentary evidences of the quality of the Toqta dangi. The answer could be obtained with the chemical analysis, but it turned to be a failure. The energy-dispersion analysis fulfilled¹⁵ to determine the silver alloy in 35 dangi of 710 H. gave only the confirmation of the well-known phenomenon: the upper layer of the ancient coins is enriched with silver (Beck and alii 2004 153–162). The result obtained – 983‰ is above the purity of any medieval silver. So it was the sequence of the enrichment one can hardly avoid using methods of the surface analysis¹⁶.

The figure, presented by the measurement of the specific gravity, looks more realistic. According to it the same dangi were struck from the alloy with the specific gravity, equal to 9,91 g per cubic cm. This figure corresponds to the alloy, composed from two parts of silver and one part of copper. However, the alloy in the core of coins has to be somewhat better to compensate low gravity in the upper layer, provoked by the holes and presence of the copper oxides. However again, to expect figure above 730‰ would be difficult (Fedorov-Davydov 1980 133, №19)¹⁷. At the same time both figures give the explanation, why even the hoard coins of Toqta-Khan have their surfaces covered with copper oxides, making it difficult to trace the contours of the letters. As well they explain why Toqta-Khan has started coinage of the particular dangi.

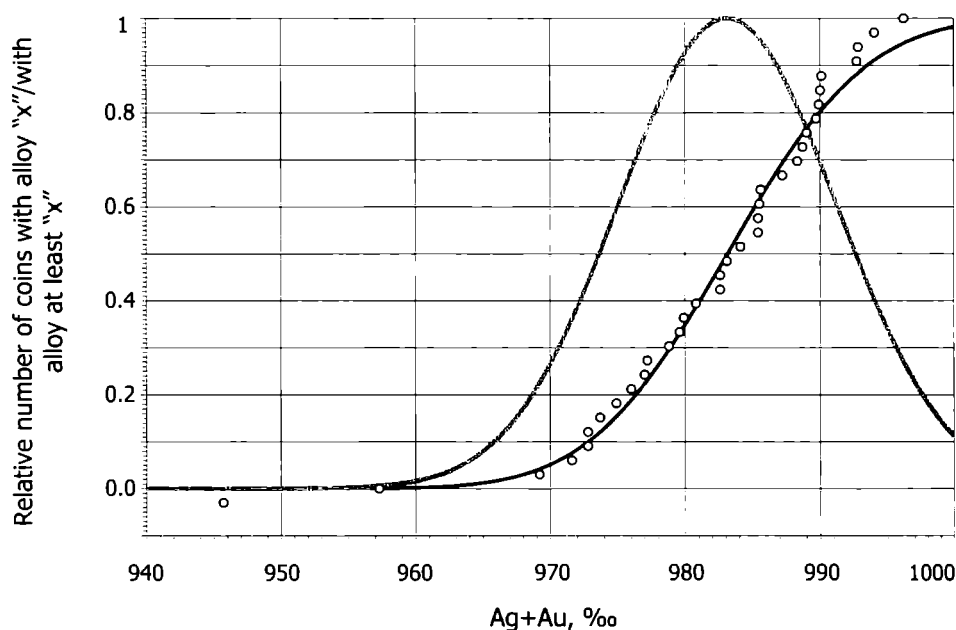


Fig. 11. Silver alloy of dangi according to the XRF analyses¹⁸
(Golden Horde, Toqta, Saray al-Makhrusa, 710 H.; 35 specimens).

¹⁴ Pegolotti mentioned that the mint of Azak returned to the seller 190 coins from 202 minted from his silver. So, the baricats were overvalues by 6,3%, as $202:190=1,063$.

¹⁵ The analyses were fulfilled at the Faculty of Geology (Moscow State University) by R. A. Mitojan. The description of the method see: Eniosova and alii 1997 113–131.

¹⁶ Figure 9 gives the combined figure for gold and silver, as in the Middle ages they measured alloy of silver coins similarly. Gold content of coins was the following: 12,6, 13,3, 8,4, 12, 15,4, 7,5, 0, 6,6, 7, 3, 8, 16,4, 0, 10,9, 17,3, 15,3, 23,4, 14,7, 4,1, 9,4, 9,3, 7,3, 18,6, 8,1, 13,6, 0, 0, 12, 3,2, 12,6, 8,4, 9,3, 10, 0, 14,4‰ (in order of the figures for common alloy).

¹⁷ The hoard of 450 coins, found in 1893 in the village Tambovka (the coins of Uzbek, dated 726 H. being the latest) contained 113 dangi of Toqta-Khan and 125 unidentified coins (probably Crimean, because common alloy of the re-melted hoard was measured as 730‰).

¹⁸ The graph gives the combined figure for gold and silver. Trend of the relation can be a linear one as well a Gaussian.

All the previous argumentation, used to prove or reject the hypothesis concerning the unification reform, fulfilled in 710 H., loses any significance after detecting alloy of the Toqta coins. The khan did fulfill the reform, but this reform has no relationship with the hypothesis of G. Fedorov-Davydov and his periodization of the Golden Horde currency, based on this reform. We need just to compare information of Pegolotti, concerning character of the Azak coins (Pegolotti 1936 25)¹⁹, with the data obtained during the investigation of the real dangi «**Toqta, Saray al-Makhrusa, 710**» to understand, why the previous argumentation doesn't matter.

In the beginning of the 14th c. the asper baricat of the Black Sea region contained 1,072 g of pure silver as they struck four coins from one mitkal (4,6779 g)²⁰ of 916,7‰ silver (it was 11 ounces in the medieval terms). The standard weight of the dang was 1,572 g (the foot of coinage was 300 coins from one ratl, equal to 144 dirhams of 3,2745 g). The figures of the specific gravity, mentioned above, specify that it contained from 1,048 to 1,1 g of silver. The possible difference is under 3% and even this estimation supposes that the financial authorities of the state had intention to equalize two kinds of specie, which were to have, after all, an identical overvaluation. How could they do this easy? How could they produce the dang, containing as much silver as the baricat? It was more, then simple to make proper silver alloy. They had to take seven parts of silver with the standard alloy 976‰ (Pegolotti 1936 27)²¹ and to add three parts of copper. In the result the specie of the Volga region could be exchanged with silver in sommo bars as easy as in Azak. In Azak they changed coins and silver in bars by weight. In Saray they could change mitkal of coins for dirham of silver. In this case alloy of silver, necessary for coinage in Saray, is to be determined as 683‰, neglecting possible inaccuracy of the specific gravity method.

Two media of exchange, coins and bars, coexisted in the Tartar state. This made the mint masters to invent coins, which could be exchanged with raw silver as easy as ABC. Combining alloy and overvaluation of coins they solved this problem. Silver sommo, weighting 60 dirhams, cost 120 dangi under Djanibek when the dangi were minted by half dirham. They estimated sommo at 140 dangi in 1370–1380s, because the coin changed its standard weight to the 3/10 of mitkal (Ponomarev 2009 595–612). And there were earlier, as we can see other elegant solutions.

It is possible to state now that the purpose and the result of the financial innovations, carried out by Toqta-Khan, was the introduction in the Volga region of the coin, identical by the purchasing power to the baricat, struck near the Black Sea from the times of Nogay and Chaka. One has to appreciate his desire to uniform currency by the standard, born in the region of his empire, which had the most developed monetary system. As the documentary evidence of this uniformity one can take the words from the Genoese-Trebizond treaty of 1314: «*implicatus fuerit in aliqua peccunia Imperii domini Imperatoris Usbech ad asperos baricatos*» (Desimoni 1877–1884 525)²². The translation of the Latin word «*aliqua*» can be «some» or «any». The first variant suggests that imprecise juridical term had found place in the juridical document, as well

¹⁹ Selling the silver sommo bars in Azak the merchants balanced their weight with coins. This practice means that the price of silver in bars was equal to the price of silver in coins. The standard alloy of sommo, according to Pegolotti, was 11 oz 17 den. (976‰), but silver in coins was overvalued by 6,3%. To achieve the balance of values, coins had to be produced from silver with lower alloy (about 97,6‰–6,3‰=91,3‰). So I should consider the simplest composition — alloy equal to 11 oz.

²⁰ This figure derives from the proportion 7 to 10 between dirham and mitkal. I take dirham as the generic equivalent of 1/100 of the late Roman-Byzantine pound, equal to 327,45 g, so the weight of the mitkal is to be 4,6779 g. If someone prefers the weight of mitkal, deducted from measuring of the medieval weights — 4,68 g, the Roman pound is to be 327,6 g.

²¹ This alloy of silver was the standard not only in the Golden Horde. «*La zecca torrisina dà d'ariento di sua lega, cioè di tenuta d'onze 11 e denari 17 d'argeno fine per libra, aspri 190*».

²² Archivio Storico di Genova. San Giorgio. Materie Politiche. Trattati e Negoziazioni. 2727, fol. 12v.

that the Genoese mercantile diplomats were indifferent to the core of trade. In the second case the expression «in any coin of the Uzbek Empire» means that the most interested participants of the Black Sea trade had the exact knowledge about parity of different Tartar coins.

Metrology of coins issued with data 710 H. and survived in the hoards was hard to explain earlier. Now it confirms the equality of the dangi and the baricat as well a desire to equalize currency in both parts of the state. Weights of these dangi in the hoard from the Selitrennoe site (**fig. 10**) makes evident that the sample breaks up into two groups with modal weights differ by 0,187 g. This difference seems to justify a popular believe that there are «large» and «small» dangi of Toqta. In reality this is the consequence of clipping affected many of the Toqta's coins. When has this clipping happened and what was the cause? The coins of Djanibek-Khan and Uzbek-Khan in the hoard have only one modal weight in distributions, so the clipping has nothing common with their dangi. This means that clipping happened in times of Uzbek. It was performed to equalize the value of the current dangi of Toqta with the nominal value of the new baricat, weighting 0,975 g (202 from sommo, but more precisely — 48 from 10 mitkals). The silver content of the new baricat was reduced by 1/6, and one could expect that dangi, issued by weight 1,572 g, had to be clipped also by 1/6, by 0,262 g. However, the current modal weight of the unclipped issue is 0,18 g less than the standard weight 1,572 g due to wear of coins and chemical cleaning. Thus, we are able to calculate, that the coins of 710 H. were clipped by a little bit over $1,205 + 0,18 = 1,385$ g, because these clipped coins have circulated less than unclipped. I think that the standard of clipping was 1,403 g, only 0,169 g instead of 0,262 g were clipped, because after the reform dangi of Toqta-Khan lost their overvaluation, equal to 6,3%, and clipping took the fact into account.

The almost complete figures pertaining to the coinage of Toqta-Khan were obtained grace to the stare study of 218 coins only. These figures let us to characterize the currency of the Golden Horde in the absolute values. The relative amount of the currency (38 dies) will become an absolute value, if we are able to detect minting capacity of a die. This capacity was determined by the lifetime of the die and the average speed of coinage. We may divide those three years 710–712 H. by the number of dies used, to get 39 days as the average lifetime of a die. However this figure in most cases is to be wrong. It would be correct just in case, if any moment there was at the mint only one pair of dies in use. But what if there were two strikers and two pairs? Or may be three? Should we prolong the lifetime of the dies by two or three? If it is possible to determine the number of the workshops to estimate the lifetime? Surely.

The total number of the obverse and the reverse dies calculated above (27 and 40) demonstrates that the reverse dies outwore 1.5 times faster than the obverse dies. This proportion determines that during the gradual replacement of the outworn dies there would appear at the mint with one workshop $27 \square (1,5 + 1) = 67$ combination of the reverses and obverses²³. The number would double if there were two workshops. The real number of dies' combinations for the coins of 710 H., present in the sample of 218 dangi, is equal to 88. This number is above the needs of one workshop. Hence, the average number of workshops at the «Saray al-Makhrusa» mint during 710–712 H. is to be determined as $88:67=1.31$. Now, using this figure, we are able to estimate the lifetime of a Tartar die — $39 \square 1,31 = 51$ working days. With a free day once a week (let us think of Friday) an average die outwore in 60 calendar days.

Another necessary parameter, speed of coinage, depended greatly on accuracy. To strike good they had to strike twice, to strike the full die they had to position a blank precisely and to

²³ This formula, linking the number of combinations with the proportion between the obverses and reverses, was found due to the computer model. Productivity of dies is submitted to a binomial law, thus random extraction from the binomial distribution provides us with the model of the minting practice.

spend extra time. These peculiarities of coinage, however, have no relation to the Toqta coins. While 7% of the Byzantine silver coins have traces of the double striking, only 2 dangi from 218 were struck twice by accident. Besides, the Tartar mint masters took little care to position the blanks evenly. As a result almost every coin was struck with some half of the die. These are the reasons, why we have to compare the productivity of the Tartar workshop with that known for the European petty coinage. For example, at the mint of Venice a worker had to produce 3360 piccoli in a winter day, i. e. 7 coins per minute during 8 hours (Stahl 2000 174, 347)²⁴. The irregular presence of the second workshop at the Tartar mint tells us that it was impossible to increase production in other way. The Venetian mint regulations specified also the minimal speed of coinage. During a year the man in the average had to strike 1740 grossi per day, or 3 coins per minute. Even if we take this minimal figure we have to come to conclusion that a Tartar die was able to produce 90 thousands of coins. Even this minimal figure is three times above the figure, which the numismatists are ready to accept as productivity of a European die. The productivity of the Tartar die has doubled because they strike it only once; it grew more because only half of a die suffered while striking.

Now it is possible to measure the shape of the Golden Horde currency in absolute figures. Since the relative value for the Volga region was 38 dies, the market consisted of about 3.4 millions of coins. The average mint production reached 900 thousands of dangi per year and took a little bit under one tonne of silver. These figures can be multiplied by 2.3 if we prefer the speed of coinage, characteristic for the Venetian piccolo. However those dangi were not the only money in use on the territory of the Golden Horde. The circulation of silver bars (Italian «sommo», Tartar «sum», Russian «rubl'») is well-known thank to the notarial documents, the hoard finds or writings of the travelers. It is hard to establish the balance between two instruments of payment. We can wonder now if irregular coinage of the early 14th century means that the dang played the secondary role in the circulation. The development of the financial system of the Golden Horde in 1320–1330s resulted in the increase of the monetary fund and the introduction of the copper coins stress and confirms this process.

The full-scale study of a single coin type put away the ideas of the past; it raises, however, new questions, which can be solved with the implementation of the quantitative methods and a scrupulous numismatic research.

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²⁴ A worker struck 2160 grossi in summer, 1440 – in winter, and 1680 – in spring, and evidently, in autumn.

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