MYSTERIOUS ALLOYS IN EARLY MUSLIM METALLURGY ON THE *ṬĀLĪQŪN* AND THE *HAFT-ǦŪŠ*

Bence Fehér

Pázmány Péter Catholic University, Budapest

In early Muslim science several metals or alloys were known (or at least referred to), the names of which are very hard to identify now, and we do not know with certainty of any objects made of them. Perhaps the most obscure of those is the so-called *ṭālīqūn*. Lakpour identifies it expressly with white bronze[1]. He quotes some Persian sources too, which identify the *ṭālīqūn* with the material called *haft-ǧūš*. Allan says that it is identical with *ḫāraṣīnī* and the Chinese mirror alloy[2].

The Arab source which writes about the *ṭālīqūn* most clearly is al-Bīrūnī's *Ǧamāhir* from the years after AD 1040. al-Bīrūnī's words deny the connection of the *ṭālīqūn* with white bronze. He gives some very concise, or rather defective information about the *ṭālīqūn* (al-Bīrūnī, *Ǧamāhir* 267):

ON THE *ṬĀLĪQŪN*

"There has already been a mention of the *ṭālīqūn* in this book due to its watery nature[3], but its peculiarities were not explained, and I am not able to define it with the support of seeing or hearing. It is said in the Book of Medicine[4], that pincers made of it, when pulling out the hairs grown by the lashes, prevent the return and stops the growth of those. It is also said that the eyes get ill and weak when looking into a mirror made of *ṭālīqūn*. It is said in the Book of Selected Pieces that it is made of brass, in the Book of Stones, that it is a kind of copper save for the fact that the ancients gained a sorely venomous drug from it, because it acts violently with flesh and blood when mixed with them[5]."

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[1] Lakpour 1997:135–134. He quotes the *Borhān-e-Qāteʿ* by Muʿīn Dehḫodā, and we can add al-Qazwīnī too; see the following quotations.

[2] Allan 1979:51. Belenitzky gives a source on it (*Ayīn-e-Akbarī*, quotes Belenitzky 1963:489): "If they do not find *ḫāraṣīnī*, they make an alloy of six metals. Some call it *ṭālīqūn*, but some rather call the *ṭālīqūn* 'artificial copper'".

[3] Explanation of this word is dubious: either it refers to liquidity, or to the melting of the metal.

[4] There are several books known titled *Kitāb aṭ-ṭibb*, translations of antique works (Galenus, Rufus Ephesius) as well as new ones. Remembering that al-Bīrūnī was especially well acquainted with the life-work of ar-Rāzī, it is a most likely presumption that this is one of his many medical treatises, maybe the *Kitāb aṭ-ṭibb al-mulūkī*, which he quotes in the *Kitāb aṣ-ṣaydala* too.

[5] It is a book of Abū Ǧaʿfar Aḥmad b. Ibrāhīm al-Ġassār, a scholar of Qayrawān (d. 979). It is the only locus in al-Bīrūnī's *Ǧamāhir* which witnesses that he knew works of authors of the Maġrib. The great importance of it is that it proves that *ṭālīqūn* was no Eastern Iranian speciality, or rather that in the 10th century they had some knowledge of it in the West, but in the East only ar-Rāzī had heard of it and even

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Based on this description, *ṭālīqūn* is no difficult copper alloy at all (anyway, an alloy made of seven metals seems to be a fabulous creature). If it can be identified with any existing material, then it is mercury, or rather the amalgams of it!

Csaba Horváth, a metallurgical expert, whose kind assistance has contributed much to the explanation of the sources, says the following words concerning this question: "Unctions of mercury have been in use for a long time for depilation, and its compounds are poisonous. The mists of it are no less poisonous; it is a well-known fact that it causes mercury poisoning. A newly amalgamated mirror may cause an acute mercury poisoning too if somebody looks at himself too much."

The later sources are partially contradictory, but I see no great importance in it because on the one hand they have clearly not enough information concerning this question, on the other, they contradict among themselves too. The only scholar writing on it in a bit more detail is al-Qazwīnī in the 13th century[6]. He defines the material rather differently, yet its peculiarities are conspicuously similar:

> "*Ṭālīqūn*: it is copper to which drug is added[7] till it is stiff. It is called *haft-ǧūš* in Persian. They say that a kind of blade is made of it; if an animal is hurt with it, it has a very violent effect. Aristotle says it is a kind of copper, except that a dry drug is added to it so as to make it have a very poisonous effect. If an animal is hurt with it or it is mixed with its blood, it acts very violently. Hooks are made of it for catching strong fish, because the fish cannot escape from it when it has bitten it, not even if the nature of the fish is strong and the hook is little, because there is a strength of pain in the *ṭālīqūn* due to its venom. If one afflicted with the paralysis of the cheek nerves goes into a house where he cannot see any light, and looks into a mirror of *ṭālīqūn* steadily, he will be delivered from the paralysis. He who melts the *ṭālīqūn* into pincers and pulls out hairs with it in the sunshine, the flies do not get close to him. He who makes pincers from *ṭālīqūn* and pulls out hairs with it from whichever of his members several times, the hairs will never re-grow on that place[8]."

This text does not rely on al-Bīrūnī's one, there is only one common element in them, the use of pincers, in a different wording. There can be a very simple cause for it: he quotes not from al-Bīrūnī, but from another *locus*, for example the above-men-

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his data are of a fable-like nature. Therefore there is no reason for accepting Allan's opinion concerning the identity of this alloy and the mirror alloy or *ḫārasīnī* – save for the possibility that the material was called in the East *ḫārasīnī*, in the West *ṭālīqūn*, and al-Bīrūnī did not know the identity of them.

[6] al-Qazwīnī, *Āṯār* 230. The second edition of this work was finished by the author in 1276 (*ibid.* VI).

[7] Drug or powdering: a technique for bettering the quality, when the rude metal is powdered with the dust of some mixture and hammered together (the technique is described by al-Bīrūnī, *Ǧamāhir* 256, 13-18.

[8] The last two sentences must be corrupted because they contain a meaningless reiteration. Presumably pincers and the pulling out of hairs were mentioned originally only in the second sentence, and there was another method of hindering the flies, which was lost from the text. There is a reiteration in the beginning of the text too: after al-Qazwīnī's own summary the same are said attributed to Aristotle. I think he used more than one source that said almost the same things, and apparently he did not know the alloy from his own experience.

tioned (unidentified) Book of Medicines. Though he makes a contrary statement on the mirrors, in fact the text speaks about the use of the exhalations of the mirror, giving some examples of its serious poisonous effect, and these examples were not known to al-Bīrūnī at all. It is important that there is no object in the broad list of the instruments made of *ṭālīqūn* of which we would know any white bronze examples (and verily it would be a rather curious thing, a hook made from the stiffly breaking white bronze), and on the other hand he does not mention any type of objects of which we know many white bronze examples. This fact, added to its poisonous character, disproves the identification with enough certainty. Nevertheless its identity with *haft-ğūš* is stated clearly, and therefore it can be regarded certain too.

But the speculations concerning *haft-ğūš* refer to an alloy, and, moreover, the use of mercury could not be performed otherwise but amalgamated – maybe two alloys unknown to the authors were simply identified. The statement of the *'Ayīn-e-Akbarī* that it is a special alloy identical with no other one but similar to the *ḫāraṣīnī* (which is likely to be the zinc) is easy to explain: on the basis of the colour of the mercury amalgams.

The greatest obstacle to the definition of *haft-ğūš* is its name, a very fabulous feature. No one can believe it was really mixed from seven materials, at least not from those seven ones the Persian encyclopaedias mention (gold, silver, copper, zinc, iron, lead and tin) (Lakpour 1997:135). It is simply an anecdotic description of the ideal metal. The hypotheses of Lakpour of an alloy seven times re-melted is more acceptable (*Ibid.*, 134), but it would be a useless procedure with an amalgam and even a highly dangerous one for the health. We must say that till we know some real objects made of *haft-ğūš*, the reason of this name must remain obscure[9].

Other mentions of mercury and amalgams

It is not at all comforting as for the identification of *ṭālīqūn* and the amalgam that in the early Islamic era mercury was surely well known and widely used (Allan 1979: 8), and even a metallic stuff of solid state was referred to with the name of mercury (*zābūq*) – evidently some alloy of mercury[10]. According to al-Bīrūnī's data there are two uses of the solid metallic mercury alloy: the makers plate coins and weights with it[11]. This technique is not impossible, disregarding any other data, because it is a known technique for money forgery to plate the coin made from a valueless material

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[9] *Mutatis mutandis*, we must say the same about the name of the *ṭālīqūn*. Lakpour (1997:134) quotes Dehḫodā, saying that "*ṭālīqūn* is the Roman name of *haft-ğūš*". As far as I know no other source tries to explain the name. Yet this word cannot be derived either from Greek or from Latin.

[10] Belenitzky 1963:216. *Muzabbaq* is a false dirham with mercury on its surface.

[11] I suppose so because the name of these weights is *muzabbaq*, too. The material of the balance weights is not mentioned *expressis verbis*.

with gold or silver amalgam, and afterwards the expelling of the mercury with glowing heat. So did *subaerati* coins originate. *Muzabbaq* dirhams are mentioned sometimes as false, sometimes as regular coins in circulation in Mecca. Yet in reality we cannot prove the existence of such coins: the standard numismatic catalogues do not know either a peculiar Meccan coinage or *subaerati* coins from the early Islamic era[12]. Naturally there was some activity of money forgery in that time, and some (very concise) technical description of it was preserved by al-Hamdānī, about AD 940[13]. This description refers to a fundamentally different technique used to forge dinars, the main point being excavating the coin, removing the inner part of it and filling the hole with antimony or lead oxide. He mentions especially that this filling can be removed from the gold with hammering. Yet, with a hardly intelligible wording, he mentions the mercury gilding: "If one places mercury on the gold coin, he makes it glow on the fire of charcoal, polishes it with sand and makes it glow again." (al-Hamdānī, *Ğawharatayn* f.81.b. /LVII/) It is not said in the description that they were *subaerati, i.e.* false ones, but there is no other technological reason for the procedure of making them glow, and therefore we can be sure of it.

We do not know of instruments made of amalgam, only of the said commercial tools (coins and measuring appliances), but even they could not be frequent, or else we would have several examples of them.

The origins of this type of objects are quite obscure. We do not know of amalgamate coins from the Sāsānid era either[14]. It seems that this type originates in the Caliphate. The localisation of it into Mecca is another peculiarity. On the one hand, the separation of Mecca from other parts of the Arab lands is hard to understand – one cannot accept a dating of this type before the self-reliant Arab coinage of the Caliphate, though the text itself would not contradict such a theory[15] –, on the other, it is dubious whether the necessary amount of mercury could be obtained in Mecca, or it would be an economic irrationality, because there are authors who say there was no mercury mining but in al-Andalus and there are other ones who mention

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[12] The catalogue of Mitchiner does not contain Meccan mints from the era of the Caliphate at all!

[13] al-Hamdānī, *Ğawharatayn* LVII. This work is easy to date because it is mentioned in the other work of the author, the *Iklīl* written in 331/943, so it had been composed in the years before. (*Ibid.* 10.)

[14] Mochiri (1977) publishes some bronze coins (Nos. 22. 62. 334. 650. 757. 1111. 1113. 1115–1120. 1123. 1124. 1170. 1171. 1360. 1388. 1468–69) and some lead ones (Nos. 1122. 1469), but nothing else but dirhams and dinars. Naturally one may suppose that some examples are incorrectly registered for gold/silver coins, but we can hardly presume that the greater part of these false ones was made so expertly that modern numismatics was not able to discern them.

[15] It is said, "They were in circulation not long ago", but it is not strictly connected with the time of minting, and the amalgam coins which are of hard material and of narrow circulation might have been in use for a long time.

Ādarbayǧān too, and no other place[16]. Some relevant sources do not mention mercury and its provenance at all[17]. al-Bīrūnī says nothing about the provenance of mercury, but he was an expert of Eastern, Iranian or Indian, geographical data. Anyway, there had to be only a few and far-lying provenances of mercury, or else such fabulous and contradictory tales as written by al-Hamdānī could not circulate (*Ǧawharatayn* f.65.a). He regards two possibilities as equally likely, i.e. that there are self-reliant mines of mercury, or that it exists in the silver mines in the form of stalactites (!), or rather he mentions a wholly absurd story, according to which some people clad in red make a solemn procession, and its effect is that mercury arises from the earth all by itself, the required amount of it is cut from it by a sword (this implies that he thinks of a material of solid state, most likely mercury ore, that is *zinnabar*, which is in good accord with the red robes of the actors of this procedure), and afterwards it founders again. Naturally even he holds this story for a tale, and cites Abū l-Ḥasan an-Naqqāl al-Baṣrī (otherwise unknown), who tells a similar story about diamonds, commenting that in reality diamonds, gold and mercury are products of mines. I think it impossible that if the said mercury mine in Ādarbayǧān had existed in the time of al-Hamdānī, such legends would have received credit in ʿIrāq or Western Iran.

The sources know about mercury gilding (Allan 1979:8), and other goldsmith techniques made with mercury too, for example penning-out[18]. It is not a well-known fact that it was used for silver-plating and silver-washing too (Belenitzky 1963:216–217, Rohr-Sauer 1939:24). As generally every metal, mercury was introduced into medicinal usage, though (or even because) its poisonous effect was well-known, but naturally it caused either the recovery or the death of the patient[19]. We know of no other use of it, but even these ones might produce a considerable mercury industry, even though various stories concerning the forgery of mercury, its extraction from lead, seem exaggerated[20]. Amalgamation for the making of instruments seems

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[16] Cf. Belenitzky 1963:478, note 3. (According to Ibn al-Bayṭār.)

[17] Though al-Qazwīnī speaks of the mercury very likely under the name of *ṭālīqūn*, he does not mention the mines of it.

[18] al-Bīrūnī, *Ǧamāhir* 240: "There are places at the sources [of the Indus river], where holes are dug into the bottom of the river, over which the river runs, and these holes are filled with mercury. They return to the place one year thereafter, and then the mercury is saturated with gold. This happens because the water is rapid in the upper reaches and brings tiny scale-form gold grains with it ... and transports them over the mercury surface, which retains the gold and lets the sand go."

[19] al-Hamdānī, *Ǧawharatayn* f.65.a. It was a medicine for colic.

[20] al-Bīrūnī, *Ǧamāhir* 260: "I was informed that a man in Balḫ produced mercury from lead, he extracted one part from every five, and he provided the whole region with it." One thing is certainly proven by the story: In that time there was a considerable gold and silver industry, but obtaining the amount of mercury required for it caused some problems. It is in accordance with the rarity of the mercury quarries.

to have played a comparatively very little role, relying either on what we know about the use of *ṭālīqūn* or on the dubious mentions of coins and weights. Their number had to be small enough, as is proven by the fact that no single example of them was preserved.

Other false identifications

The alloy comparatively closest to white bronze is the so-called mirror metal, an alloy of tin and copper the use of which spread from China, which contains even more tin than white bronze, ca. 30% or more (Melikian-Chirvani 1974: 124). Naturally, the separation of these two materials is sometimes a hard task, as far as concrete objects are concerned. The conclusion might emerge from this fact that the origins of both alloys are the same, which is to say that the Iranians would have learned white bronze making from the Chinese. A support for that conclusion is that there are Persian sources which name white bronze as "Chinese copper" (Allan 1979:49). Yet our sources mention Chinese mirrors, but they do *not* identify them as white bronzes, but as an alloy of *ḫāraṣīnī* (zinc?) and tin, or as pure *ḫāraṣīnī*[21]. On the other hand, we know some real white bronze Chinese or Chinese-like objects[22]. I think the name of "Chinese copper" is nothing but a false identification; it was applied originally to the mirror metal; such a confusion might arise easily because the real mirror metal was mostly unknown in the Muslim world from the 10th century – the typical Muslim mirrors were made of bronze[23].

The mirror metal, becoming rarer and rarer, and even some other rare and legendary kinds of metal, were mostly confused with the metal called *ḫāraṣīnī*. (In modern Arabic it means zinc.)

al-Bīrūnī names three places as the provenances of *ḫāraṣīnī*: China, Kashgar and the region of the Issyk-Kul. Only a half-sentence of his is the base for the presumed identification with the Chinese mirror alloy: "it is similar to the Chinese mirrors"[24]. Yet, as far as al-Bīrūnī knows, the stuff of the Chinese mirrors is not pure *ḫāraṣīnī*, but mixed with tin (al-Bīrūnī, *Ǧamāhir* 262,6–7). If we believe it literally, we must say *ḫāraṣīnī* is nothing else but copper!

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[21] al-Bīrūnī, *Ǧamāhir* 262,6–7: "It is said that they mix *qalaʿī* tin [Malayan tin] with it and it is the material of Chinese mirrors."

[22] Melikian-Chirvani 1974:fig. 12. (A white bronze cup from the 8th century?)

[23] Cf. Brosh 1986: figs. 1–6., Pugachenkova 1961:155 (the mirror of the Harari collection and a mirror found in an excavation at Termez, Turkmenistan), Museum of Islamic Art, Tehran Inv.Nr. 3472., Museum of East Asian Art, Budapest Inv.Nr. L.52.59.

[24] Allan 1979:51. Another name for the material of the Kashgarian bells, *ḥadīd ṣīnī*, has no connection with it.

It is hard to accept al-Bīrūnī was so inexperienced with it. Nevertheless, it is clear that *ḫāraṣīnī* does not always mean the same thing; its meaning varies according to regions. An evidently different, arsenic-like natural alloy is mentioned from Zābulistān: "There are stones in Zarūbān, Zābulistān, called *murdāsanǧ*. These are of a different shape, like a black thing coloured with yellow, like arsenic. It is melted and poured into such moulds as those of the amulets or plaits[25] of the Indian women; it is called *ḫāraṣīnī*. It is similar to the Chinese mirrors, mostly there is the blackness of iron therein" (al-Bīrūnī, *Ǧamāhir* 262,8–11). Otherwise *murdāsanǧ* is a lead compound (lithargyrum).

Evidently there was a kind of comprehensive knowledge regarding *ḫāraṣīnī* in the ᶜAbbāsid era; even the said centres of production (wherefrom it was imported, though only in a small amount) could be connected with different techniques and types of objects: it was used in China for "elegant and fine" things, maybe (also) mirrors, in the Issyk-Kul region for cauldrons, and, as al-Bīrūnī says, "vessels at the utmost stage of ugliness". Its production in the regions of Kābul[26] and Zābulistān certainly refers to a different material. The Eastern metal merchandize seems to have disappeared at the beginning of the 10th century, since in that time they were no more able to define its character, and there was at least one significant author (ar-Rāzī) who declared it non-existent (al-Bīrūnī, *Ǧamāhir* 261,11–14):

> "Muḥammad b. Zakarīyā[27] says it is similar to the Chinese mirrors, but it does not exist[28]. This lack of it is connected doubtless only with our countries, and if it existed not, there would be no similar thing either, but it would be a pure name, like the gryphon, the *ġabrāyil*[29] or the *awā*. It is said in the Book of Selected Pieces that tin resembles it in terms of colour and melting."

The *ḫāraṣīnī* of the Kābul region is an identifiable alloy. Csaba Horváth says: "It is most likely that the *ḫāraṣīnī* is zinc. It is a commonly known fact that zinc is stiff and breakable at normal temperature, but it can be shaped at a temperature of 150 to 200°C. Over 200°C it becomes rigid again, so that it can be grinded to powder.

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[25] It can be understood in various ways: plaits of hairs, or braids of cloths, or maybe decorations of plaits?

[26] The same locus speaks of a tin-like glassy (?!) metallic material produced along the Karān (it is a little river north from Kābul, on the Southern borders of Badaḫšān). It seems to be not the Chinese or Kashgarian, but the Zābulistān kind of metal.

[27] Abū Bakr ar-Rāzī (AD 854–925/935), a philosopher, physician and alchemist from Rayy. He wrote very abundantly, so it is practically impossible to check this declaration in his work. al-Bīrūnī knew his works very well, quoting them frequently (cf. note 4), and he collected ar-Rāzī's bibliography some years earlier (1036).

[28] Manuscript B of the *Ǧamāhir* reads: "it is well known". But this chapter of Manuscript B is seriously corrupted, and the proposed reading is less logical than that of the other two manuscripts.

[29] Manuscript B: *ʿizāyil*, Manuscript S: *ʾansābil*. These are mythological beings too, like the gryphon.

It is unlikely that they could alloy it with tin and so make mirrors thereof, because zinc dissolves tin only in a very restricted quantity in its solid state." We cannot identify the *ḫāraṣīnī* of Zābulistān. The identification with the mirror alloy is a simple error of some 10th century source of al-Bīrūnī's.

The broadening of the meaning of this word did not stop at that. Later readers might have been excited by the dubious nature of the stuff, because the manuscripts are adorned with marginal glosses which try to explain the text with the aid of ar-Rāzī's and Ǧābir's words. One of them (Manuscript S) says: "The astrologer sheikh Abū Bakr b. Dalāl told me that this material is the *zahī* (glittering, bright) used[30] in the saltpetre industry. It is strange in the text of ar-Rāzī that it cannot be found near his country." (Abū Bakr is a person evidently different from ar-Rāzī, but unidentifiable, because we know about several astrologers with this name, yet the name of Ibn Dalāl is unknown.)

Confusion of *ṭālīqūn* and *ḫāraṣīnī* became a constant phenomenon: al-Qazwīnī (in the 13th century) practically repeats the information given on the *ṭālīqūn*, when speaking of the *ḫāraṣīnī* [31], yet he quotes it not from the same source but from a more concise one. Maybe the obscurity of the word was enhanced by the fact that there was another word for zinc too, used in the brass industry, that is the most relevant use of zinc from the 11th century: *tūtiyā*.

Presently we know no object from the early Islamic era which can be regarded with certainty as made of *ḫāraṣīnī*, or zinc.

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[30] *Textu editionis correcto*: تستعملها

[31] al-Qazwīnī, *Āṯār* I 201: "Its provenance is like that of the above-mentioned materials, its mine being in the country of China. Its colour is black inclining to red. All weapons made of it are very dangerous. Hooks are made of it for catching strong fish, the fish cannot release itself when it has bitten it, but forced. Mirrors are made of it, used by people afflicted with paralysis of the cheek nerves, sitting in a gloomy house and looking at it steadily. It is the most useful medicine for cheek neuralgia. Pincers are made of it for pulling out the hairs and the spot in which they had grown are smeared several times, and then the hairs do not grow again." On the basis of its colour, this description refers to the most important ore of mercury, *zinnabar* (HgS). We can also see that an unction was produced from it too.

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