Published: December 15, 2006
Last Updated: March 30, 2012

IRON IN EASTERN IRAN

IRON IN EASTERN IRAN. The Iron Age (q.v.) started in eastern Iran later than it did in the Near East and western Iran, where its beginning is dated to the middle of the 15th century B.C.E. (Dyson, pp. 193-217). This was due to the fact that, in Central Asia, copper deposits were more widespread than iron deposits, and tin deposits also were available and mined. A developed bronze metallurgy had perfectly provided the demand for metals, especially since the manufactured iron was softer than bronze. Nonetheless, acquaintance with iron products from areas to the west and availability of sufficient iron deposits in various regions of Central Asia (mountain ranges around the Farḡāna [q.v.] valley, mountains of the Hissar [see ḤEṢĀR] belt, etc.) led to the development of local iron metallurgy.

Ancient iron objects in Central Asia were found for the first time at the southern mound of Anau (Turkmenistan) by the expedition of R. Pumpelly in 1904; fragments of an iron sickle and an iron knife were unearthed there. According to modern understanding, these objects should be dated to the 9th-8th centuries B.C.E. Together with some other findings, they give evidence for the availability of iron products that probably had appeared for the first time much earlier. The Iron Age reached its developed phase by the 6th-4th century B.C.E. Iron objects for mainly household purposes, such as knives, sickles, needles, etc., were uncovered at the sites of the ancient settlements of Parthia and Margiana (e.g., Yazdepe, Elkendepe), Bactria [q.v.] (e.g., Qalʿa-ye Mir, Qyzylcha, Taḵt-e Sangin), Sogd (e.g., Daraḵš Tepe, Afrasiāb [q.v.]-Samarqand, Lalazār), and Farḡāna (e.g., Dalbarjin [q.v.], Aktam). There were

also weapons made of iron, but such findings at ancient settlements are only represented in the collections from the Temple of the Oxus (Takt-e Sangin). Artifacts of the nomads (the Sakas) of the 6th-4th centuries B.C.E. include many examples of iron weapons. For example, Pamiri burial grounds contain iron-bronze daggers of two types: (a) those with an iron blade fit into a bronze handle richly decorated in the Animal Style; (b) those with an iron blade, an iron handle tightly covered with bronze leaf, and a bronze crossguard. The great majority of the daggers of the 6th-4th centuries B.C.E. were made of iron. From the burial ground of Tagisken are also known long iron swords with gold foil on the hilts with Animal Style motifs. Iron battle-axes, arrow points, and other items have come down in wide ranges. Defensive armor was made of iron as well (Litvinskiĭ, 1972, pp. 100-130; idem, 1984, pp. 27-51, 98-133; Vishnevskaya, pp. 96-99).

Extraction of iron ore, smelting, and manufacturing of iron products rapidly increased in the Kushan (1st century B.C.E.–3rd century C.E.) and the Hellenistic (end of the 4th century to the 2nd century B.C.E.) periods. We hardly have any real data about iron mines at that time and about iron production, but some urban centers have preserved traces of such activities. One of them is the city of Termeḏ (Uzbekistan), where a “quarter of metalworkers” of the Kushan period has been found. Investigation has turned up more than a ton of bloom iron, which indicates that here either the ore was transformed into blooms, or that the bloom was turned into commodity/marketable iron. This is an indication of the puddling type of manufacturing iron that was practiced in the mountains of Central Asia until the first quarter of the 20th century.

No matter how paradoxical it may seem, ancient peoples produced iron without melting it properly, since they could not reach the temperature of 1539° Centigrade in their primitive bloomeries. The bloomeries were loaded with finely crumbled iron ore mixed with charcoal. The burning of the charcoal produces carbon monoxide, which is heated, ascends in the furnace, and chemically reacts with the ore. As a result, carbon oxide in the ore deoxidizes into metal iron. At the same time, the rock of the ore becomes liquid slag. Separating from the metal, it pours to the bottom of the furnace. The granules of iron, deoxidized during the burning of the charcoal, descend towards the lower part of the furnace and stick together into a clumped mass (the bloom) that still contains separate pieces of slag. Metallurgists have established that the temperature of 900° Centigrade is sufficient for the

deoxidizing of carbon oxide, while liquid slag is formed at 1030°-1130° Centigrade. Separate granules of iron stick together into a bloom at 1300°-1400° Centigrade, which could be achieved in the furnaces of that type. The whole process is called puddling, because the furnace is blown not with heated air, but with normal ("dirty") air (Litvinskiĭ, 1954a, p. 37, with bibliog.). Usually, the blooms had the shape of a round or oval, convex-concave "flat cake," more massive in its central part. Further operations with these blooms are only known for the Middle Ages (see below), which quite likely were, in principle, the continuation of a similar practice in ancient times.

Literary sources provide some data. The report of the Chinese envoy Chang Ch'ien (2nd cent. B.C.E., about the country of Ta Yüan (present-day Farḡāna) mentions that "when some deserters from the retinue of a Chinese embassy had settled there as subjects, they taught them how to cast weapons and utensils other than that they already had" (in Hirth, pp. 108-9). Modern Sinologists prefer a text variant which mentions only utensils; they consider these to have been made of iron (Hulsewé, p. 137, n. 148). Indeed, as bronze-founding production had reached a high level by then, it is hard to imagine that the text deals with copper rather than iron (or cast iron?).

At a much later time, in the epoch of the Chin dynasty (265-419 C.E.), Chinese texts from Sinkiang mention *hu t'ie* "iron of the *hu*" (Laufer, p. 202). It is not quite clear what the term *hu* refers to, but it is considered to have been a generic designation for the northern and western nomads, probably meaning Central Asian iron.

At the battle of Carrhae (53 B.C.E., q.v.), "the Parthians, all of a sudden, threw off the covers from their armor and appeared before the enemy like flames of fire, in helmets and armor made of glaringly shining Margian steel, their horses being in copper and iron armor" (Plutarch, *Crassus* 23-24). There are no iron mines in the oasis of Marv (called Margiana in ancient times) or anywhere else in all southern Turkmenistan. It is unlikely that raw iron stock was brought to Marv from mines located at long distance to the east of the Oxus river (see ĀMU DARYĀ). One would rather presume that the raw materials were imported from the region of modern Mashad, which was famous for its iron already in the Middle Ages. In any event, archeological excavations at Marv revealed a workshop of the Parthian period, which had melting furnaces and residues of copper and iron slag. Here and at other places of the Marv settlement of Gyaur Kala, iron raw materials were found in the shape of iron blooms that are similar in size to the blooms from Termeḏ

and weigh 0.5 to 2 kg. Bloom iron was likewise found at Nesā/Nasā (Usmanova, pp. 173-74), Saraḵs, and other places.

The Hellenistic epoch and the Kushan period were the time when ironmaking production in Central Asia reached a very high level. This becomes clear from both the evidence of Plutarch and, mainly, from plentiful findings of iron objects at the sites of the settled population and the nomads. Thus, actual archeological proof of the availability of a highly developed weapons industry in Central Asia confirms Plutarch's evidence. Iron armor protecting the upper part of the body and the neck has been identified for as early as the 5th-4th centuries B.C.E. (Čerik Rebāṭ in the Aral Sea region), and a big set of iron plates for scale armor and dateable to the 2nd-1st centuries B.C.E. was discovered at Old Nesā. They were of excellent steel, probably of the same kind that formed the armor of the Parthian army in the battle at Carrhae. Plates and fragments for scale armor found at the Temple of the Oxus are more diverse. Iron cuirasses continued to be used along with scale armor. A large number of various arrow points have been found. During the excavations of the Temple of the Oxus alone, more than three thousand iron arrow points were discovered, together with many spears, darts/javelins, butts, daggers of assorted types, as well as other weapons, all made of iron (Litvinskiĭ, 2001). Many objects related to construction work and fittings were made of iron, such as nails of various length (2-3 to 30 cm), spikes, linings, yokes, and rings. Diverse artifacts and agricultural tools made of iron were also found at the Temple site.

Literary sources provide substantial information about the mining of iron ore and the production of iron objects in the Middle Ages, as the rare and not very definite information in the Chinese sources of the 6th-8th centuries is then supplanted by the more complete data contained in Islamic sources. For the period from the late 7th century to the first half of the 8th century, these report about the high quality and abundance of weapons, specifically those made of iron, used by Central Asian military contingents. Muslim geographers of the 10th century report about iron deposits and iron mining. Abu Esḥāq Ebrāhim Eṣṭaḵri (pp. 313, 334) refers to the mining of iron in the mountains of Farḡāna. The anonymous Persian geographical work of the late 10th century, *Ḥodud al-ʿālam*, mentions the region of Sorušana/Osrušana, from whose "mountains comes iron" (p. 110; tr, p. 115). In Fargāna and Osrušana, and, as revealed by the archeological data, in Šāš-Ilak and the Seven Rivers region, not only was iron mined, but also a developed production of iron objects existed.

High-quality iron objects and weapons were made in Marsmanda (or Arsmanda, in Osrušana), whose regular monthly fair attracted buyers from various regions and countries; and the smiths of Farḡāna excelled in their craft and made wonderful objects of iron (Ebn Ḥawqal, pp. 506-7; tr. Kramers and Wiet, II, pp. 484-85). According to Moqaddasi/Maqdisi (p. 325), military equipment, swords, and iron were imported from Farḡāna, scissors and needles from Šāš, stirrups and bridles from Samarqand, and padlocks and keys from Ḵᵛārazm.

Mining and processing of iron ore continued in the 11th-12th centuries. Moḥammad b. Najib Bakrān (fol. 14v) reported of the existence of iron mines in Osrušana at the beginning of the 13th century. Blacksmiths had their own quarters in many cities (e.g., Marv, Nišāpur), as mentioned in literary sources and evidenced by archeological finds (Belenitskiĭ et al., pp. 285-87). Sometimes, government dues in a city included iron weapons manufactured locally. Archeologists and geologists have identified a large number of ancient iron mines in the mountains around Farḡāna, in the mountainous ranges of Ilak, the Seven Rivers, and Soghd, in the mountain ridge of Hissar, and in Kugitang. The techniques of drifting (tunneling) and ore extraction in such mines have been studied in detail by M. E. Masson, and Boris A. Litvinskiĭ (1954a).

Upon being delivered to the surface, the ore was sorted, and the pieces enriched by iron were separated. The latter were then crumbled and baked together not far from the extraction site. The product was half-ready bloom iron (see also above), which was then sent to city centers, where a part of it, apparently a considerable one, was used by blacksmiths in manufacturing household commodities. The remaining portion was manufactured by crucible melting into high-quality iron, steel, and cast iron. Traces of crucible melting have been found in a series of city centers in Farḡāna, and in Termeḏ, Marv, and other cities (Feuerbach, Markol, and Griffiths; Papakhristu).

Production of high-quality ferrous metal in Aḵsikaṭ (q.v.), the medieval capital of Farḡāna, has been studied in detail. This city was one of the major centers of metallurgy and ironmaking in Central Asia from the 9th to the early 13th century. The furnaces in the city centers were fitted with bellows for air supply, which, together with the rational structure of the furnaces, could have provided temperatures of 1250° to 1500° Centigrade. The crucibles in Aḵsikaṭ had the shape of high (up to 40 cm) and narrow (diameter of 7-8 cm) barrels and were covered by lids with outlet holes for gas exhaust. Workshops for melting metal, many thousands of crucibles, and immense accumulations of

slag have been found in Aḵsikat. Remains of ironmaking production have been discovered in the village of Ravad in southwestern Farḡāna, but the details of production are not known. This center was in operation earlier than the one in Aḵsikaṯ (Papakhrisru, 1985; idem, 2000; Papakhristu and Swertchkow).

A workshop in another center of ironmaking in the region (in Marv) has also been studied. Here, a 9th-century workshop with two types of furnaces for producing crucible iron and a large number of crucibles were excavated. The latter were about 20 cm high and 8 cm in diameter, and were covered by a lid with a wide hole. Crucibles in both Marv and Aḵsikaṯ were made of special heat-resistant materials. Metallurgists maintain that, in spite of the similarity, different processes were carried out in the two centers. In Aḵsikaṯ, crucibles were loaded with iron ore (possibly bloom iron), charcoal, and dolomite as flux, and the process of reduction and cementation of steel took place after heating. In Marv, co-fusion was performed for iron of various degrees of carbonization, possibly for cast iron and for certain kinds of iron (Herrmann et al., pp. 10-13; Feuerbach, Markol, and Griffiths).

Sources contain information about highly developed ironmaking manufacture in Marv, Herat, Nišāpur, and other centers in Khorasan. Data on co-fusion manufacturing of steel in Eastern Iran is available up to the 16th-17th centuries. Both iron production and blacksmith activities took place in city centers, and judging by excavation results, early medieval Panjikant had workshops, in which both marketable iron objects were produced and blacksmith activities took place. In particular, there were workshops with special melting furnaces for manufacturing bloom iron. The bloom iron, however, was porous and had low concentration of metal proper. In small premises with one or two furnaces, a complicated technological process of converting the bloom iron into commodity/marketable metal took place. The blooms, with flux added, needed to be heated to a high temperature and forged in order for the slag to be separated from pure metal. High temperatures were achieved by charging the air through a two-channel nozzle to which two bellows were fixed. Use of the bellows provided continuous flow of air. Goat horns, frequently found in workshops, were evidently utilized in carbonization of the object surfaces or in the muffle type of manufacturing used for hardening and tempering. As a result, iron (in some cases steel and cast iron) was produced. The iron was then converted into smaller, marketable work pieces in the shape of rods with square cross-section weighing up to 250 g, or round cross-section weighing up to 100 g. Larger work pieces could have

existed too. Forge houses had one or two chimneys with two-channel nozzles, anvils of various types, conduits, and other forging tools, which were kept in special niches. Special pits with water were arranged for cooling and hardening of the manufactured products.

The evidence provided by Abu Rayhān Biruni makes it quite clear that, in the first half of the 11th century (and probably much earlier), various kinds of iron ores were known, and so were the various ways of melting them, such as by use of crucibles, together with diverse assortment of finished iron and steel, including damascene steel (*fulāḏ*; Biruni, tr. 1963, pp. 230-41, 1989, pp. 217-20). The volume of production was very large. Tools manufactured included anvils of several types, large and small hammers, nippers, mandrels, files, hatchets, adzes, axes, plowshares, spade blades, and sickles. A large amount of the available iron went for making weapons: points for arrows and spears, daggers, swords, battle-axes, maces, protective armor (of scale and chain-mail types), components of helmets, parts of shields, as well as many items of horse harness. As in ancient times, iron continued to be used in construction and in manufacturing of fittings. Padlocks and keys, various household utensils, including dishes (especially pots and kettles), knives, spoons, bodkins, scissors, and needles were all made of iron.

More detailed data are available for the later period beginning with the 15th century. In an illustrated manuscript containing a work by ʿAli-šir Navāʾi, which is preserved in the National Library of Russia in St. Petersburg and dated 928/1521-22, there is a depiction of a forge house (Galerkina, p. 228, fig. 4). The miniature painting in question was doubtlessly made in Transoxania and reflects early medieval realities. In the depicted forge house, there is a furnace of cubic shape, and a youth who, standing nearby, charges the air with two bellows. The master smith holds a heated work piece, just taken out of the furnace, on the anvil with the help of long pincers. Four men standing in a semi-circle around the anvil strike the work piece with hammers in sequence. On the floor, not far from the anvil, a basin (with water?) is placed, and so are a chest and some tools or other work pieces. Other depictions of forge houses have also come down to us (e.g., Institute of Oriental Studies, St. Petersburg, MS C1654, fol. 212). Narrative documents of the 15th to 17th centuries from Samarqand, Bukhara, and other centers inform that these cities had quarters of blacksmiths, whose products were traded at the bazaars. Numerous city smiths (*āhangar*) were ordinary craftsmen with limited scopes of specialization. A special place was occupied by weapon-makers. Those of

them who served for the court of a ruler worked in official workshops (*kār-ḵāna*) located inside the citadel, as was the case under Timur.

In the 15th–early 16th centuries, the main center of weapons production was Samarqand, while later, after the Shaybanids came to power and made Bukhara their capital, as well as under the subsequent Uzbek dynasties, the latter was the center of production. Iron was used for making parts of shields; and steel armor, often in the shape of the chain mail, was used to protect the body of warriors. Chain-metal protectors were fixed to helmets. Horse armor also was manufactured. Artisans specializing in swords (*šamširgar*) manufactured large quantities of swords and daggers. In the early 15th century, Ruy Gonzalez de Clavijo (q.v.) noticed (p. 174) that Samarqand master smiths could not harden the iron, and therefore the armor produced did not have sufficient durability and strength, but a century later Central Asian weapons were being exported to other countries, including the Moscow state.

As far as other artisans are concerned, the following specialized tradesmen were distinguished among them: knife-makers (*kārdgar*), fitters (*čelangar*), file-makers (*suhāngar*), needle-makers (*suzangar*), nail-makers (*miḵ-čagar*), horseshoe-makers (*naʾlband*), and many others. Cast-iron making is mentioned as a special occupation (*čoyangar*; Belenitskiĭ, pp. 43-47; Mukminova, 1976, pp. 106–11). Cast iron was most of all used for making pots and kettles and portable roasters. Steel objects are mentioned also, first of all, concerning weapon items (Belenitskiĭ, 1940, pp. 43-51; Davidovich, pp. 401-7; Mukminova, 1976, pp. 104-7, 114-26).

It is possible that iron pots and kettles started being produced in the 2nd century B.C.E. (travel of Chang Ch'ien, see above). The most ancient known pot from Central Asia was found by Boris A. Litvinsky, while excavating a 3rd-4th-century burial mound in the Farḡāna valley. In the 16th and 17th centuries, the making of cast iron pots was so widespread in many cities that quarters with names derived from the Tajik Persian *dēgrizi* (pot making) or *dēggaron* (*diggarān* "pot makers") were known up until the 20th century. Already prior to the Russian conquest, due to mass import of pots made in Russia, the amount of pot production had decreased, and the chief local product was cast-iron plowshares (Sukhareva, 1976, pp. 148-55).

According to Ẓahir-al-Din Moḥammad Bābor (pp. 38, 39) in the early 16th century, there existed turquoise and iron mines in the mountains around Farḡāna. In the beginning of the 18th century, the Russian envoy reported the

availability of “very fine iron.” But iron mining gradually decreased, and in the 18th-19th centuries, the ironmaking craft more and more used iron imported from Russia. Only in the mountainous regions of south Central Asia and the Pamirs, village blacksmiths continued smelting iron in primitive furnaces up until the 1920s (or even the 1930s). The folklore of the Tajiks and of the inhabitants of the Pamir mountains has preserved an extremely interesting cycle of beliefs related to iron, forge houses, and blacksmiths (Litvinskiĭ, 1954a, pp. 38-40).

BIBLIOGRAPHY

Ẓahir-al-Din Moḥammad Bābor, *Wā-qeʿāt-e bābori*, tr. Wheeler M. Thackston, *The Baburnama: Memoirs of Babur, Prince and Emperor*, Washington, D.C., 1996.

Alexandr Markovich Belenitskiĭ, “Organizatsiya remesla v Samarkande” (Organization of crafts in Samarqand”), in *Kratkie soobshcheniya o dokladakh i polevykh issledovaniyakh Instituta istorii material’noĭ kul’tury* 6, 1940, pp. 43-47.

Alexandr Mar-kovich Belenitskiĭ et al., *Srednevekovyĭ gorod Sredneĭ Azii* (The medieval city of Central Asia), Leningrad, 1972.

Abu Rayḥān Biruni, *Ketāb al-jamāher fi maʿrefat al-jawāher*, tr. Alexandr Markovich Belenitskiĭ as *Sobranie svedeniĭ dlya poznaniya dragotsennosteĭ (mineralogiya)*, Leningrad, 1963; tr. Hakim Muhammad Said as *Book on Mineralogy: The Book Most Comprehensive in Knowledge on Precious Stones*, Islamabad, 1989.

E. A. Davidovich, “Uzbekskoe zavoevanie: Gosudarstvo Sheĭbanidov” (The Uzbek conquest: The state of the Shaybanids”), in *Istoriya Tadzhikskogo naroda* (The history of the Tajik people) II/1, Moscow, 1964, pp. 364-420.

Robert Dyson, Jr., “Problems of Protohistoric Iran As Seen from Hasanlu,” *JNES*

24, 1965, pp. 193-217.

Anna M. Feuerbach, John F. Markel, and David R. Griffiths, “An Examination of Crucible Steel in the Manufacture of Damascus Steel, Including Evidence from Merv, Turkmenistan,” in Thilo Rehren, Andreas Hauptmann, and James David Muhly, eds., *Metallurgica Antiqua in Honour Hans-Gert Bachmann and Robert Maddin*, Bochum, 1998, pp. 37-44.

O. I. Galerkina, “Rukopis’ sochineniĭ Alishera Navoi 1521-1522 iz sobraniya GPB im. Saltykova-Shchedrina v Leningrade” (A manuscript of works by ʿAli-Šir Navāʾi dated 1521-1522 in the collection of the S[tate] P[ublic] Library named after Saltykov-Shchedrin in Leningrad), *Trudy Akademii Nauk TadzhSSR* 42, Stalinabad [Dushanbe], 1956, pp. 221-34.

Ruy Gonzales de Clavijo, *Narrative of the Embassy of Ruy Gonzalez de Clavijo to the Court of Timour at Samarcand, A.D. 1403-6*, tr. Clements R. Markham, London, 1859; repr., New York, 1970.

Georgina Herrmann et al., “The International Merv Project: Preliminary on the Fifth Season (1996),” *Iran* 35, 1997, pp. 1-33.

F. Hirth “The Story of Chang K’ien, China’s Pioneer in Western Asia,” *JAOS* 38, 1917, pp. 89-153.

Ḥodud al-ʿālam, ed. Manučehr Sotuda, Tehran, 1961; tr. with comm. Vladimir Minorsky as *The Regions of the World: A Persian Geography 372 A.H.–982 A.D.*, London, 1970.

Anthony François P. Hulsewé, *China in Central Asia: The Early Stage: 125 B.C.–A.D. 23*, Sinica Leidensia 14, Leiden, 1979 (an annotated tr. of chapters 61 and 96 of Ban Gu’s “The history of the former Han dynasty”).

Bethold Laufer, *Sino-Iranica: Chinese Contribution to the History of Civilization in Ancient Iran*, Chicago, 1919.

Boris A. Litvinskiĭ, *Drevneĭshie stranitsy istorii gornogo dela Tadzhikistana i drugikh respublik Sredneĭ Azii* (The most ancient pages on the history of mining in Tajikistan and other republics of Central Asia), Stalinabad [Dushanbe], 1954a.

Idem, “Iz arkheologicheskikh materialov po istorii gornoĭ tekhniki Sredneĭ Azii

(preimushchestvenno IX-XII vv.)" (From the archeological materials on the history of mining in Central Asia [mainly in the 9th-12th centuries]), *Trudy Akademii Nauk Tadzhikskoĭ SSR* 37, Stalinabad [Dushanbe], 1954b, pp. 119-71.

Idem, *Drevnie kochevniki "Kryshi Mira"* (The ancient nomads of the "Roof of the World"), Moscow, 1972.

Idem [Litvinskij], *Eisenzeitliche Kurgane zwischen Pamir und Aral-See* Materialien zur Allgemeinen und Vergleichenden Archäologie 22, Munich, 1984.

Idem, *Khram Oksa v Baktrii (Yuzhnyĭ Tadzhikistan)* II: *Baktriĭskoe vooruzhenie v grecheskom i perednevostochnom kontekste* (The temple of the Oxus [southern Tadzhikistan] II: Bactrian weapons in the Greek and Near Eastern context), Moscow, 2001.

Mikail E. Masson, *K istorii chyornoĭ metallurgii Uzbekistana* (On the history of iron metallurgy in Uzbekistan), Tashkent, 1947.

Moḥammad b. Najib Bakrān, *Jahān-nāma*, facs. ed. Yu. E. Borshchevskiĭ, Moscow, 1960.

R. G. Mukminova, *Ocherki po istorii remesla v Samarkande i Bukhare v XVI veke* (Essays on the history of crafts in Samarqand and Bukhara in the 16th century), Tashkent, 1976.

O. A. Papakhristu, *Chyornaya metallurgiya Severnoĭ Fergany (po materialam arkheologicheskogo issledovaniya Akhsiketa IX–nachala XIII vv.*) (Iron metallurgy of northern Farḡāna on the basis of the archeological study of Aḵsikaṯ of the 9th–early 13th centuries), Tashkent, 1985.

Idem, "Keramicheskie sosudy: tigli dlya vyplavki stali" (Ceramic vessels: crucibles for melting steel), in *Srednyaya Aziya: arkheologiya, istoriya, kul'tura. Materialy konferentsii, posvyashchyonnoĭ G.V. Shishkinoĭ*, Moscow, 2000, pp. 92-94.

O. A. Papakhristu and L. M. Swertchkow, "Eisen aus Ustrushana und Tiegelstahl aus dem Fergana-Beckhen," *Anschnitt: Zeitschrift für Kunst uns Kultur im Bergbau*, 45/4, 1993, pp. 122-31.

V. I. Raspopova, *Metallicheskie izdeliya rannesrednevekovogo Sogda* (Metal

objects of early medieval Sogd), Leningrad, 1980.

Idem, *Metallicheskie izdeliya iz Pyandzhikenta (nakhodki 1971-1998 gg.)* (Metal objects from Panjikant [Findings of the years 1971 to 1998]), St. Petersburg, 1999.

A. S. Sagdullaev, “Zametki o rannem zheleznom veke Sredneĭ Azii” (Notes on the early Iron Age of Central Asia), *Sovetskaya Arkheologiya*, no. 2, 1982, pp. 154-61.

Olga Alexandrovna Sukhareva, “K voprosu o lit’e metallov v Sredneĭ Azii,” (On the question of smelting metals in Central Asia), *Trudy Instituta ètnografii*, N.S. 97, Leningrad, 1971, pp. 147-67.

Idem, *Kvartal’naya obshchina pozdnefeodal’nogo goroda Bukhary* “The quarters community of the late feudal city of Bukhara”), Moscow, 1976.

Z. I. Usmanova, “Raskopki masterskoĭ remeslennika parfyanskogo vremeni na gorodishche Gyaur-kala” (Excavations of the artisan workshop of Parthian times at the settlement of Gyaur Kala), in *Trudy Yuzhno-Turkmenistanskoĭ arkheologicheskoĭ kompleksnoĭ èkspeditsii* 12, Ashkhabat, 1963, pp. 164-200.

O. A. Vishnevskaya, *Kul’tura sakskikh plemyon nizov’ev Syrdar’i v VII-V vv. do n. è. po materialam Uĭgaraka* (The culture of the Saka tribes of the Lower Syr-Darya in the 7th-5th centuries B.C.E. on the basis of materials from Uigarak), Trudy Khorezmskoĭ arkheologo-ètnograficheskoĭ èkspeditsii 8, Moscow, 1973.