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METAL MINING IN ROMAN DALMATIA

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The mining of metal ores was an important industry in the ancient world because it provided valuable resources: precious metals for coins and non-precious metals for tools and weapons. The Roman province of Dalmatia possessed significant deposits of gold, silver and iron. This article combines evidence from archaeology, coins, inscriptions and literature to assess the nature of the management, organisation and significance of this industry in Dalmatia during the Roman period with an eye especially to the involvement of the Roman state. It also considers the greater economic impact of the mines in terms of employment and provision of supplies.

Keywords: Roman Dalmatia, mining, gold, silver, iron, metalla

1. Introduction

The mining of metallic ores was a significant activity which contributed greatly to the financial and military stability of the Roman empire, and it was an economic activity with great potential for interference from the state, which constantly required precious metals for the minting of coins and iron for the supply of the army. Not only did the interior regions of Dalmatia possess an abundance of gold, silver and iron, but the province, while itself stable and peaceful, was also conveniently situated near the Danube frontier.

The nature of mining in Dalmatia, especially the administration of the mines, has been the subject of much study in the past (e.g. Imamović 1976; Dušanić 1977; Bojanovski 1982; Škegro 1999), but advances in Roman studies, especially in the areas of mining and the Roman economy in general, now require a reassessment of the Dalmatian evidence in the light of our new understanding. For example, our old notions of the Romans as dictatorial and proactive have given way to more recent ideas of a more reactionary and opportunistic mode of governance, and more nuanced ideas of employment have replaced former notions of an economy based on forced labour. The evidence for mining in Roman Dalmatia must now be reinterpreted according to our new understanding of Roman economic activities and of Roman society as a whole.

I present here an up-to-date account of the physical, administrative and social aspects of metal mining in Dalmatia, attempting to place it within the framework of the economy of the region during the Roman period and also within the greater world of Roman mining in order to show the significance of such activities within the region not only locally but also across the province and throughout the empire, adding to our growing understanding of the nature and importance of mining in the Roman world.

2. Mineral resources

We know without doubt that the Romans extracted gold from the river basins of central Bosnia (Fig. 1), yet there is almost a complete absence of gold in modern mineralogical reports and maps of the region (e.g. *Jugoslavia III* 1944). Wray's report, written after the First World War, covers gold deposits in this area, but most of the discussion centres on evidence for ancient mining rather than physical properties and recent workings (1921: 50). The Roman workings are mostly in alluvial deposits and in placer deposits along ancient riverbeds, formed of gold which probably originated in the Vranica mountains where Wray records gold in quartz veins near Travnik, Čehovac, Uložnica, Rosinj mountain and Radovina. In the area along the Vrbas River on the other hand, Wray comments that 'examination within recent years of what gravels the ancients left untouched in this area show them to be extremely poor in gold,' causing him to conclude: 'It is now regarded as more probable that the relative cheapness of labour in former days, rather than the abundance of gold, accounts for the extensive workings in the Vrbas valley' (1921:50). Our understanding of Roman mining practices and the evidence for them has advanced in the last hundred years so that a careful examination of the evidence that existed already in Wray's time leads us rather to the conclusion that the Romans worked the area so extensively and intensively that they effectively exhausted the resource in this part of the world, and whatever they may have left behind was further depleted by their medieval counterparts.

Although some small deposits of argentiferous zincs and lead ores are known throughout the region of the Roman province, by far the most important region for the mining of both silver and lead is around Srebrenica where the veins are sometimes so dense that they form a solid mass of ore, known as a stockwork. The deposits here are known to have been worked extensively in the Roman period and the Middle Ages, and also on a small scale in the early twentieth century (Wray 1921: 65).

Iron ore occurs in this region in the form of siderites, limonites and hematites, and the ores are found close enough to the surface to be worked almost exclusively as opencast mines. They occur in significant quantities in two areas of the region: Ljubija and Vareš. Ljubija in the northwest provides the bulk of the archaeological evidence, though there is some debate as to whether it fell under the jurisdiction of Dalmatia or of Pannonia since the exact course of the boundary between the two provinces is not known with certainty. Because the literary evidence shows beyond doubt that iron production played an important role in the Dalmatian economy, I feel it is safe to include the evidence from Ljubija as an indication of the nature of iron mining in the Illyrian region regardless of which specific administration profited from the area for which we happen to have archaeological evidence. Further to the east, the ancient evidence is less clear for mining around Vareš, but in the late nineteenth and early twentieth centuries, Vareš was the more important of the two regions and an important centre of Turkish mining and iron production (Wray 1921: 39–42).

Modern Bosnia also contains small deposits of copper around Srebrenica, near Mrkonjić Grad and in the area around Fojnica, where iron and gold have also been found. Although it is likely that they were mined to some extent in antiquity, evidence is lacking, and it was probably of little consequence as compared with the mining of gold, silver and iron.

3. Literary evidence

The literary evidence for mining in Roman Dalmatia is sparse and although it confirms the existence of gold and iron production, it gives very little practical information for the modern researcher. These few passages are the obvious starting point for any consideration of Dalmatian mining and so have been discussed by many other writers, and I feel it is important to consider them again in this comprehensive overview of Dalmatian mining for the insights which could never be gleaned from mute objects and landscapes.

Most of the literary evidence regarding mining in Dalmatia dates to the first century AD and refers to the extraction of gold, providing useful contemporary, datable confirmation of this activity. In his very brief account of the war against the Delmatae during the time of Augustus, Florus reports that Vibius Postumus had the defeated people extracting gold for the Roman state, which may record the

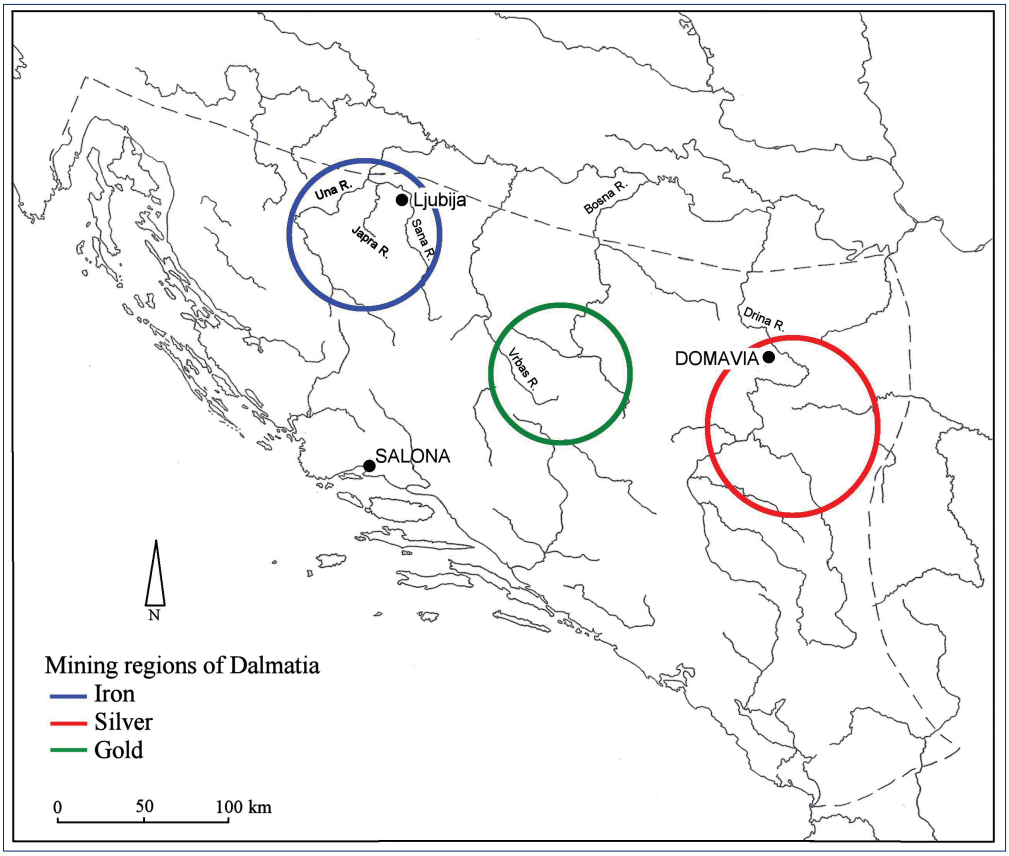

Figure 1. Major metal mining regions of Dalmatia (by K. Glicksman, 2009).

use of prisoners of war condemned *ad metalla* and may also indicate local knowledge of gold-mining techniques prior to the Roman conquest (Florus, *Epit*. 2.25; Bojanovski 1988: 149). However, Florus, writing in the second century, is generally considered an unreliable source in terms of historical detail, and although his statement here may have some truth, there is no way for it to be verified (on the reliability of Florus, see den Boer 1972: 1–18).

In a frequently quoted and sometimes misunderstood passage, Pliny the Elder, while discussing the methods of gold mining, mentions Dalmatia in passing (*HN* 33.67). He enumerates the three forms in which gold can be found, the first of these being gold-bearing sand, which may indicate a nearby vein. To illustrate this point, he recalls the recent discovery in Nero's reign of a pocket of sand in Dalmatia which yielded up to 50 *librae* (16–17 kg) of gold in a single day.

The event recorded by Pliny is tantalising because it offers the only existing contemporary quantification of mining in Dalmatia, and there seems to be some confusion surrounding Pliny's brief remark and its applicability to Dalmatian gold mining in general, but it is important to retain a healthy scepticism. Pliny is clearly referring to gold-bearing sand and not to any other type of mining in Dalmatia. Auriferous sands, or alluvial deposits, are usually found along rivers which have passed through hard-rock veins further up their course; the natural erosive force of the water causes the gold to break away and also to become loosened from any surrounding matrix as it is carried along by the river. Gold in this form is the easiest to recover in terms of cost and labour, and it also requires the least amount of purification. Alluvial deposits occur naturally along a number of rivers in central Bosnia which pass through gold veins within the mountains. There is some evidence for hydraulic mining in Dalmatia, and although the rate of recovery suggests a high rate of extraction, possibly through the use of waterpower, Pliny makes no direct mention of the method employed.

It is also crucial to consider Pliny's motive for including this example in his text. Although it could be argued that Pliny is giving a standard example, it is much more likely that Pliny refers to the episode as an extraordinary occurrence which is what makes it worth mentioning. The entire extractive effort of the Spanish provinces is thought to have

produced just under a ton of gold every year (cf. Wilson 2007: 113). If all of Dalmatia produced only 16 kg/day, it would equal the yearly Spanish output within two months. Looking at the evidence on a practical level, it is just not possible that Pliny is describing the average Dalmatian mine, and even if Pliny's information is strictly accurate, it cannot be applied to achieve a more specific understanding of Dalmatian gold mining or any reliable form of quantification. It does, however, echo the enormous gold-producing potential of the region suggested by the archaeological evidence.

Martial and Statius, both writing at the end of the first century AD, make references to Dalmatian gold, indicating an identification of the region with this particular precious metal. As the remarks are intended as poetic tools, they should be taken as such and not as direct comments on the nature of mining in Dalmatia. For example, in *Silv*. 4.7.13–16, Statius asks his friend: *quando te dulci Latio remittent/ Dalmatae montes, ubi Dite viso/ pallidus fossor redit erutoque/ concolor auro?* It is tempting to take this passage as evidence of the use of shaft-mining in the Dalmatian gold-mining region, but while Statius may have had some basic knowledge of mining in general and was apparently aware that gold was mined in Dalmatia, we cannot expect him to have known anything specific about the nature of mining in Dalmatia itself. But just as poets make reference to 'gold-bearing Tagus' as a poetic tool, it is significant to find two such important poets using Dalmatia as a byword for gold. It is a testament to the importance of the Dalmatian mines that they held such a position in the consciousness of Roman society in general, as they surely must have done in order to have been used in such a way. But whereas 'aurifer Tagus' rises to the position of literary trope, being used in the fifth and sixth centuries, long after the heyday of the Spanish mines (Edmondson 1989: 86), these references to Dalmatian gold are confined to a narrow timeframe, indicating that they were probably used at a time when the gold of Dalmatia was reaching the shores of Italy in significant quantities.

Statius' *Silv*. 3.3.89–90 is especially interesting. *Silv*. 3.3 was written on the death of a man who had risen from slavery to become an imperial freedman and the head of the imperial treasury (Shackleton Bailey 2003: 170). In a poetic description of his responsibilities, Statius lists valuable treasures from across the empire and beyond which this father of Claudius Etruscus would have been calculating and recording. To find Dalmatia's gold numbered among the empire's riches is highly encouraging, not only for what it implies about the general abundance and value of the ore but also for what it suggests about imperial interest. Although he is not writing a treatise on the working of the Roman government, we can surely give Statius some credit for knowledge of his subject, and so with some caution we can use this passage as evidence for what we would already suspect: that the central government at Rome took great interest in collecting the produce of the Dalmatian gold mines, just as it collected the gold of Spain and the wheat of Egypt.

Two later authors refer to the extraction of iron in Dalmatia. The *Expositio totius mundi et gentium* lists iron as one of three products exported from Dalmatia along with cheese and timber (*Expositio* 53.5–9; *Descriptio* 53.3–5). Written in the fourth century AD, it is the earliest reference in the preserved literature to the extraction of a metal other than gold; the original Greek text is now lost, and our evidence comes from two Latin versions: the longer, and probably more precise, being the *Expositio totius mundi et gentium*, and the other being the *Descriptio totius mundi*. Škegro interprets *tres species* to mean that iron was exported in three forms (1999: 300), but the usual translation of the passage takes the term as a reference to the three types of exports listed. This latter interpretation is clearly the more reasonable one, for while the position may cause confusion in the version presented in the *Expositio*, the text of the *Descriptio* makes the situation very clear.

The latest literary reference to Dalmatian mining comes from the sixth-century *Variae* of Cassiodorus in which he records a letter from Theodoric to the *comes* Simeon instructing him to collect the *Siliquaticum* (sales tax) which is in arrears and to attempt to find suitable veins of iron (3.25). The following letter to Osuin confirms the two commands given to Simeon (3.26). Although it is not necessary to assume that all iron mines in Dalmatia were out of commission at the time that these letters were written, it is safe to conclude that iron-mining in Dalmatia had not been functioning at full capacity, a situation which corresponds very conveniently with archaeological indications of a significant decrease in mining activity, probably due to invasions in the late fourth and fifth centuries, and a resurgence of activity sometime during the sixth century.

4. Administration

Many forms of administration in the Roman world varied across the empire, and the regulation of mining activity was no exception. It was not uniform but flexible, being adapted to specific circumstances,

such as the type and amount of metal being mined and the method of mining required. While this variety adds to the beautiful complexity which is the hallmark of Roman administration, it is also maddening for the modern researcher in that the details of such administration in any particular area are difficult to establish with any real specificity because they must rely on local evidence, which can only be safely applied, in the broadest terms, to a specific province and may even only apply to a specific chronological period (Orejas & Sáchez-Palencia 2002; Hirt 2010). What applies to first-century Spanish gold mines, for example, cannot be used to determine the nature of the organisation of Dalmatian silver mines in the third century. Because of this decentralisation of mining authority, we can only rely on the fragmentary evidence from within Dalmatia itself.

4.1. Gold

The administration of the gold mines is the least understood of the three major forms of metal-mining in the province, but it is likely that the mines were owned by the state rather than by the emperor or any other public individual. Florus records the use of Dalmatian prisoners of war in the gold mines of the first century AD (*Epit.* 2.25), and while Florus is generally unreliable (den Boer 1972: 1–18), and there is no corroborating evidence, it is at least worth considering the implications of the use of convict labour in the mines. *Damnatio ad metalla* seems to have been a fairly standard sentence, but it also seems to have applied only to the use of convicts in state-owned mines, and there is no evidence that any of those condemned to the mines were ever used on private property, even for mines owned by the emperor (Hirt 2010: 97–98).

The other piece of evidence for the administrative system surrounding the mining of gold in Dalmatia is a single funerary inscription from Salona dedicated by a *dispensator* named Felicissimus to a man named Thaumastus who held the office of *commentariensis aurariarum Delmatarum* (*CIL* III, 1997). Škegro places this inscription within the Trajanic period on the basis of an altar inscription from Capena in Etruria which records the dedicator as *M(arcus) Ulpius Aug(usti) l(ibertus) / Thaumastus / a commentariis / operum publicorum // et rationis patrimoni(i)* (*CIL* XI, 3860). Though the name *Thaumastus* is rare, it is unlikely to be the same person; there is no way to reconcile the omission of his full name and status on the later inscription.

Considering the early road built between central Bosnia and Salona, the excellent harbour at Salona and Salona's important position along trade routes through the province, this inscription is sometimes taken as evidence that gold from the central Bosnian mountains was sent to Salona and also outside the province through the port there (e.g. Imamović 1976: 16; Škegro 1999: 56), but Hirt goes some way towards a better explanation by pointing out that the administration of the gold mines may have been located at Salona because it was attached to the office of the financial procurator, which would have prevented its being placed within the mining region itself, as happened with the silver and iron mines by the end of the second century (2010: 162). If this hypothesis is correct, it would indicate a less autonomous mining administration than is clearly seen in later evidence from the province.

4.2. Second-century reform

There is no direct evidence for the nature of mining administration in Dalmatia before the middle of the second century AD. One could hypothesise, however, on the basis of a handful of inscriptions, that at some point before the reign of Marcus Aurelius, the silver mines were governed separately from other types of extractive operations and that they were not yet linked with the Pannonian mines. An inscription from Domavia in the silver mining region along the border with Moesia Superior, though damaged, seems to mention a procurator of Dalmatian silver mines (*CIL* III, 12739+12740 = *ILIug* 83 = *AE* 1948, 243). The inscription is undatable, but the existence of a separate procurator for the silver mines of Dalmatia in the early second century is supported by three inscriptions from various parts of the empire dating to the time before Marcus Aurelius and mentioning *procuratores argentariarum Pannonicarum* (*AE* 1915, 46; *AE* 1958, 156 = *AE* 1960, 245 = *AE* 1961, 227; *ILS* 9019 = *AE* 1905, 152 = *AE* 1907, +40).

At some point during the reign of either Antoninus Pius or Marcus Aurelius, the administration of all mines in Dalmatia and Pannonia was brought under the authority of one man: the *procurator metallorum Pannonicae et Dalmaticorum* (or alternatively *Pannoniorum et Delmatorum*). One datable inscription (*AE* 1956, 123 = *AE* 1991, 1691) comes from Lambaesis in Numidia and lists this position among many others held by Tiberius Claudius Proculus Cornelianus. Based on the other offices held by Cornelianus, Hirt asserts that he must have held the procuratorship of the mines around AD 161/2 and 164, placing the earliest evidence of the mining reform at the very beginning of the reign of Marcus Aurelius (2010: 134–135). The honor-

ary inscription mentioning a Lucius Domitius Eros as procurator (*CIL* III, 8361 = *CIL* III, 12721 = *ILS* 1443) is significant in that it was found at Domavia, which seems to have been the administrative centre of the Dalmatian silver-mining region based on the number of inscriptions mentioning procurators. The last inscription (*ILIug* 1655) probably mentions a procurator and was found at Glamoč in western Bosnia, close to the gold-mining region.

There is no way of knowing if the term *procurator metallorum* was the official title and did in fact signify a responsibility for all extractive operations within the two provinces or whether the reader was supposed to understand that the term applied only to certain types of mines. While this latter interpretation could be proposed for the inscription of Eros, which was found within the silver-mining region, or even for the one found close to the gold-mining region, it is highly unlikely for the inscription of Cornelianus, erected in Africa.

The administrative centre for all mining and quarrying in Pannonia and Dalmatia may have been located at Domavia, which was later the centre for administration of the silver mines, but being rather isolated and having no significance apart from its position in the silver-mining region, it seems a rather unlikely place from which to run a number of different extractive operations for both provinces. The discovery in two separate locations of two inscriptions mentioning the same office suggests, rather, an itinerant nature to the position with the procurator perhaps making circuits of the region under his control, regardless of where his main residence was located.

4.3. Silver

The position of a procurator in charge of all mining in Pannonia and Dalmatia does not appear to have lasted very long because there is evidence of a separate procurator for silver mines by the end of the 180s AD. An inscription found in Ephesus to Titus Claudius Xenophon lists among his many offices the title of *procurator argentariarum Pannoniarum et Dalmatiarum* (*CIL* III, 6575 = *CIL* III, 7127 = *ILS* 1421), and Hirt dates his possession of this office to sometime between AD 185 and 190 (2010: 134–135).

An inscription on an altar from Campona in Pannonia also refers to a united management of the silver mines of both Pannonia and Dalmatia (*AE* 2003, 1426). The damaged text has been reconstructed thus:

] / T(itus) Karinius Iuliacen[sis domo] / Arelate ex provin[cia Nar]bon(ensi) / b(ene)f(iciarius) co(n) s(ularis) leg(ionis) II Adi(utricis) P(iae) F(idelis) sta[ti]ones / habui arg(entariarum) Pan(nonicarum) e[t Del(maticarum) pro]c[u]rato(ris) / Aciminci Camp[onae a]ram / [feci] translate [stat(ione)] X K(alendas) Iunias / [Pe]done et Br[a]dua co(n) s(ulibus).

Although the name of Dalmatia is not legible and only appears as a reconstruction of the text, the reconstruction is reasonable; it is clear that another province was mentioned in conjunction with Pannonia, and Dalmatia would be the most obvious solution. The inscription dates to AD 191, and it is even possible that the dedicator held the post of *beneficarius consularis argentariarum Pannonicarum et Delmaticarum* during the procuratorship of Titus Claudius Xenophon.

Eleven other inscriptions mentioning *procuratores* all come from Domavia or the surrounding region (*CIL* III, 8363 (p 2328,117) = *CIL* III, 12733 = *ILS* 5587; *CIL* III, 12734 = *AE* 1893, 130; *CIL* III, 8360 = *CIL* III, 12720b; *CIL* III, 8359 = *CIL* III, 12720a; *CIL* III, 12724; *CIL* III, 13849 (p 2320, 2328,115) = *AE* 1998, 1027; *CIL* III, 12736 = *AE* 1893, 131; *CIL* III, 12725 = *CIL* III, 14219 = *ILIug* 1519 = *AE* 1893, 10; *CIL* III, 12732 = *AE* 1893, 129; *CIL* III, 12737; *CIL* III, 12738). None of them gives the full title of the office, referring instead to the *procurator argentariarum* or *procurator Augusti*. Because the inscriptions are found within the silver-mining district, these procurators can all be understood to be administrators of the Dalmatian *argentariae*; the full title would have been understood by those viewing the inscriptions. Since many of these inscriptions were found in Domavia, the most significant settlement and the only known *colonia* in the area, Domavia seems to have been the administrative centre for the Dalmatian silver-mining district.

The last datable inscription, that of Aurelius Verecundus (*CIL* III, 12736 = *AE* 1893, 131), puts the latest evidence for a procurator in the region of Domavia at AD 274. The traditional interpretation has assumed a unified procuratorship of Pannonian and Dalmatian silver mines continuing at least up to the third century, if not beyond (e.g. Dušanić 1977: 86–87; Škegro 1999: 81–89; Hirt 2010: 133–136), but there is room for scepticism here. Our understanding of the administration of the Dalmatian silver mines rests on a handful of inscriptions, mostly containing unclear references to the office of the procurator. If we see the change from *procurator metallorum* to a *procurator argentariarum* as a sign of failed reform and perhaps an attempt to bring the responsibilities of the procurator to within manageable limits, is it reasonable to assume that the control of silver mines in both provinces should prove

any more manageable? That is not to say that the traditional view is impossible, but the evidence is ambiguous, and at the moment we have evidence for only one *procurator argentariarum Pannoniarum et Dalmatiarum*. The administration of the Dalmatian mines may well have been less static than the picture proposed by the traditional view.

In terms of the procurator's staff, there is evidence of two auxiliary positions related to the silver-mining administration of Dalmatia. One dedication to Silvanus names an *argenti actor* in the vicinity of modern Prijepolje in western Serbia (*ILIug* 1685), the exact significance of this figure remaining elusive. The other evidence comes from the abovementioned inscription from Campona, Pannonia dated to AD 191 (*AE* 2003, 1426); as well as having been *beneficarius consularis argentariarum Pannonicarum et Delmaticarum*, the dedicator also held the position of *beneficarius consularis legionis II Adiutricis Piae Fidelis*, indicating that the mining procurator had military personnel among his staff.

4.4. Iron

The iron-mining region of northwestern Bosnia has also yielded a number of inscriptions which help to illuminate the nature of the administration of the mines in this part of the province. One of the difficulties which plagues discussion of this region is the problem of the border between Pannonia and Dalmatia, and it is unclear how much of this region, if indeed any, actually belonged to the Dalmatian province. While some would have the region shared between the two provinces (e.g. Wilkes 1969; Dušanić 1977), others propose a border running further south, leaving the entire iron-mining region within Pannonia (e.g. Bojanovski 1983; Hirt 2010).

Hirt's reconstruction of the Pannonian-Dalmatian border is based on two inscriptions. The first comes from Ljubija, which is within the mining region, and names Gaius Iulius Agathopus as a *conductor ferrariarum* (*ILIug* 779 = *AE* 1973, 411). The second comes from Osijek, ancient Mursa, in Pannonia and also contains the name of Agathopus but giving his full title as *conductor ferrariarum Pannoniarum itemque provinciarum transmarinarum* (Bulat 1989, 36). Hirt interprets the inscriptions as an indication that Ljubija, and thus the entire iron-mining region of northwestern Bosnia, belonged to Pannonia. However, his analysis is based on an assumption that mining regions could not be split between provinces, and although he may be correct, he offers no explanation for this assumption.

Other areas within Dalmatia could have produced iron; for example, there are pockets of iron, known to have been exploited during the Roman period, in the central Bosnian region, predominantly mined for gold. These veins, however, are more scattered than in the northwestern region, and it is doubtful that they could have produced a significant enough amount of iron for the province to have been established as an iron-producing region, as seen in the two late literary references to Dalmatian iron (*Expositio* 53.5–7; Cassiodorus, *Variae* 3.25–26).

Whether or not the area around Ljubija belonged to Dalmatia, it seems possible, nevertheless, that Dalmatian iron mines were leased out at some point in the same manner as the mines of Pannonia and Noricum. In support of this hypothesis is an inscription to Isis erected at Virunum in Noricum for Quintus Septueus Clemens, *con(ductor) fer(rariarum) N(oricarum) P(annoniarum) D(almatarum)* (*CIL* III, 4809 = *ILS* 1467). Evidence for the existence of a *conductor ferrariarum* in Dalmatia is limited to this one undated inscription and so is reliant on the correct interpretation of the abbreviations; however, the interpretation is supported by the names of three procurators, suggesting that the letters do indeed stand for three provinces.

The standard view is that the Pannonian and Dalmatian iron mines were united under one administrator at least from the middle of the second century, a view seemingly based on a logical conclusion following from the existence of a *procurator metallorum* for all mines in the two provinces and, later, a separate procurator for the silver mines of both Pannonia and Dalmatia. There is, however, no direct evidence, apart from the possible inscription discussed above, that there was ever a united administration of the iron mines.

At some point between AD 201 and 209, an administrative switch was made, taking general authority away from the *conductor* and giving it, in a probably more controlled form, to the procurator. This transfer of power is suggested by two inscriptions from Ljubija; *ILIug* 779 = *AE* 1973, 411 can be dated to AD 201 and names Callimorphus as the *vilicus* attached to the *conductor* Agathopus, while *ILIug* 157 = *AE* 1958, 63, which dates to AD 209, names the same *vilicus* in association with the procurator Verecundus. It seems that sometime between those two dates, the iron mines of the region became more closely controlled by the state with an imperial procurator replacing the *conductor*. As a likely role of the *conductor* was to collect rents from lessees running the mines, this implies that the organisation of the mines in this area went from indirect control through the renting out of property to

direct governmental control over the running of the iron mines.

That the iron mines in northwestern Bosnia were overseen from the beginning of the third century by a procurator based somewhere near Ljubija is apparent from the numerous inscriptions from the area naming such a position (*ILIug* 157 = *AE* 1958, 63; *ILIug* 778 = *AE* 1973, 412; *ILIug* 158 = *AE* 1958, 64; *ILIug* 781 = *AE* 1973, 414; *CIL* III, 13240 = *AE* 1958, +65; *ILIug* 161; *CIL* III, 13239 = *ILIug* 162 = *AE* 1958, +65). The full title of the procurator is not given in any of the inscriptions, so it is difficult to know the extent of his authority. The latest clearly datable inscriptions come from the reign of Philip the Arab during the 240s (*CIL* III, 13240 = *AE* 1958, +65; *ILIug* 161), although another may possibly date to the reign of Valerian (*CIL* III, 13239 = *ILIug* 162 = *AE* 1958, +65; cf. Hirt 2010: 137), and after this time there is no epigraphic evidence for the nature of the organisation of the iron mines.

The other known offices, attested in inscriptions from Ljubija and the surrounding area and often used in association with the name of the procurator, are those of the *vilicus officinae ferrariae* and the *vilicus ferrariarum* (*ILIug* 157 = *AE* 1958, 63; *ILIug* 778 = *AE* 1973, 412; *ILIug* 158 = *AE* 1958, 64; *ILIug* 781 = *AE* 1973, 414; *CIL* III, 13240 = *AE* 1958, +65; *ILIug* 161; *CIL* III, 13239 = *ILIug* 162 = *AE* 1958, +65; *ILIug* 775; *ILIug* 776; *ILIug* 777). The exact nature of the offices is unclear, and they may even refer to the same post; Dušanić prefers to see them as separate positions with the *vilicus ferrariarum* controlling the entire mining territory, while his colleague oversaw only the metallurgical workshops (1977: 85).

4.5. Fourth century and later

Evidence for the administration of the Dalmatian mines is almost exclusively restricted to inscriptions from the late second and third centuries AD. The only clue to later administration comes from the *Notitia Dignitatum* which records the office of *comes metallorum per Illyricum* (Or. 13.11). This points to yet another change in mining administration in the area sometime between the late third and late fourth centuries AD. The name implies one overarching authority for all the extractive operations in the whole of Illyricum rather than the more autonomous administrations organised according to province and type of operation, which seem to have existed in the century before the *Notitia Dignitatum* was compiled.

5. Physical evidence of mining

5.1. Gold

Evidence of gold-mining can be seen both in the large deposits of river gravel accumulated along riverbanks through the working of alluvial deposits and in the remains of opencast mines for the working of placer deposits higher up the mountains in the ancient riverbeds. These gravel deposits and opencasts have not been the subject of any systematic study, nor have they been studied recently, but a re-evaluation of early documentation combined with our improved knowledge of Roman mining reveals some important evidence.

The late nineteenth-century studies published by Walter (1887) and von Foullon (1892) are extremely valuable sources; they are the only studies of their kind and the only published sources which actually discuss the archaeology in any detail, and while more recent studies refer to them as evidence of Roman gold-mining, these more recent works do not repeat to any extent the information given in these earlier studies (e.g. Imamović 1976; Bojanovski 1982; Škegro 1999). These early works are not systematic studies and present only a sample of the sort of archaeological material available in the region, or at least what was available at the end of the nineteenth century; their value lies in their uniqueness. It should be kept in mind that there is some uncertainty as to the dating of the mining works as gold is known to have been mined in the central Bosnian region not only in the Roman period but also in the Middle Ages between the fourteenth and sixteenth centuries (Conrad 1870: 221; Walter 1887: 153).

Conrad, a mining engineer who wrote a brief account of the mineral resources of Bosnia, reports seeing several hundred mines on the slope of Rosinj (Conrad 1870, 221),[1] but although this statement is tempting, it is the result of a visual impression rather than a study of the terrain. Indeed, von Foullon declares the statement to be foolish and proceeds to give a more systematic description, which, while showing Conrad's several hundred mines to be an exaggeration, clearly indicates a heavily-worked landscape with between 60 and 70 opencast mines running almost from the valley and throughout the

[1] 'An dem Abhang des Rosinj-Gebirges sind mehrere hundert Ringe von größerer oder geringerer Tiefe vorhanden, welche unter sich eine stetige Richtung der dort auftretenden Goldgänge zeigen und eine ungeheure Thätigkeit auf Goldgräberein documentieren.' The word 'Ringe' (rings) does not make sense and must be read as 'Pingen' (mines). Cf. von Foullon 1892: 23 for confirmation of this interpretation.

two kilometres to the ridge of the mountain (von Foullon 1892: 23–26). They are relatively small, generally about 6–12 metres in diameter; the depths were often unmeasurable, but where they could be measured, they were no more than 12 metres deep. Walter says that 30–40 of the mines are very similar and offers a sketch of this 'normale Typus' (Fig. 2), but von Foullon dismisses the drawing as a figment of the imagination ('Phantasiegebilde'), so even between these two sources there is some disagreement (Walter 1887: 160; von Foullon 1892: 24).

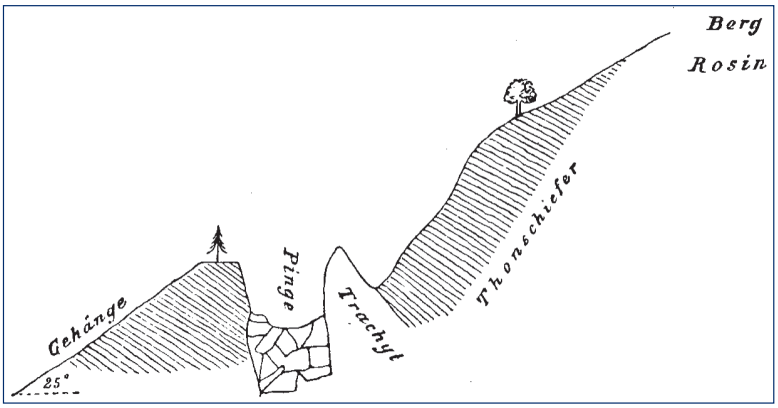

Figure 2. Typical opencast mine on the slope of Rosinj, according to Walter (1887: 160).

Walter and von Foullon describe the gold-mining landscape of central Bosnia but do not distinguish between Roman and later works, a distinction which can really only be achieved through the study of associated finds. If this sort of material was available to either of the authors, neither mentions its existence, and I have not found any evidence that such a study was carried out at a later date. Despite the difficulties in dating, the information provided by these two works gives us important insights.

One of the most noticeable details is that almost all of the mines are opencasts, while some underground prospecting also seems to have occurred at the bottom of the opencasts. Walter reports one large opencast close to the Vrbas River at Uložnica near Bistrica with 31 mining shafts ('Schachtpingen'), each with a 3- to 5-metre diameter, sunk into the floor of the opencast. The opencast itself is the largest known goldmine in the province: nearly a kilometre long, its width varies greatly between 10 and 150 metres, and it reaches a maximum depth of 10 metres (Walter 1887: 154; von Foullon 1892: 22).

Walter also mentions an 850-metre-long water channel and nearby, at the edge of the opencast, 'ein kleines Wasserbassin und die Reste eines Wassergrabens' (1887: 155). It is difficult to know exactly what he means and impossible to make any conclusions without at least some measurements, but the description sounds suspiciously like an installation for hydraulic mining, that is a hushing tank with water channels running between it and the opencast. This may be the system depicted by Rücker (Fig. 3), seeming to show an aqueduct leading from the Bistrica, a tributary of the Vrbas, to various opencast mines and probably extended as mining works moved further downstream. Although the illustration is unclear and does not match any physical descriptions, this could be related to the fact that no area is fully described. The water channel with its basins could represent evidence of hushing or groundsluicing or both. Certainly, a deposit of such dimensions would be more easily and efficiently worked with the help of waterpower. Both the enormous scale of the undertaking and the possibility of hydraulic mining are in favour of a Roman date for the mine, as the use of waterpower is well-known from other Roman gold-mining sites, especially from Dolaucothi in Wales and the extensive network of mines in northwest Spain.

The shafts in the bottom of the opencast are large even by Roman standards; Walter is not even clear whether they represent an underground mining system or fruitless prospecting. They could have been made by the Romans once the opencast method of working the deposit became unprofitable, or they could have been made at a much later date by people using the presence of the opencast as a sign for the existence of gold in the area.

In some places, especially near river courses, the mines seem to have been constructed for the exploitation of secondary deposits, but opencasts were also used to expose auriferous quartz veins. The mines vary in size, but they are mostly rather shallow with maximum depths of about 10 metres, indicating that gold in this region was generally found very close to the surface, a situation supported by Pliny's remark on the location and easy recovery of Dalmatian gold in one documented instance (*HN* 33.67). This is in stark contrast to Roman gold mines in Spain where up to 50 metres of overburden sometimes needed to be removed prior to recovery of gold (Wilson 2002: 17).

The only associated archaeological evidence given in the reports is the presence of aqueducts, which can safely be assumed to have been built during the Roman period, and if they can clearly be associated

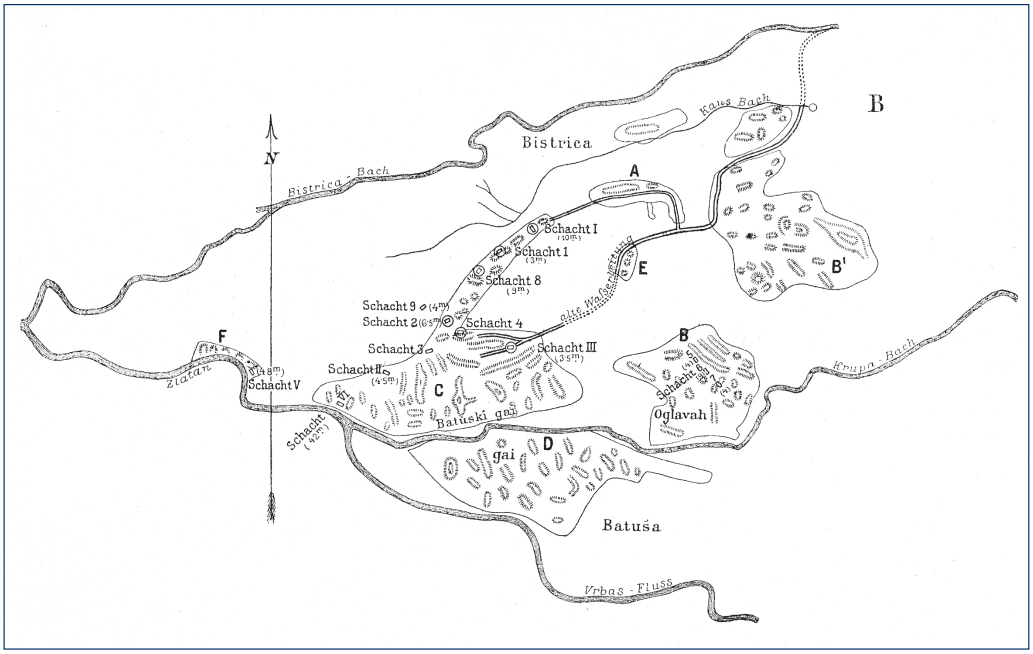

Figure 3. Aqueduct system used for mining near Bistrica. The numbered shafts represent late-nineteenth century plans for gold-mining. (Rücker 1896: 85).

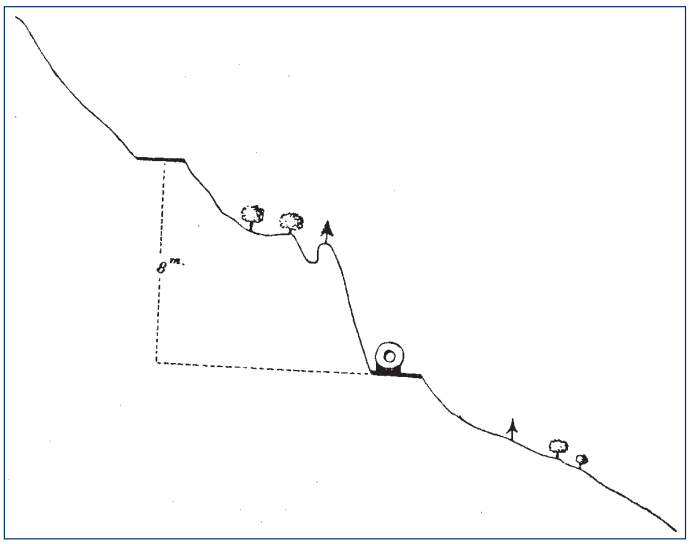

Figure 4. The double-channel aqueduct at Crvene Zemlje. The illustration shows the two channels as being eight metres apart, one over the other, and depicts the lower channel as a pipe. (Walter 1887: 159).

with the working of the mines themselves, as opposed to water supply for associated settlements, they also lend support to the theory of hydraulic mining in Dalmatia, an expensive undertaking which points to state management of the mines and large-scale industry, which suggests in turn a high level of extraction.

The mine at Uložnica is one example in which an aqueduct seems to have been used for mining; Walter also mentions another aqueduct which has been traced for 9.3 kilometres on the west slope of Rosinj and which he connects to gold mining (1887: 161). This identification is a distinct possibility considering the amount of mining in the area and the lack of any large settlement justifying the presence of an aqueduct.

At Crvene Zemlje, there is another large opencast mine, measuring 250–300 metres long, 50–60 metres wide on its narrower side, and up to 30 metres in depth (Walter 1887: 158; von Foullon 1892: 20). To the upper part of this mine flows a double aqueduct, the channels running parallel to each other and 8 metres apart, one above the other. Walter indicates that in some parts of the channel, apparently where the rock face was too hard to work, a pipe was used to conduct water (Fig. 4; Walter 1887: 159). This detail suggests that in parts of its course, the aqueduct was little more than a channel cut into the rock of the mountainside.

5.2. Silver

Walter is our main source for the physical properties of the silver mines in eastern Dalmatia, though Davies also gives some helpful descriptions (Davies 1935). The problem related to dating is relevant

also to the lead- and silver-mining region; the lack of good studies of the region makes it difficult to distinguish between Roman and later mines. Walter makes a distinction between Roman and medieval mines, but the reasons behind his division are unclear. He attributes all work on outcrops of veins to the Roman period and also smaller underground shafts relatively close to the surface. The larger, deeper mines he attributes to Saxon mining in the Middle Ages (1887: 134–136). If there is any archaeological basis for his categorisation, he gives few details, and it seems that the dating is based on the logic that deeper mines must be later in date than surface mines.

The works on outcrops are not described in any detail. They often extend to a depth of 20 metres and were placed in regular rows along a vein (Walter 1887: 134; Davies 1935: 192). A bronze coin of Constantius II was found in one of the shafts at Crvena Zdonja (Walter 1887: 134; Davies 1935: 192), and Davies also makes some comparisons of style, remarking on the relatively wide spacing between the shafts and on their rectangular sections, which he takes as a sign of probable Roman date (1935: 192).

For Walter's type of Roman underground mining, Davies gives valuable archaeological evidence. These shafts are narrow and were dug at about a 15-degree angle following the vein, which Davies compares to a late-Roman mine at Cythnos Milyes in Greece; he dates the brief working of the Cythnos Milyes mine to the third century on the basis of numismatic and ceramic evidence (1935: 192, 258–259). Some limited evidence is available from the Dalmatian mines as well: a lamp from Krivi Breg, a second-century lamp and three coins of Caracalla at Ošista, and two inscriptions dedicated to Alexander Severus by the procurator at Domavia, apparently found within one of the mines (*CIL* III, 8360 = *CIL* III, 12720b; *CIL* III, 8359 = *CIL* III, 12720a; Davies 1935: 192, n. 1).

Walter gives dimensions for certain galleries; while he reports many low and narrow galleries, generally about a metre high and 0.6 metres wide, there are also some with larger dimensions, usually running under the main vein. These larger galleries are in general about two metres in height and between one and two metres in width, which would correspond well with the dimensions of Roman-period galleries in Spain and in Romania. The date for these galleries is unclear, and Walter attempts only one identification, which is of the lower gallery at Kvarac. With a height of 1.75 m and a width ranging between 0.3 and 0.6 m, it is apparently comparable to identifiably Saxon works in Sardinia (Walter 1887: 136). It is curious that this gallery, clearly Saxon according to Walter, is wider at the top, while where the width varies in the others, the greater width is at the bottom, a form of gallery well-known in Roman-period gold mines of Dacia.

By contrast, Davies identifies Roman galleries near Srebrenica (without, however, giving a clear indication of how he determined their Roman date), which he claims are 'fairly large', giving the dimensions for the opening of one at Kovačice as 3 m high and 2.5 m wide (1935: 192). Davies also describes a couple of galleries with similar dimensions to the ones recorded by Walter, but he also notes that the one at Šarene Rupe has lamp niches spaced two feet apart, while the one at Kudrevoda has small alcoves every 30 yards, which may have allowed for two-way traffic in the tunnel (Davies 1935: 192–193).

The only recorded opencast silver mine is given by Davies as being 200 feet wide and 50 feet deep (~ 61x15 m). It is interesting to note that there is no other reported evidence of opencast mining in the lead- and silver-mining region of Dalmatia, while it was clearly in common use for mining of both secondary and also primary deposits of gold. Where argentiferous veins were found relatively close to the surface, they were mined using series of shafts rather than large opencasts. It may be that erosive mining was not thought to have been a profitable technique in this location due to the geology, or perhaps it is an indication that suitable water sources were not available.

5.3. Iron

That iron was worked in the Roman period is clear from the remains which do exist of associated settlements and from the literary and epigraphic evidence, but it is difficult to have any sense of the scale of this industry. We have little knowledge of what the Roman-period iron mines in Dalmatia looked like; this is due in part to inadequate exploration of the region but also largely to the fact that the iron deposits have been worked throughout the region's known history, and more recent workings have undoubtedly destroyed much evidence of Roman activity.

Škegro reports that the mines around Ljubija were dug as pits (*ferrifodinae*), probably indicating opencast work. One mine, over 300 metres in length, indicates the sort of scale at which these ore deposits were worked; it is undoubtedly Roman in date based on the ceramic evidence and a hoard of coins dating between the reigns of Gallienus and Probus, indicating that the mine was out of use by the late third century (Škegro 1999: 112–113).

There are large slag deposits in the Ljubija region and some around Vareš as well (Pašalić 1965: 82; Škegro 1999: 103, 124); these cannot be used to estimate the scale of extractive operations for a number of reasons. The numbers vary so widely as to be almost useless; the estimates of the amount of slag in the Ljubija region range between three hundred thousand (Wray 1921: 42) and two millions tons (Pašalić 1965: 82). Even if a reasonably accurate estimate could be made of the amount of slag remaining in the region, its usefulness would be limited for two reasons. The first is that iron has been mined in this region for at least two thousand years, and it would be difficult to know how much to ascribe to Roman occupation of the mines, and although some sections could certainly be attributed to the Roman period on the basis of finds within the slag or association with iron-working settlements, such analysis would almost certainly give us only a minimum. The second limitation on estimates of slag is the fact that in the past century the slag itself has been mined in large quantities as a source of iron (Pašalić & Basler 1962: 218; Basler 1977: 122). By contrast, however, slag heaps in the Weald in southern Britain have been estimated at 50,000 tons and are thought to represent 'one of the largest operations of its kind in the Roman Empire' (Jones & Mattingly 1990: 192–193), so all in all, the large quantities of slag in Bosnia do suggest large-scale exploitation of the ores in whatever period, and the evidence for administration and the level of imperial interest suggests that a substantial amount of the extraction attested by the slag heaps must have occurred during the Roman period.

6. Associated settlements

The evidence of settlements related to the mining and working of metal ores is also significant to our understanding of the industry, though in Dalmatia it is at the present moment relatively scarce. Domavia seems to have been the administrative centre for the silver-mining region; this can be inferred from the number of inscriptions from the area naming mining procurators and also from its unique status. Among the known settlements in the interior of the Roman province of Dalmatia, Domavia was the only one which rose to the rank of colony; having been made a *municipium* in the late second century, it had become a colony by the middle of the third (*CIL* III, 12728).

Excavations conducted at the end of the nineteenth century revealed at Domavia a number of private houses and public buildings (baths and a basilica), as well as one structure which shows that at least some of the processing of the ores occurred in the city. The building consists of a large room with an apse, a long, narrow entrance hall, and two side chambers; two smaller structures are attached to its east and west sides. The central building measures 33.1 metres long and 18.7 wide, and it was predominantly in the main room of this building that excavators discovered lead in its various forms: raw and partially-smelted ores, litharge (lead oxide)[2], slag and pieces of lead, some still with encrustations of litharge indicating that they were probably found in the place where they were produced. In one part of this hall was also found an ellipsoid pit measuring 3 metres by 2.3 and 90 centimetres deep about half full with lime (Rücker 1901: 3–6). Lime has been used in more modern times to help thicken the slag, making it easier to draw off, so it is possible that this pit served to supply lime for the smelting process, for though no hearth appears to have been found, the presence of so much lead in various forms indicates that the site was used for the smelting of local ores, at least at the end of its active life. The numismatic evidence indicates a period of use dating roughly between AD 224 and 340, which coincides well with the height of silver mining in this region.

Another city, known only by its title *municipium* and its first letter *S*, located at modern Komini near Pljevlje in Montenegro, seems to have had a role in the mining industry, as five inscriptions mentioning mining procurators have also been found in this location (*CIL* III, 12734 = *AE* 1893, 130; *CIL* III, 12724; *CIL* III, 13849 (p 2320, 2328,115) = *AE* 1998, 1027; *CIL* III, 12737–12738), and a further two inscriptions from this site but mentioning the administration of Domavia suggest a strong connection between the two cities (CIL III, 12728–12729). These two sets of inscriptions may be taken as further evidence of a centralised authority for Dalmatian silver mining located at Domavia. This settlement remains unexcavated; therefore, its role within Dalmatian mining remains as yet unknown.

Mention of smelting works in the eastern part of the province sometimes appears in modern literature but without specific details (e.g. Škegro 1999: 67; Zotović 1973: 21), making it difficult to come to any useful conclusions regarding size, scale or distribution.

One mining settlement has been excavated in the iron-mining region in the Japra valley at a locale called Majdanište (Basler 1977). The relationship of this site to the mining industry is made clear by the

[2] A by-product of the smelting of argentiferous galena which can then be re-smelted to produce lead.

continuous deposition of slag with contemporary building activity. One of the structures has been interpreted as a workshop with probable bases for anvils; although no tools were discovered as the building had clearly been emptied before abandonment, a number of unfinished nails were found beside the anvil bases (Basler 1977: 126–131). The settlement also included a small temple, two bath complexes, a Christian basilica and a number of buildings of indeterminate function.

The earliest layers of slag have been dated by numismatic evidence to the beginning of the first century AD at the very latest and may even predate Roman involvement in the region. While there is some evidence of building in the early imperial period, the majority of evidence for construction dates to the period between Septimius Severus and Gordian III, suggesting an increase in the intensity of mining around this settlement in the early third century AD. Evidence from the site seems to indicate a general period of destruction in the fifth century, possibly related to the Visigothic invasions, but it also shows a general resurgence of activity in the sixth century, and although many of the buildings are larger than their predecessors, they are also less luxurious, lacking the heating and decoration visible in the remains of earlier structures (Basler 1977: 161–165).

The settlement at Majdanište is clearly a mining settlement with its metal workshop and its layers of slag, and it is a vital piece of evidence which gives a glimpse into the civic life of the mining population. Further excavation of settlements associated with mining would help to clarify the picture and would also broaden our knowledge concerning the chronology of mining in Dalmatia.

7. Mining coins

The mining coins, so-called *nummi metallorum*, of the Balkan provinces are a bit of an enigma; they allow a certain amount of understanding, but their exact purpose is still somewhat of a mystery. Measuring between 14 and 19 millimetres in diameter and weighing between 1.6 and 4.35 grams, these small bronze coins resemble superficially the *quadrans*, which was the smallest denomination of regularly-minted Roman coinage at the time (Vagi 1999: 90), and bear on their obverses either the emperor's head with a legend or the head of a god or goddess; the images on the reverses vary, but they all bear a legend referring to some mining region in the Balkans. In the case of Dalmatia, these legends are METALLI VLPIANI DELM and METAL DELM (Fig. 5). Out of a total of ninety-six mining coins recorded by Škegro in 1995, nineteen bear a legend with the letters DELM (1995: 176).

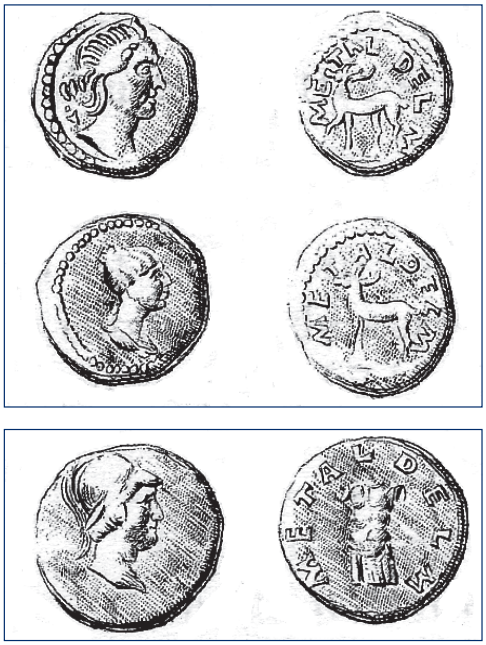

Figure 5. Examples of mining tokens with the legend METAL DELM. Top and middle: obv. Diana, rev. stag; bottom: obv. Mars, rev. cuirass (Mowat 1894: P. XI)

One of the major problems with the evidence from these coins is the relatively small number with known provenances; most published specimens come from collections, some being recorded as far back as the 17th century and undoubtedly having moved quite far from their original findspots, ending up in Vienna, Berlin, Paris and London (Mowat 1894: 374–392). Their association with the Balkan mining regions is based predominantly on the reverse legends, which point to Pannonia, Dalmatia, Noricum, and Pincum and Dardania in Moesia Superior, and while most examples with known provenance have come from the Balkan mining districts, a number have been found in other areas. The majority of these latter type come from Austria, especially Carnuntum, and also from southern Germany, but individual specimens have also been found during excavation at the Tiber River in Rome and in Cyprus (Woytek 2004: 52–54).

A number of coins bear the head of the emperor on their obverse; the dating offered by the imperial portraits and titles points to minting under Trajan and Hadrian, while one reverse legend, METAL AVRELIANIS, suggests that this practice carried over at least into the reign of Antoninus Pius. Analysis through x-ray fluorescence has revealed that

all the series have a similar chemical composition to each other and to contemporary bronze coins minted at Rome, by contrast with coins minted at Viminacium and Stobi (Simić & Vasić 1977: 60).

The other form of mining coin is the so-called anonymous *quadrans*, bearing the heads of gods and their attributes; some have the *metalla* legend on the reverse but others have no legend at all except for the letters SC on the reverse. It has been suggested that the gods/goddesses represented indicate the type of mining region in which they were used (i.e. Diana=silver; Mars=iron) or to a certain branch of the *fiscus* (i.e. Roma=Urban mint; Jupiter=*domus Augustana*), but this sort of analysis is highly speculative (Mowat 1894: 397; Bojanovski 1982: 97; Dušanić 1978: 38). They have been given a time range from the reign of Domitian to that of Hadrian, and testing of five examples from Kosmaj suggests a similar chemical composition to that of the mining coins.

Along with the examples from Kosmaj, another set of anonymous *quadrantes* with known provenance comes from the area of the Ljubija iron mines in northwestern Bosnia. These 16 coins bear the head of Neptune on the obverse and a dolphin on the reverse with the initials SC. Basler, while admitting the difficulty of dating the coins, identifies them with the pre-Roman Illyrian occupation of the area, supposing them to be local imitations of Roman-style coinage (1972-73: 268–269), while Dušanić counts them among the ranks of the Roman anonymous *quadrantes* associated with the mines (1977: 60).

The only analogy within the Roman empire is a series of bronze coins from the time of Augustus, similar in appearance to the *as* and found near the mines of El Centenillo in southern Spain; these coins are different in that they were minted in Spain and problematic in that their relation to the mine is uncertain. They bear no legend except SC on both obverse and reverse, and their proposed relation to the mines comes from their rarity and their discovery in a mining region (Hill & Sandars 1911; Villaronga 1979: 251, 301–302).

The exact purpose of these Balkan mining coins is unclear. The normally issued *quadrans* had a value so low that some numismatists have speculated that the *quadrantes* may have been used as tokens redeemable for certain goods and services, an idea supported also, to a certain extent, by literary references, although most numismatists maintain that they functioned as normal low-value coinage (Vagi 1999, 90–91). The currently known distribution of the coins suggests a focus on the Balkans not only in terms of decoration but also in terms of usage; their distribution outside the Balkans tends toward an area on the periphery of the mining regions, while the rest of the Roman world is hardly represented. Their presence outside the mining communities lends weight to the argument that they had monetary value outside these districts, but whether their use in the wider Roman world was intentional is less clear.

To use a modern example: until recently, both the United States of America and Canada minted pennies, their lowest value coinage at one percent of a dollar. Each country, naturally, has its own currency, and the currency of one country has no purchase power in the other. However, it is not unusual on occasion to receive as change in America a Canadian penny or vice versa. The reasons for this are to be found in the low value of the penny and the superficial similarity of one to the other, being of similar size, weight and colour. If the mistake is noticed immediately, the rogue coin will generally not be accepted, but it is often not noticed until later due to the small attention paid to coins of such little value. And when the error is noticed at a later point, depending on the whim (and honesty) of the owner, the coin may be discarded, kept as a novelty or passed off on another unsuspecting recipient, thus keeping in circulation certain coins which should as a rule have no purchase power in the country in which they are being used. This example, of course, cannot serve as an exact parallel for the potential escape of coins possibly meant to be used only in certain contexts, but it should stand as a note of caution against hasty judgment.

The coins could reasonably be seen as an attempt to alleviate the problem of new money supply to fairly isolated communities, a concern known in the coal-mining communities of early twentieth-century America (Fishback 1986; Timberlake 1987). It is possible that in the early stages of Roman occupation of the mines in these regions, there was a need for small coinage that could be used for everyday needs such as food, equipment repair and entertainment. If this is true, it would also suggest indigenous communities not fully engaged in the Roman monetised economy. An effective first test of this hypothesis would be an analysis of numismatic finds from these mining regions and also a comparison with similar analyses from other mining regions in the Roman empire.

But we are still left with two overarching questions: why only *quadrantes*, a coin with almost no value, and were all types of these coins treated in the same way? For the latter question, one answer comes in the form of the chemical composition. The similarity between the *nummi metallorum* and the *quadrantes anonymi* and between these coins and others

minted at Rome does indeed suggest that both of these types of mining coins were minted and distributed by the central Roman authority. But could it be possible that the anonymous coins were meant to be used as tokens? And for what purpose?

If these coins were used as a token currency, it could have been, again, as part of an effort to address the difficulty of supplying money for wages in such isolated areas, and as most of this money will have been spent locally on food, equipment and entertainment, it could also have been used as a way to ensure that monies paid to mine workers were spent on food and tools provided by approved suppliers, creating a relatively closed economic system. It is unlikely that a completely closed system would have been tolerated by free workers, but if such workers existed, it is possible that they could have been paid in part with scrip currency, or it could have worked as a sort of credit system or an advance on wages already earned before payday, which would have ensured that the majority of wages paid would have been recycled through an economic system of the mines.[3]

Whether the reverse legends of the *nummi metallorum* signify a celebration of these important mining regions or whether they indicate the intended area of use, and whether or not the mining coins were meant to be used as normal currency, by their very existence, these unique coins attest to the importance of the Balkan mines since this is the only known occurrence of the *metalla* legend on Roman coins or a large-scale effort to supply coins to a specific economic region.

8. Chronology

In general, the nature of mines means that there are few associated finds, and they have been so poorly studied that there is almost no direct datable archaeological evidence for the mines themselves. A chronology of mining in Dalmatia must rely, therefore, on indirect evidence: related literature, inscriptions from the mining areas and the scant archaeological material from associated settlements.

8.1. Gold mining

According to Florus, if he can be trusted, gold was being mined in the Dalmatian mountains before the consolidation of Roman control over the area, and the Roman state lost no time in appropriating the mines and conscripting the Dalmatian miners into its service when the area was decisively conquered under Vibius Postumus during the reign of Augustus (Florus, *Epit*. 2.25). This passage implies a continuation of mining between the pre-Roman and Roman occupation of the area and gives an Augustan date to this transfer of authority, but given Florus' unreliability concerning historical facts and given also that the passage supports Florus' aim in recounting the subjugation of nations and the glory of Rome, it cannot be used purely as historical evidence.

That gold was being mined throughout the first century can be deduced from other references from that period: Martial, *Epigr*. 10.78; Pliny *HN* 33.67; Statius, *Silv*. 1.2.140–157, 3.3.85–110, 4.7.13–16 (see above for discussion of these sources). We might suppose there to have been an increase in the intensity of mining with the introduction of Roman authority, which we might also conclude from the presence of investment in hydraulic infrastructure for the mines. It is also impossible to tell when mining stops in this area. The latest datable evidence which can be related to mining is a bronze coin found at Ilidža; its reverse legend (*metalli Ulpiani Delm*) identifies it as coming from one of the mining series, and its obverse with the head of Trajan and a legend referring to his sixth consulship dates it to AD 112 (Bojanovski 1982: 96).

It is interesting to note that although intensive gold mining clearly existed in the first century AD, there is no clear economic or social effect on this region visible from the archaeology of the period, and it is not until the third century, when there is a general boom in the Dalmatian economy, that this interior region begins to show evidence of increased prosperity and of more Roman-looking forms of lifestyle (cf. Glicksman 2009).

8.2. Silver mining

When the Romans started to mine silver in Dalmatia is unknown as there is no secure evidence predating the middle of the second century AD when we begin to see inscriptions at Domavia referring to *procuratores argentariarum*. This increase in the number of inscriptions towards the end of the second century probably reflects an increase in Roman interest in the area, possibly related to the closing or decreased output of the major Spanish mines, which occurred around the same time. Some archaeological material was found in mines near Srebrenica (see above); Davies compares one of the lamps to second-century examples, and even more

[3] These hypotheses take as their basis the functioning of private scrip currencies in the coal-mining communities of early twentieth-century America: Fishback 1986; Timberlake 1987.

reliable evidence comes from coins of Caracalla and inscriptions to Severus Alexander, placing activity at the mines well within the third century (Davies 1935: 192, n. 1).

The necropoleis of Domavia show an interesting trend which supports this hypothesis. In examining the forms of cremation graves at Domavia, Srejović has discovered that they vary in form according to date (1965: 21–26). The earliest graves date to the first century and are of a native Illyrian type; there are three types: shallow, round or ellipsoid pits; larger ellipsoid or rectangular pits, sometimes with a bottom lined with river gravel; and large rectangular graves formed with a (wooden?) frame also sometimes lined with river gravel. At the Karaula necropolis are represented two other types which are not found in the other two explored cemeteries of Domavia. Represented by two examples each (out of a total of forty-two graves excavated at the Karaula cemetery), one type is distinguished by being completely lined with stone slabs, while the other type has drystone walling built along its sides. Neither type is known in eastern Dalmatia, Moesia Superior or Pannonia Inferior but have been found in western Dalmatia, Noricum and Pannonia Superior, according to Srejović. The first type is difficult to date and may be linked to pre-Roman Celtic practices; Srejović gives the latter type a second-century date based on analogous graves from Noricum and Pannonia.

Srejović interprets these forms, clearly foreign elements, as evidence of some migration of people from the west; however, the sample is small, and its significance is unclear. It is interesting to note that while the later necropoleis to the south of the city exhibit Roman forms, the two foreign types found at the Karaula necropolis do not reappear in the other two. Although people can move for any number of reasons and the movement does not necessarily need to be related to mining, the fact that these burial types are found nowhere else in this part of the province lends strength to the argument that the settling of these people in Domavia was related to mining activity.

Clearly Roman grave forms begin to appear in the necropoleis of Domavia in the early third century AD, indicating a greater proportion of foreigners (i.e. non-Illyrians) in the city's population (Srejović 1965: 26). The most reasonable explanation for a visible influx of non-Illyrians into this area would be a general interest in the region's silver mines, as reflected in the epigraphic evidence.

8.3. Iron mining

The epigraphic evidence shows an increased interest in the northwestern iron mines in the late second century and lasting at least through the third century AD. The passage from the *Expositio totius mundi et gentium* clearly demonstrates the importance of iron as a provincial product in the fourth century, and the letters recorded in Cassiodorus' *Variae* indicate a lapse of production and an attempt to restore the industry in the sixth century.

This very basic sketch is reflected in the evidence from the one excavated settlement, at Majdanište. The archaeology seems to indicate iron production by the beginning of the first century AD at the very latest and an increase in construction, which probably reflects an increase in mining intensity, in the third century. The settlement also seems to have been destroyed sometime in the fifth century and rebuilt in the sixth. Although one settlement cannot be taken as evidence of chronology for the whole region, it is significant that the dating given by the archaeological evidence of this one settlement not only resembles very closely the picture given by literary and epigraphic materials but also echoes general chronological trends seen across the broader spectrum of the economy of the Dalmatian province (cf. Glicksman 2009).

9. Mining and migration

Mining also played an important role in the migration of Dalmatians beyond their native province. One well-identified example of this occurrence is the Dalmatian communities found in Dacia. A number of second-century inscriptions and wax tablets attest to the presence of non-Dacians within the province, understood predominantly through onomastic evidence. Although there is evidence of Illyrians in a number of places and representing various activities, especially military service, the only real concentration of evidence comes from the gold-mining region at the city of Alburnus Maior. Some claim a concentration at Ampelum (Protase 1978: 127–135; Zaninović 1995: 111), and there is evidence of Dalmatians at Apulum, but the evidence there is much less clear; the Illyrian presence is less well-defined and may be related more to military activity than to mining.

The evidence for the Dalmatian mining community at Alburnus Maior has been well documented and published (Protase 1978; Zaninović 1995; Ciobanu 1999; Piso 2004); the wealth of evidence through toponyms, names and origins recorded in inscrip-

tions and business transactions leaves little doubt as to the Dalmatian identity of a large proportion of the population in this area. The most recent work on the subject puts the total number of individuals identified through inscriptions at Alburnus Maior at 177, with 91 of these individuals clearly identified as Illyrian, that is over fifty percent of the identified population, and it is possible that many more of the Roman citizens named had Illyrian origins; some have clearly adapted Illyrian names, like Scenobarbus, to the Roman formula or have recorded patronymics, while others have only the very Roman *tria nomina* with no reference to origin (Piso 2004: 273). There are only seven clearly Illyrian Roman citizens; the majority of the Illyrian population of Alburnus Maior seem to have been *peregrini*. The personal names all belong, linguistically, to the tribes in central Dalmatia, that is the Delmatae and the tribes of the interior (Piso 2004: 295). One inscription mentions as a hometown Aequum, which is well within the territory of the Delmatae (*CIL* III, 1262 = *IDR* III, 417), while another declares his membership in the Pirustean tribe (*IDR* I, 36).

Some of the wax tablets recording contracts and building transactions also mention groupings of people according to ethnicity within the mining community; such ethnic groupings are not uncommon in Dacia, where there is also evidence for a *collegium Pontobithyniorum*, a *spira Asianorum* and a *collegium Galatarum* (Ciobanu 1999: 318). At Alburnus Maior, there is evidence of a *collegium* of the Sardeates (*AM* 294A; *AM* 297D; *AM* 304B = *AE* 2003, 1491), an Illyrian tribe from western Bosnia, probably inhabiting the area around modern Šipovo (Wilkes 1969: 170).

There is also mention of a *vicus Pirustarum* (*IDR* I, 39), probably originally a quarter of Alburnus Maior occupied by members of the tribe Pirustae, originating in southeastern Dalmatia (Wilkes 1969: 174–176). Another possible ethnic settlement is the *castellum Baridustarum*; while Zaninović (1995: 113) considers it a direct reference to the town Baridua, located somewhere in the territory of the Delmatae, Ciobanu (1999:317) believes the *castellum* to have been located in Dacia and with a name reflecting the origins of its inhabitants (*IDR* III, 388 = *AE* 1944, 24).

Dušanić sees this relocation of Dalmatians to the mines of Dacia and Moesia Superior as a forced migration (1977: 93), and indeed, such large-scale movement of populations seems to indicate a centrally planned and administered undertaking, but this idea does not consider the status of the members of this displaced population. Dušanić believes that the peregrine status of much of the Dalmatian population living in this Dacian mining region is proof of a forcibly exiled, and therefore dissident, population (2000: 348). However, this hypothesis does not take into account the relatively high status of some of the members of the community nor of the apparent financial independence of even the *peregrini*.

The Dalmatians do not represent a single sector of society within Alburnus Maior; they range from Roman citizens to *peregrini* to slaves. It is difficult to know how the divide between citizenship and peregrine status affected people on a practical level. The fact that a man named Aelius Quintus Dii dedicated an altar to the genius of the *collegium Sardiatarum* (*AM* 304B = *AE* 2003, 1491) suggests that some people at least must still have retained tribal identities alongside their Roman ones.

The wax tablets are very instructive regarding the social and financial situation of the Dalmatians living at Alburnus Maior. Some of the population at least was involved in financial transactions, including the buying and selling of slaves and property (*IDR* I, 36–39). Three of the tablets also record mining contracts (*IDR* I, 40–42), recording both the name of the employer and the waged labourer (and also the man writing for the illiterate labourer); *IDR* I, 42 records the name of the employer as *Titus Beusantis qui et Bradua*, a Dalmatian. This evidence points towards at least part of the Dalmatian population being financially solvent, a circumstance contrary to Dušanić's theory of an oppressed and forcibly exiled population; Hirt probably comes closer to the mark in suggesting an imperially-backed motive for these significant migrations, which include not only Dalmatians but also people from the eastern part of the empire (2010: 335). Such an immigrant community was not rare; as has already been noted, people from the Greek-speaking East settled in mining areas of the Balkans and Dacia and even formed *collegia* based on ethnicity; there is also evidence in Iberia of migrational patterns related to mining (Hirt 2010: 273–274).

The evidence from Alburnus Maior all falls within the second century, and the wax tablets, which give specific dates, point to a narrow timeframe of AD 131 to 167 (Piso 2004: 301). Zaninović suggests that the Dalmatians may have followed Trajan, whose army crossed through Dalmatia on its way to conquer Dacia in the first decade of the second century (1995: 112). However, one might wonder why people would be inspired to leave their homes and follow the emperor to work mines in a foreign land when they had mines to be worked at home. It is notable that while the archaeological landscape of central Bosnia indicates a large gold-mining industry, there

is no datable evidence for gold mining here after AD 112, and the earliest date for Dalmatians in Dacia is AD 131. It is conceivable that Dacia with its wealth of gold was conquered just as the large-scale mining operations in Dalmatia were becoming unprofitable, so it is possible that the large-scale migration of Dalmatians into Dacia resulted from a collapse of the gold-mining system in their own native region.

It would not be unreasonable to propose that sometime toward the end of Trajan's reign, or the beginning of Hadrian's, experienced miners left the failing Dalmatian gold mines to find better employment in the newly conquered province of Dacia, where their expertise was needed. The migration may have been triggered predominantly by a lack of work in the central Dalmatian mines, or there may have been some added financial or social incentive offered, or these stimuli may have acted concurrently. The failing of the Dalmatian gold mines could not have been the only reason for migration because the evidence points to a community of Pirustae at Alburnus Maior; the Pirustae came not from the central gold-producing region but from the southeastern silver-mining region. However, the Dalmatian silver mines seem not to have had much importance before the end of the second century, so perhaps this is another example of people with some mining expertise in search of a more profitable location.

Dušanić suggests that Dalmatians also worked in the mines of Noricum and Moesia Superior (1977: 74, n. 137; 1989: 155), but the evidence is not as clear as for Dacia. The epigraphic record of Noricum is devoid of Illyrian names, except for the southeastern region around Wiesenau where the rivers were exploited for their auriferous properties, and it is not clear whether even these represent an immigrant community of Dalmatian miners or a remnant of the original Illyrian population which mostly migrated south before the Roman period (Alföldy 1974: 20–21).

Dušanić also believes that Dalmatians were working in the Kosmaj region of Moesia Superior but offers as evidence only a handful of scattered inscriptions bearing Illyrian names, certainly nothing comparable to the clear ethnic concentration found at Alburnus Maior. It is curious to note also that a number of the names indicate a Liburnian origin; not only does Liburnia not have any mines, but this pattern (such as it is) is different from the Dacian one in which Liburnians make no appearance (*IMS* p. 108–109; Piso 2004: 290).

The last possible bit of evidence for Dalmatians mining in Moesia Superior comes from Procopius, who, in his list of forts built or restored by Justinian, records the name of Δάλματας in the region of Ῥεμισιανισία (Remisiana), an area of eastern Moesia Superior known for its silver mines (*De Aedificiis* 4.4). The significance of this evidence is unclear; while it is reasonable to suppose that the name signifies a settlement of Dalmatians here at some point in the Roman period, the date of its founding is unknown because Procopius does not divide the places into forts built and restored for Remisiana as he does for most other districts. Also, the occupation of the members of this community is unclear; they may have been a mining community, or the name may represent a Dalmatian cohort stationed here (Beševliev 1970: 109).

10. Conclusion

The currently available evidence from archaeological, epigraphic and literary sources all combine to demonstrate the importance of Dalmatia's metal resources both locally and at an imperial level. They also reveal the socio-cultural as well as the economic impact of mining activity in the province.

In terms of imperial interest in the mines, the evidence of administrative practices and investment in waterpower are the most telling. We see that the state had an interest in the area and considered it important to control the output not only of the gold and silver mines, as we might expect considering the need for precious metals for coinage, but also of the iron mines, probably motivated by a need to supply the armies on the Danube.

The administration of the iron and silver mines underwent a number of changes through the late second and early third century, and though the exact roles of these administrators and the finer points of these changes may be unclear, the suddenness of this attention and the relative rapidity of the shifts speaks for a rise in significance in the Dalmatian mines at this time. The abandonment of the Spanish silver mines in the latter half of the second century and the needs of the army on the Danube frontier suddenly gave an importance to the mineral resources of this region, and it was at this moment of necessity when Dalmatia came into sudden focus that control on the mines was tightened, demonstrating with clarity the reactive, rather than visionary, nature of Roman provincial administration, for we see not a central authority with an overarching scheme for conquest and exploitation, as the Roman government has been perceived in the past, but one functioning on a reactive basis, responding to needs as they arose.

State involvement in Dalmatian mining implies not only a certain significance but also suggests that

mining must have been conducted on a fairly large scale, an idea supported by the presence of aqueducts in the Dalmatian gold mines. The use of hydraulic mining techniques allows us to make important conclusions regarding gold mining in Dalmatia during the Roman period. The first is that at least some of the mining in that central region was conducted by the government, possibly through state contracts. It is unlikely that any one person or community could have afforded to build an aqueduct to bring water to the site, not only because of the great expense of building the aqueduct itself but also because they would have needed to own not only the land where the mines were located and the land where the water source was found but all the land in between as well. Any mining project which would have made the building of a private aqueduct worthwhile could scarcely have gone unnoticed by the Roman government. The presence of aqueducts also demonstrates the great amount of money and labour which the Roman state invested in the Dalmatian mining industry and implies mining conducted on a very large scale, even to the point of depleting the landscape of this particular metal.

The closing of the gold mines, probably sometime during the reign of Hadrian, must have had a significant effect on the economy of the province. It is almost certain, given the importance of gold to the Roman state and the implication of large-scale imperial investment in the mining works, that the mining of gold never contributed directly to the province's economy. In other words, the removal of gold from the earth would have been carefully monitored so that the central imperial authority received every gram, and no gold would have influenced Dalmatia's internal economic system. However, it is unlikely even if the metal had stayed within Dalmatia's system that it would have had much discernible effect either on the overall economy or on the standard of living of most of its inhabitants (Scheidel 2009: 50).

Beyond the extraction of the metal, the running of the mines must have had a forceful impact indirectly on the local population in terms of providing a source of steady employment and also a point of consumption for food, tools, oil and other necessities. When the gold mines closed, a large number of people must have lost a substantial source of income. It may be this reason, and not any form of physical coercion, which drove Dalmatians to the newly conquered gold mines of Dacia. While this relatively large-scale migration would have solved the personal financial crises of individuals, the exodus of a part of the workforce and also of a number of people able to invest financially in economic pursuits must also have affected the Dalmatian economy adversely. However, this probable economic slump in the interior of the province should only have lasted at most a generation or two because by the end of the second century, there was an increase in imperial concern with the silver mining in the interior with immigrants from other parts of the empire appearing in association with the silver industry.

The state invested large amounts of money in the running of the silver and iron mines, indicating activity on a relatively large scale from the end of the second century; it is not clear when silver mining stopped, but the mining of iron continued until the end of the fourth century and was definitely resumed in the sixth, again under imperial influence. Again, it is doubtful that any precious metals entered Dalmatia's economic system, but these works would have affected the population in terms of employment and also incentives for greater production, since the mining communities would have needed supplies which they would not have been producing themselves. The closing of the mines would have created a flood of people with specialist knowledge, and the relative ease of travelling within the Roman world would have influenced the movement of people to areas with better prospects of employment. But by the same token, increased mining activity attracted people from other parts of the Roman world, adding to the socio-cultural milieu of the province.

As our understanding of the Roman economy develops, we are becoming increasingly aware of a system which was both highly fragmented and highly connected, working on a variety of interacting local, regional and imperial levels (Davies 2005; Mattingly 2007). Research into the impact of specific economic activities can help us further to understand this complex aspect of the Roman world. Mining is a particularly good example because it had wide-ranging effects at every level.

Each of the Dalmatian mines, or groups of mines, may have functioned as individual units, under the control of specific individuals and worked by others; at a slightly broader but still very localised level, each mining region as a whole must have stimulated local economies in agriculture, construction, craft production and trade, and the socio-cultural makeup of these areas would have been affected by the groups of immigrants drawn by the promise of work. At the provincial level, the metals needed to be exported, which meant overland or, to a certain extent, riverine transport to the coast or to the Danube; the need to export the products of the mines, combined with the probable need to import men,

equipment or supplies not readily available locally, may be one of the major reasons for the continued good upkeep of the trunk roads through a province otherwise difficult to navigate; these good roads not only serviced the mining communities but also facilitated access between the coast and the interior and stimulated trade into and out of the interior regions. At an imperial level, those running the mines under the lease system would have paid taxes to the state, and all silver and gold would also have become the property of the state and entered the greater Roman financial system as coinage.

Without doubt, many archaeological remains related to mining still lie undiscovered in all three of the major mining regions of Roman Dalmatia, and further excavation and field survey would not only greatly benefit our understanding of how these local industries functioned but would also offer us more and better insights into this complex and fascinating Roman activity. However, all three areas have also been badly affected by the recent war in Bosnia-Herzegovina resulting in a landscape contaminated with unexploded ordnance, and though efforts have been made ever since the war's end in 1995 to clear the hundreds of thousands of landmines, it will be many decades at least before effective archaeological fieldwork can be safely conducted in these areas. In the meantime, we can improve our picture of Roman mining in these regions by returning to the material gathered by archaeologists and engineers in the past and reassessing the evidence in the light of our constantly developing understanding of the Romans and their world.

ABBREVIATIONS

AE	*L'Année Epigraphique*, Paris.
AM	P. Damian (ed): *Alburnus Maior*, Bucharest, 2003.
BMC III	H. Mattingly: *Coins of the Roman empire in the British Museum, Volume III: Nerva to Hadrian*, London, 1936.
CIL	Th. Mommsen *et al*. (eds): *Corpus Inscriptionum Latinarum*, Berlin.
IDR	*Inscriptiones Daciae Romanae*, Bucharest.
ILIug	*A*. Šašel & J. Šašel: *Inscriptiones Latinae quae in Iugoslavia ...repertae et editae sunt*. Ljubljana, 1963–1986.
ILS	*H.* Dessau (ed): *Inscriptiones Latinae Selectae*, Berlin, 1892–1916.

Sources

	Cassiodorus (Flavius Magnus Aurelius Cassiodorus Senator)
	Cassiodori Senatoris Variae, recensuit Th. Mommsen, Berolini, 1894.
	Expositio totius mundi et gentium/Descriptio totius mundi
	Expositio totius mundi et gentium, avec introduction, texte critique, traduction, notes et commentaire par Jean Rougé, Paris, 1966.
Florus	*Florus*, Epitome of Roman history, with an English translation by E. S. Forster, London, 1929.
Martial	
Marcus Valerius Martialis	Martial, Epigrams, Vol. II, with an English translation by D. R. Shackleton Bailey, Cambridge, Mass., 1993.
Notitia Dignitatum	*Notitia Dignitatum*, edited by R.H. Ireland, Stuttgart & Leipzig, 1999.
Pliny *Caius Plinius Secundus*	Pliny, Natural History, Vol. IX, with an English translation by H. Rackham, Cambridge, Mass., 1952.
Statius	
Publius Papinius Statius	*Statius*, Silvae, with an English translation by D. R. Shackleton Bailey, Cambridge, Mass., 2003.

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