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Biohistory of the Roman Republic: the potential of isotope analysis of human skeletal remains

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The Republican era of Roman power was characterized by massive wars and population unrest. Vagaries in politics and economics meant that large numbers of people moved from rural to urban areas, and influxes of slaves from around the Mediterranean flooded Italy. The lives of these immigrants to Rome are not well understood from the historical record. This article presents results of a small study of human skeletal remains from a Republican-era cemetery in the suburbs of Rome and discusses the potential for osteological and biochemical analyses for understanding the demography of the city.
Keywords: Roman Republic, isotope analysis, migration, demography

La Roma repubblicana fu caratterizzata da guerre e movimenti popolazionistici. Disordini politici ed economici causarono spostamenti dalle aree rurali alla città e ingenti flussi di schiavi invasero l'Italia. Le vite di questi migranti a Roma non sono ancora ben conosciute dal punto di vista storico. Questo articolo presenta i risultati di un piccolo studio sui resti umani di un cimitero repubblicano nel suburbio di Roma e discute il potenziale delle analisi osteologiche e biochimiche per approfondire la demografia della città.
Parole chiave: *Roma Repubblicana, analisi isotopiche, migrazioni, demografia*

1. Introduction: living and dying in Republican Rome

In just over a century's time, Rome came to dominate the Mediterranean. Between the 3rd and 2nd centuries BC, Rome fought a series of successful wars with rival powers and formed strong alliances with others. The Punic Wars allowed Rome to expand into the sphere of North Africa, while the Macedonian wars and the Achaean War paved the way for Rome's entrance into the East. The flood of money from war spoils, new business opportunities, and conquest washed over the city. While

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this expansion extended the influence of Rome, it also encouraged influx into Italy and the urban area of Rome of both free and enslaved individuals. As Rome reconfigured the Mediterranean politically, the Mediterranean reconfigured Rome demographically. Yet very little is known about the people who migrated to Rome during the Republican era, meaning migration remains a difficult variable to model in understanding the demographics of the city. An untapped data source in this regard is the human skeleton, which can reveal a wealth of information about an individual, including the person's diet, overall health, and place of origin. Analysis of human skeletal remains from cemeteries in Rome is becoming increasingly common, but the vast majority of those studies focus on Imperial-era remains. Data drawn from Republican-era burials are therefore extremely important in crafting future arguments about the population composition of Republican Rome. In this article, I present available osteological and biochemical data from the Republican-era cemetery of Castellaccio Europarco in the suburbs of Rome and discuss what these data tell us about immigrants to Rome and what additional data can contribute to our understanding of the biohistory of the Roman Republic.

1.1. Population history and migration to Rome

Between the 3rd and 1st centuries BC, or the mid- to late-Republican period, the greater Roman world underwent significant changes, both politically and demographically. Rome and Carthage fought the Punic Wars (264-146 BC), easily the largest battles the classical world had ever known, in competing bids for control over territory in the Mediterranean, and Rome sacked Corinth and took over Greece in 146 BC. Shortly after the end of the last Punic War came the so-called crisis of the Roman Republic, which began with the attempted land reforms of Gaius Gracchus in 133 BC and ended with the ascension of Julius Caesar and the beginning of the Roman Empire (Flower 2004).

Previous treatments of mobility in the Republic, such as Brunt's 1971 *Italian Manpower*, assume that most migration was short-distance and that adults, particularly women, lived their lives in roughly a 30 km geographic radius. The last decade of research on migration, however, has yielded important new information about the movement of people on the landscape of Italy and the wider Mediterranean. The most thorough treatment of migration and mobility in the Republican period comes from William Broadhead, who has argued that migration during the Republic was significant and cannot be overlooked in assessing the demographic and political history of this time period. Broadhead (2002, p. 172) views the demographic changes that occurred in Italy between the 3rd and 1st centuries BC as inextricably related to Roman political history, specifically the 'agrarian crisis' and the inability of the Roman government to control the landscape of Italy.

Much of the migration that occurred during the Republic can be attributed to the machinations of the Roman state. Rome's war against the Latins in 338 BC, for example, catalyzed the founding of dozens of new colonies throughout the Italian peninsula. The Macedonian, Achaean, and Punic Wars resulted in the increased circulation of slaves and captives in the 3rd and 2nd centuries BC. Additionally, the elite's penchant for seizing land in the countryside resulted in the displacement of a huge number of rural peasants who migrated to urban areas in search of work (Hopkins 1978; Pleket 1993; Broadhead 2002), which in turn caused the government to periodically expel groups from Rome, such as the thousands of Latins forcibly removed from the city in 187 BC and repatriated to their hometowns. Further, military conquests during the Republic brought people from diverse geographic areas to the Italian peninsula, particularly slaves from Gaul, Hispania, Germania, Magna Graecia, Asia Minor, Phoenicia, Egypt, and North Africa (Noy 2000). There is also the question of migration of free people for reasons of education, politics, and job opportunities (Noy 2000). The forms of migration and mobility that occurred during the Republic were multifarious. Horden and Purcell (2000, p. 382) note that the population of a given ancient locale at a given time will not reflect those who are "pursuing seasonal agricultural goals ten, a hundred, two hundred miles away; or following the lure or compulsion of political or military activity two hundred, five hundred or a thousand miles away; on pilgrimage, sold into slavery, emigrating, engaged in the redistribution of surpluses."

Although we know that migration was a reality, we do not know the scale of the practice within the Roman world during the Republic. Historical demographers have shown that the growth of the population of Rome cannot be attributed to reproduction alone; a significant amount of immigration to the city would have been necessary to result in the dramatic increases seen in the Republican and later Imperial period populations (Erdkamp 2008). The population of Italy in the 3rd and 2nd centuries BC has been estimated in the low millions, with the population of the city of Rome growing rapidly from 200.000 in the early 2nd century BC to 500.000 around 130 BC (Morley 1996; Scheidel 2008). This dramatic increase in the population in effect started at the end of the Hannibalic War, and around 2 million people immigrated to Rome during the last two centuries BC (Scheidel 2004), with an annual immigration figure estimated at around 10.000 free immigrants and slaves (Morley 1996).

The demographically reconstructed scale of migration in the Republic is impressive but belies the various levels of mobility engaged in during this time period. As Broadhead (2002, p. 11) notes, "The answer to the question 'Who lived where in Italy' is very different for the early 1st century BC from what it is for the late 4th century BC." In spite of the vast historical record of ancient Rome, the information on migration that can be drawn from censuses and epitaphs is quite limited in scope. This irregular and often unevenly distributed material evidence has hindered demographers' ability to create models of the population of the Roman world that take migration into account (Parkin 1992; Erdkamp 2008).

While the dearth of material evidence has relegated migration to the margins (Laurence 1999; Frier 1999), bioarchaeological evidence holds promise as a means of bringing it to the fore. In his chapter "Progress and Problems in Roman Demography", Walter Scheidel (2001, p. 48) notes that "in the future, appraisals of migration will benefit from the biomolecular analysis of skeletal remains, which may shed light on geographical provenance". A decade hence, biochemical analyses are indeed being used regularly by classical bioarchaeologists to answer questions about foodways (Prowse *et alii* 2004, 2005; Craig *et alii* 2009; Rutgers *et alii* 2009; Killgrove, Tykot 2013), cultural activities (Montgomery *et alii* 2010), and migration patterns (Prowse *et alii* 2007; Killgrove 2010a,b). Skeletal remains of people who lived during the Roman Republic can help us identify immigrants in the archaeological record, particularly those individuals who were not commemorated as such, and they can provide clues to the lives of people native to Rome and the lives of foreigners. At a large enough scale, these data can form a complementary set to census records and epigraphical information from tombstones. Biochemically analyzing human bones and teeth can therefore yield new answers to the important politico-demographic question of migration within the Roman Republic.

1.2. Limitations of bioarchaeology

The potential for skeletal analysis to add to our knowledge of the Roman Republic is evident, and yet there remain obstacles to overcome in terms of both burial fashions and the few published Republican cemeteries (Parkin 1992, p. 43). Although there has been a steady increase in bioarchaeological studies of Roman cemeteries in the last decade (Killgrove 2013), the majority of these date to the Empire, a time when inhumation was the dominant burial rite. Less attention has been paid by bioarchaeologists to the Republican era owing to the popularity of cremation, which tends to destroy or chemically alter the human skeleton.

In the Italian peninsula, cremation became fashionable with the Villanovan culture, which existed from around 1000 BC to 750 BC in Etruria. The Etruscans themselves practiced both inhumation and cremation, more or less in equal measure. Between the 7th and 6th centuries, there was a change in burial form among the elite from single cremation or single inhumation to collective inhumations in chamber tombs (Prayon 1986). Starting in the 4th century BC, cremation was the dominant burial practice in Rome, spanning the Republic and the Early Empire (Toynbee 1971). Writing in the 1st century BC, Cicero (*De Legibus* II, 22.56) noted that inhumation was the primitive burial practice in Rome, and Pliny the Elder (*Naturalis Historia* VII,187) wrote in the 1st century AD that cremation was a relatively new tradition among the Romans and that the popularity of cremation among the elite was the conservation of an old custom. Yet by the time of Hadrian, inhumation had come back into vogue, surpassing cremation as the most popular burial practice. Most scholars do not attribute this change solely to the advent of Christianity, as the timing is too early, but rather to a change in custom brought about by some unknown complex of causes (Toynbee 1971; Morris 1992).

Although cremation was the most popular burial rite during the Republican period, not everyone would have been treated in this way. Cremations in the ancient world required a significant amount of natural resources, particularly wood, in order to effectively consume a corpse (Barber 1990). We can therefore infer from the costs associated with cremation and from the historical record that inhumation did not completely disappear in any time period.

Few cemeteries dating to the time of the Roman Republic have been published so far, although the evidence for burial in this time period is growing. For example, the necropolis of Porta Nocera at Pompeii (1st century BC to 1st century AD) includes both cremations and inhumations (Lepetz, van Andringa 2008), and the necropolis at Via Basiliano in Rome includes both forms of burial in the Republican and Imperial eras (Buccellato *et alii* 2003). As interest in the Republican era of Italy grows and as more cemeteries and skeletal remains are found, bioarchaeological research into the diets, disease load, population history, and physical habits of people living in this time period is sure to increase.

1.3. Using isotope analysis to answer anthropological questions

Starting in the 1990s, archaeologists realized that isotope analyses had the potential to identify immigrants to an area, or individuals whose skeletal chemistry was different from what was expected in a particular geographic locale. The first archaeological applications of this method involved strontium, and today the vast majority of strontium isotope analyses address questions of human mobility (Knudson, Price 2007, p. 25). Strontium enters the biosphere through the weathering of rocks and is deposited into groundwater, soil, plants, animals, and humans basically unchanged from its original geological ratio. The $^{87}Sr/^{86}Sr$ ratio of a given rock is related to both its age and its isotopic composition; older rocks have more radiogenic ^{87}Sr than younger rocks. As the atomic radius of strontium is similar to that of calcium, strontium can substitute for calcium in certain minerals, including apatite and phosphate. Almost all of the strontium in the human body, therefore, is found in skeletal tissues (Underwood, Mertz 1977). Bioavailable strontium thus moves unchanged from rocks through the food chain to the human body, where it is incorporated through passive substitution for calcium into the mineral phase of tissue development (Montgomery 2002, p. 34).

Analyses of oxygen isotope ratios became popular in the early 2000s and were quickly applied to archaeological questions about past mobility in Egypt (Dupras *et alii* 2001) and Britain (Budd *et alii* 2003). Oxygen isotope analyses are also being used today to understand the ancient climate, water sources available to humans in the past, and human and animal mobility. The $\delta^{18}O$ of both meteoric (rain, snow) and environmental water (rivers, springs, lakes) varies by region in relation to factors such as temperature, humidity, distance from the coast, latitude, rainfall, and elevation (Craig 1961; Gat 1996). Measurement of $\delta^{18}O$ of a sample can thus provide an indication of the climate of the area in which the sample was formed. The majority of humans' $\delta^{18}O_p$ (phosphate) and $\delta^{18}O_{ca}$ (carbonate) signatures, however, is related to the composition of drinking water (Longinelli 1984, Luz, Kolodny, Horowitz 1984; Levinson, Luz, Kolodny 1987; Iacumin *et alii* 1996). If the majority of the oxygen that a person ingested or inspired while his teeth and bones were forming came from local water sources, the measured $\delta^{18}O$ value from his hard tissue would be characteristic of the geographical peculiarities of that water, taking into account metabolic fractionation between enamel and body water (Levinson, Luz, Kolodny 1987; Iacumin *et alii* 1996; Daux *et alii* 2008). It is therefore possible to use measured $\delta^{18}O$ values to identify individuals who accessed either local or nonlocal water sources and, by inference, locals and immigrants.

The frequently utilized elements of strontium and oxygen form independent systems that reflect their consumption by plants, animals, and humans in the food chain. The combination of strontium and oxygen isotope analyses thus provides a powerful method of identifying immigrants in the archaeological record (Bentley, Knipper 2005; Evans, Chenery, Fitzpatrick 2006; Schroeder *et alii* 2009).

2. Materials

The Republican-era skeletal sample comes from the site of Castellaccio Europarco, which was located 11,5 km south of Rome along the ancient *Via Laurentina* (fig. 1). Buccellato (2007) and Buccellato and colleagues (2008) report that the earliest occupation of the site, 4th-3rd centuries BC, included a rustic building that measured about 280 m^2. Between the construction of the building and its abandonment by the 2nd century BC, the *Via Laurentina* was turned from a beaten path into a paved road, yielding various levels of road construction throughout the use of Castellaccio Europarco.

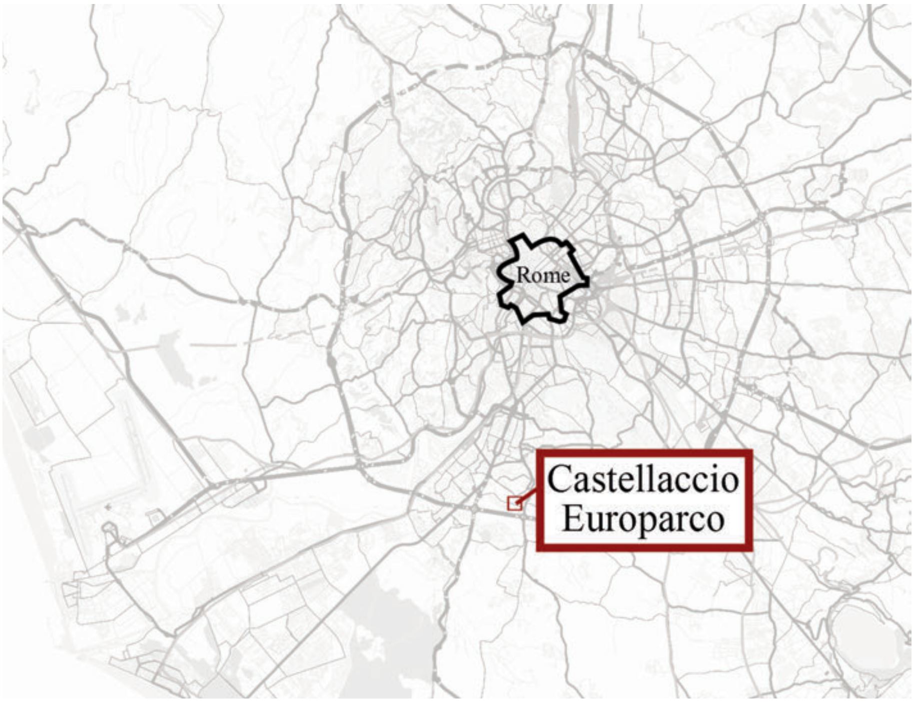

Fig. 1. Map of Rome Showing Location of Castellaccio Europarco.

Coinciding with the first phase of built architecture at the site, Phase 1 burials from Castellaccio Europarco date to the 4th-3rd centuries BC, or the early- to mid-Republican era. Burials that date to this time period include 14 inhumations (12 single and 2 multiple), 1 *bustum* (*in situ* cremation), and 3 pits with no human remains. In total, 17 individuals were studied. Phase 2 burials date to the 2nd-1st centuries BC, or the Late Republican era, when the *Via Laurentina* was covered with gravel and lined with walls of *opus incertum*. During this phase, the cemetery area held 11 cremations (two of which were *busta*) and 14 burials. In total, there were 11 skeletons available for study.

There is no historical or epigraphical evidence naming the individuals buried at Castellaccio Europarco. Because of the simple grave types and the lack of numerous grave goods, it is likely that this necropolis contained individuals from the lower classes, possibly laborers associated with the villa.

3. Methods

3.1. Demography

Demographic data were collected from the skeletons based on the guidelines in Standards (Buikstra, Ubelaker 1994). Pelvic morphology (Phenice 1969), cranial morphology (Acsádi, Nemeskéri 1970), and long bone measurements (Ousley, Jantz 1996) were used to assess sex, and pubic symphysis morphology (Todd 1921a,b; Brooks, Suchey 1990), auricular surface changes (Lovejoy *et alii* 1985), and cranial suture closure (Meindl, Lovejoy 1985) were used to assess age-at-death of adults. Subadult age-at-death was estimated using tooth formation and eruption (Moorrees *et alii* 1963a,b; Gustafson, Koch 1974; Anderson, Thompson, Popovich 1976) as well as epiphyseal union and long bone length (Baker, Dupras, Tocheri 2005; Johnston 1962).

3.2. Biochemistry

The skeletal tissue chosen for this biochemical analysis is enamel from the first molar. This tooth begins forming at birth, and the crown is complete by age 3 (Hillson 1996). Isotopes present in the first molar therefore reflect the foods and water sources an individual was consuming in early childhood.

Before beginning strontium isotope analysis, each molar was first cleaned by abrading the tooth surface. Between 5 to 10 mg of dental enamel was extracted using a Brasseler hand-held dental drill fitted with a 0,3 mm round tungsten carbide bit, weighed on a Sartorius microbalance, and stored in 5 mL Savillex vials with deionized water until it could be processed. Strontium was extracted from the powdered enamel by dissolving it in 500 µL of 7M HNO_3, then evaporating and redissolving it in 500 µL of 3,5 M HNO_3. Sr-Spec™ columns were cleaned and loaded with 50 to 100 µL of EiChrom SR-B100-S resin, and the enamel sample was centrifuged. The sample was loaded by pipette from the centrifuge vial and subjected to dropwise and bulk sample rinses with HNO_3. Strontium was eluted into a clean Savillex vial with water, 25 µL of H_3PO_4 was added, and the water was allowed to evaporate on a hotplate. The sample was redissolved with 2 µL of TaCl5. Half of the strontium was loaded onto a rhenium filament, and the $^{87}Sr/^{86}Sr$ isotope ratio was measured on a fully automated VG Micromass Sector 54 TIMS spectrometer in reference to standard NBS-987, which has a value of 0,710270 ± 0,000014 (2σ). The internal precision for strontium runs is typically ± 0,0012 to 0,0018% (2µ) standard error based on 100 dynamic cycles of data collection.

Prior to analysis of the light isotopes of carbon and oxygen, the outer layer of each tooth was cleaned using a diamond dental burr. A single sample of approximately 15 mg was extracted from the enamel of each tooth. Between individuals, the dental burr was cleaned with 4 M HNO_3, rinsed with deionized water, placed in an ultrasonic bath for five minutes, and swabbed with acetone. The procedure for pre-treatment of enamel apatite is based on Sponheimer (1999). Each sample received 1,8 mL of NaOCl. Samples were rinsed with deionized water and centrifuged three times. 1,8 mL of 0,1 M acetic acid was added, and the samples were again rinsed with deionized water and centrifuged three times. Samples were heat-dried overnight and finally freeze-dried before being weighed and loaded onto the IRMS. Values of $\delta^{18}O_{ca}$ and $\delta^{13}C_{ca}$ were obtained from the hydroxyapatite carbonate portion of tooth enamel using a Thermo Delta V Advantage CF-IRMS, and the samples were normalized relative to two laboratory standards: NBS19 and Merck $CaCO_3$. The international standard for reporting oxygen isotope abundances is Vienna Standard Mean Ocean Water (VSMOW), and the standard for carbon isotope abundances is Vienna Pee Dee Belemnite (VPDB). The average values of duplicate or triplicate samples of enamel are reported below relative to these standards, with standard error (1σ) of 0,12 for $\delta^{18}O_{ca}$ and 0,06 for $\delta^{13}C_{ca}$.

4. Results

4.1. Demographics

Table 1 presents the Republican period individuals broken down by age, table 2 presents the adults broken down by sex, and figure 2 presents the data in an age-at-death histogram.

	Phase 1 #	Phase 1 %	Phase 2 #	Phase 2 %	Total #	Total %
Fetal	2	11,8	—-	—-	2	7,1
0-5	3	17,6	3	27,3	6	21,4
6-10	1	5,9	—-	—-	1	3,7
11-15	2	11,8	1	9,1	3	10,7
16-20	—-	—-	—-	—-	—-	—-
21-30	—-	—-	—-	—-	—-	—-
31-40	4	23,5	5	45,4	9	32,1
41-50	3	17,6	2	18,2	5	17,9
51-60	—-	—-	—-	—-	—-	—-
61-70	—-	—-	—-	—-	—-	—-
Adult	2	11,8	—-	—-	2	7,1
Total	17	100%	11	100%	28	100%

Tab. 1. Age-at-Death of the Republican-Era Castellaccio Europarco Population.

	Phase 1 M	Phase 1 F	Phase 2 M	Phase 2 F	Total M	Total F
16-20	—-	—-	—-	—-	—-	—-
21-30	—-	—-	—-	—-	—-	—-
31-40	3	1	2	2	5	3
41-50	2	1	1	1	3	2
51-60	—-	—-	—-	—-	—-	—-
61-70	—-	—-	—-	—-	—-	—-
Adult	—-	—-	—-	—-	—-	—-
Total	5	2	3	3	8	5
Sex Ratio	71,4%	28,6%	50%	50%	61,5%	38,5%

Tab. 2. Sex and Age-at-Death of Republican-Era Castellaccio Adults.

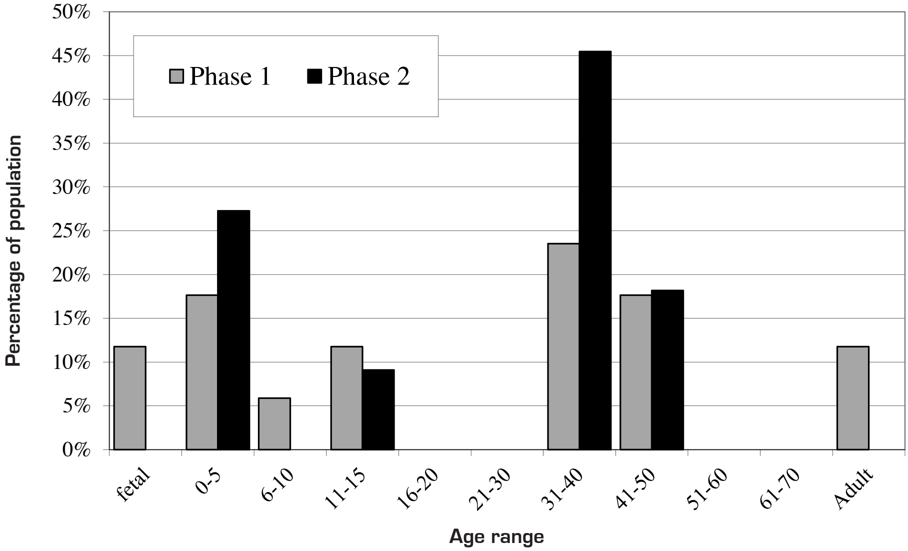

Fig. 2. Demography of Republican-Era Castellaccio Europarco Population.

There are clearly too few individuals in Phases 1 and 2 to assume that this is a representative sample of the Republican population of Rome or to draw conclusions about the demographic structure of the population. Nevertheless, owing to the distinct lack of analyzed skeletal remains from the Republican period of Roman history, these demographic data should prove important in future comparative studies. Based on the demographic data from Castellaccio, it is clear that men, women, and children were all buried within this suburban cemetery, and based on the archaeological data, inhumations and cremations were equally popular during the Late Republican phase of the cemetery.

4.2. Isotopes

Of the 28 skeletons examined from the two Republican phases of Castellaccio, only 6 presented first molars that could be biochemically tested. All of these were subjected to strontium isotope analysis, and four of them were also subjected to oxygen and carbon isotope analysis. Results of the biochemical testing are presented in table 3.

In order to identify immigrants to Rome, it is necessary to delimit the expected ranges for strontium and oxygen isotopes given the geology and climate of the region. Creating the expected ranges is complicated, how-

Skeleton	Phase	Age	Sex	$^{87}Sr/^{86}Sr$ Ratio	Sr ppm	$\delta^{18}O_{ca}$ VSMOW	$\delta^{13}C_{ca}$ VPDB
ET93	1	6-10	I	0,709838	329	26,20	-13,21
ET82	1	31-40	M	0,707175	—-	25,78	-7,36
ET79	1	31-40	M	0,710076	—-	—-	—-
ET98	1	31-40	M	0,709977	—-	—-	—-
ET85	1	41-50	F	0,709523	—-	27,51	-12,26
ET70	2	41-50	F	0,710127	—-	27,46	-11,81

Tab. 3. $^{87}Sr/^{86}Sr$ and $\delta^{18}O_{ca}$ of Republican burials from Castellaccio Europarco.

ever, by the paucity of published human and faunal studies from the Italian peninsula and by the presence of aqueducts that imported water from areas with significantly different Sr and O values into Rome.

A strontium range for Republican Rome can be modeled based on geology and checked with archaeological faunal samples from the region. Rome is positioned between two dormant volcanic complexes, the Colli Albani and the Monti Sabatini, and situated to the west of the Apennine Mountain foothills (Monti Simbruini), which are composed of Meso-Cenozoic sandstones and limestones (Pellegrini *et alii* 2008; Vinciguerra *et alii* 2009), and to the east of the Tyrrhenian Sea. The strontium isotope ratio of volcanic rock in central Lazio ranges from 0,7090 to 0,7107 (Faure, Powell 1972), while the Apennine foothills are significantly lower, at 0,7079 to 0,7080 (Barbieri, Sappa 1997), and the Tyrrhenian Sea is 0,7092 (Bentley 2006). One tooth from *Sus scrofa* found in association with an Imperial-era burial (ET20) from Castellaccio Europarco was measured for strontium isotopes and yielded a value of 0,710313 (Killgrove 2010b, p. 210), in line with expectations for an animal that lived on the volcanic geology around Rome.

Based on the geology of central Lazio and the assumption that locals in the Roman suburbs obtained the majority of their water locally, a conservative strontium isotope range of 0,7090 to 0,7103 can be suggested, which would make only 1 of the 6 individuals tested an immigrant to Rome. People who lived within the city of Rome as children, however, may have been able to obtain water with significantly lower strontium isotope values due to aqueducts. During the mid-Republican phase, the Aqua Anio Novus brought water from the foothills to Rome, and during the Late Republican phase, the Aqua Marcia was added to import more water, both providing millions of gallons of water each day to the city (Taylor 2000). The one individual identified as an immigrant based on a low strontium isotope value, however, has a much lower measurement than found in the geology of the foothills. The most parsimonious explanation is that individual ET82, a male in his 30s when he died, immigrated to Rome some time after childhood. Further, his low $\delta^{13}C_{ca}$ value suggests that, compared to the locals, his diet consisted of more millet, a result that is unsurprising when viewed in the light of palaeodietary results from the Imperial phase of Castellaccio Europarco (Killgrove, Tykot 2013).

One previous study assessed the potential oxygen isotope range for Rome using 24 deciduous teeth from 19 children confirmed to have been born in the city between 1985 and 1989 (Prowse *et alii* 2007). The oxygen range that Prowse and colleagues (2007) calculated in order to assess immigration to Imperial-era Portus Romae is -6 to -4‰ VPDB, which is equivalent to 24,73 to 26,80‰ VSMOW (Coplen, Kendall, Hopple 1983). Further, this range is consistent with expectations based on the current knowledge of environmental oxygen isotope ratios in Italy (Longinelli, Selmo 2003; Bowen, Revenaugh 2003). Given this range, two additional individuals from Castellaccio may have been immigrants:

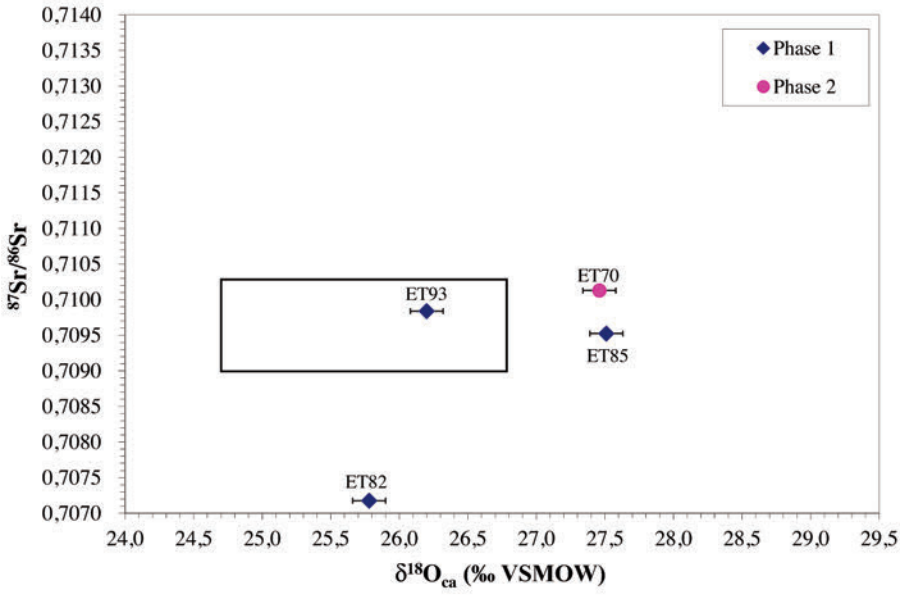

Fig. 3. Republican Strontium and Oxygen Isotope Ratios.

ET85 and ET70, both females in their 40s at death, whose oxygen isotope results are slightly higher than expected. Nevertheless, it is not unusual in oxygen isotope studies of populations to see a tail on the positive end of a distribution as a result of boiling, evaporating, or brewing dietary water (Daux *et alii* 2008), which enriches an individual's $\delta^{18}O_{ca}$ value. The $\delta^{13}C_{ca}$ values for these individuals are not unusual for Rome, but carbon isotopes do not capture all of the human diet, nor do they provide much information on ways that food was processed. Dietary variation could explain the high $\delta^{18}O_{ca}$ values of ET85 and ET70, but migration from an area with similar strontium values and a slightly hotter, drier climate is also plausible.

A graphical representation of the calculated local range of strontium and oxygen can be found in figure 3. Hypothesized limits for the two isotope systems are indicated such that points within the box represent locals, or people who were born and raised in Rome, while the points outside the box are likely immigrants, or people who were born elsewhere and came to Rome some time after early childhood.

The Republican population at Castellaccio Europarco thus includes one individual (ET82, a male in his 30s) whose strontium ratio, 0,707175, is unlike the other individuals in those time periods. He may have arrived at Rome from an area with much younger geology but with a similar climate, such as Pompeii (Turi, Taylor 1976; Avanzinelli *et alii* 2008). Further, individuals ET85 and ET70, both females in their 40s, have anomalous $\delta^{18}O_{ca}$ measurements compared to the range established. They may have been preparing food differently than other people in the Roman suburbs, or they may have arrived from an area that was hotter and drier than Rome but with similar geology.

5. Discussion

5.1. Population history and migration

Millions of immigrants arrived at Rome during the Republic. Some were slaves hoping to gain manumission and a chance at Roman citizenship; others were transient merchants and artisans who traveled to the Roman Forum to sell their wares and who inhabited the hundreds of rented apartments within the city; still others were local elites, such as Pompey or Cicero, who had come from cities within Italy to launch a political career on the national stage. Although this biochemical study of four presumably lower-class individuals buried in the outskirts of Rome cannot be extrapolated to encompass the entirety of Rome's diverse population, these new data hint at the kinds of questions that will soon be answered on a large scale with isotope and DNA analyses.

Individual ET82 was quite clearly not born or raised in Rome. His strontium isotope value cannot be reconciled with local geography, even given the importation of water via aqueducts, and his childhood diet was also anomalous. Even leaving aside the question of whether ET70 and ET85 were immigrants or were just engaging in different foodways, the data generated from ET82's dental enamel indicate the existence of a long-distance immigrant to Rome during the early to mid-Republican period. This evidence runs counter to previous assumptions about the lack of mobility of the lower classes in Republican times (Brunt 1971). It is, however, just one data point, and even a liberal interpretation of the isotope data reveals just three potential immigrants in this sample.

It is also important to note the differences in burial tradition at Castellaccio Europarco, as in both Republican phases of use, the cemetery held both inhumations and cremations. In Phase 1, burials outnumbered cremations 12:1, and in Phase 2, burials only slightly outnumbered cremations, at a ratio of 1:1,2. Biochemical analysis can only be performed on inhumed skeletal remains, as the heat of cremation can alter the biochemical structure of bone and enamel (Killgrove 2005). If foreigners at Rome were being buried rather than cremated, we would expect to find a significant number of them in the osteological record; this is a possible explanation for the finding that three out of four individuals tested fell outside of either the local strontium range or the local oxygen range. A burial bias such as this does not detract from the fact that there were foreigners buried in the suburbs of Republican Rome, but it does call into question the scale of migration, as being unable to test the cremations hinders the potential for extrapolation of these and future data.

5.2. Osteobiography of ET82

While the tendency with bioarchaeological data is to view immigrants as a group, the information generated from osteological and biochemical analyses can also be employed to tell the life history of individual immigrants. In this small study, ET82 – a male in his early 30s at death (fig. 4) – emerged as a clear outlier, with a strontium signature suggestive of a childhood spent living on younger geology and with a carbon isotope value that shows this man ate more millet (or animals foddered on millet) as a child than did people local to Rome.

Fig. 4. The face of ET82, an immigrant to Republican Rome.

This man came to Rome between the 4th and 3rd centuries BC, at some point after his childhood, from an area geographically similar to Naples, although it is unknown if he made additional stops along the way or if the city was his intended destination. His skull interestingly had evidence of a paracondylar process (fig. 5), an anatomical variant that is quite rare in contemporary European populations but is common in India (Anderson 1996). Direct Indo-Roman relations did not start until the early Empire, but it is possible this man came from a population genetically similar to Indians. An ancient DNA assessment of individuals buried at Vagnari in south-central Italy revealed an individual with an East Asian haplogroup (Prowse *et alii* 2010), so it is not completely out of the realm of possibility to suggest someone with Indian ancestry could make his way to Rome.

Skeletal injuries and dental disease sustained before his death speak to a challenging life for ET82. Decay is rampant in his molars, with carious lesions in all of them, antemortem loss of one molar, and abscesses in two of the remaining molars, in addition to widespread dental calculus and chipping. Clearly, ET82's dental hygiene was poor, and it is possible that a diet high in carbohydrates contributed to this. Marked muscle development, particularly of the lower arms and lower legs, suggests an active lifestyle, and periostitis in these areas also speaks to perimortem insults to his body.

ET82 was buried in the suburbs of Rome, in a pit grave nestled against a retaining wall for the ancient *Via Laurentina*. Whether he had a grave marker or not will never be known, but his skeletal remains reveal more about his life than an epitaph ever could.

6. Conclusions

The skeletons of the Roman world can tell us much about the migrants to the city of Rome who until now have garnered little attention. One of the most exciting possibilities in studying the skeletons of the

Fig. 5. ET82's Paracondylar Process (center of photo; inferior cranial base toward top).

Roman world is the increased precision and dropping cost of ancient DNA analysis. This method has already been employed at Imperial-era Vagnari in south-central Italy to identify an individual with East Asian heritage (Prowse *et alii* 2010). Coupling individuals' haplogroups with their strontium and oxygen isotope values is a powerful way to look at the genetic history of immigrants in the Roman world and will allow bioarchaeologists to get closer to pinpointing an immigrant's homeland. Another useful application of biochemical analysis is in tracking migration over the life of an individual, by sampling teeth that form at different times in a person's life. These enamel time-capsules may be able to answer questions about whether migrants moved from point A to point B or whether they wended their way from the place of their birth to the place they were buried. Skeletal tissue has the potential to reveal the dynamic nuances of migration in a way that static histories and epitaphs cannot.

Bioarchaeology in the Roman world is a growing field but still has a long way to go. Skeletal remains need to be studied and cemeteries need to be fully published before it becomes possible to use these data in creating and refining models of migration to Rome and around Italy and the Empire. There is a distinct need for bioarchaeological studies of Republican-period cemeteries, although a large hurdle is the fact that cremation was a popular burial rite in this time period.

This paper has presented the basic demographic data collected and the results of the stable isotope analyses undertaken on a small sample of burials from a suburban Roman cemetery. It is my hope that future studies will help clarify the data on migration that these individuals from Republican-period Castellaccio Europarco have furnished. The immigrant population was very visible in Republican Rome, and skeletal studies may allow these people to reappear before modern eyes.

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