RESPONSE by K. Killgrove

to C. Bruun, “Water, oxygen isotopes and immigration to Ostia-Portus”

I read with interest C. Bruun’s re-interpretation of the oxygen isotope results of T. Prowse and colleagues from human dental enamel from Portus.\(^1\) Bruun raises an excellent point about the need for students of the classical world to engage both hard and soft data in their discussions of the Roman past; his re-analysis of the conclusions of Prowse et al. demonstrates that both humanistic and scientific approaches can be taken to the same data set. For those of us who work in a well-documented era of history, it is important to debate, challenge and eventually incorporate new information that results from both kinds of inquiry. I do, nevertheless, have a few comments, made from the perspective of a bioarchaeologist engaged in isotopic analysis of human remains from Rome.

Physical anthropology, which, in the United States, incorporates bioarchaeology among other subfields, tends towards the scientific. Because of the divergent evolution of classics and anthropology in the U.S.A., it is unsurprising that, as Bruun notes, the American Journal of Physical Anthropology is not at the top of any classicist’s list of important publications, even if it is considered foremost in its own field. In addition, the dearth of skeletal populations from Rome available for osteological and chemical analysis means that the development of a bioarchaeological research program for the Roman world has lagged behind other avenues of archaeological inquiry.\(^2\) However, as the recent JRA supplement 78 (H. Eckardt [ed.], Roman diasporas: archaeological approaches to mobility and diversity in the Roman Empire) shows, within recent years producers of hard and soft data have begun to work together.\(^3\) At the same time, those who deal more often with scientific data and those dealing with humanistic data have their own methods and their own language, which can lead to misinterpretations on either side of what is too often a divide in academe.

In his second paragraph, Bruun notes that his discussion will address “the way in which the dental material was made to yield this conclusion”, namely the suggestion by Prowse et al. that migration was a complex phenomenon that involved families. This is a somewhat unfairly worded criticism of their study and it implies a dissatisfaction with the scientific method. There exists a general theory of migration to Rome (and to Portus) based

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on data drawn from history, epigraphy and archaeology, and to this collection of sources Prowse et al. hoped to add biological remains. Their assumption was that human remains from Isola Sacra could yield information on individuals who had originated elsewhere, and they successfully found such evidence. Further, they were able to say that several individuals had come to Portus before their third molars had finished forming. Although Bruun may be correct in his assumption that chemical testing itself is not often repeated to confirm independently every result, he is incorrect in his insinuation that the sources and methods of laboratory analysis are not as open as those of epigraphy, and that the results are not continuously tested. Isotope results are frequently re-analyzed, often within the context of new data. It is true that there is a longer history of this practice in the case of carbon and nitrogen isotope analyses of palaeodiet than with oxygen and strontium isotope analyses of movement and mobility, since the latter constitute a much newer approach in bioarchaeology. In order to construct a better theory of migration to Rome, it is therefore important to continue to subject additional populations to isotope analysis and to examine critically the resulting data, particularly from a humanistic standpoint.

Bruun challenges the suggestion by Prowse et al. that they have produced evidence of family migration, and in this we agree. What Prowse et al. have provided is evidence of the mobility of several individuals at some point during childhood, defined as roughly the range of 3-12 years old based on molar formation. The decision to test both first and third molars constrained the lower age limit of individuals available for the study. Proving family migration would require testing younger children and looking at epigraphical evidence, as Bruun notes, and/or doing costly analyses of ancient DNA. Bruun further challenges the conclusion of Prowse et al. that they identified people who “migrated to Ostia-Portus ‘during childhood’.” He constructs plausible alternate scenarios or “life stories” for these immigrants, including the suggestion that “these figures might equally well fit an individual who grew up in the mountainous interior of Spain or N Africa, moved down the coast at 13 ..., and only took ship to Ostia as an adult”. Here I believe that the scientific and humanistic traditions may have run up against a language barrier. Bruun suggests that “we can only talk about likelihoods” of migrant homelands and age at arrival.

Bruun (n.51) writes that “Killgrove 2010 ... agrees with the team in their conclusions regarding immigration to Portus and especially the immigration of young people (p. 267-72)”. I did note (268) that Prowse and colleagues convincingly indicate that individuals immigrated during childhood, that is, between 3 and 12 years old, but on 287 I specifically disagreed with their conclusion of family migration and suggested that slavery, marriage and apprenticeships could all be valid explanations for the appearance of non-local young people at Portus and at Rome. At Rome I tested 14 individuals whose age at death was less than 16 and found that 64% were unlikely to have been born locally (ibid. 286-87). At least two of these children came to Rome before the age of 9 (p. 267). Testing first molars from young children can therefore help refine the terminus ante quem for their arrival at Rome.

5 However, see A. Millard and H. Schroeder, “‘True British sailors’: a comment on the origin of the men of the Mary Rose,” JArchSci 37 (2010) 680-82, for a recent re-analysis of oxygen isotope data from the Mary Rose shipwreck. More directly relevant here is my re-analysis of the modern Roman sample presented in Prowse et al. (supra n.1), reaching new conclusions: Migration and mobility in Imperial Rome (Ph.D. diss., Univ. of N. Carolina, Chapel Hill 2010) 245-50.
6 In order to construct a better theory of migration to Rome, it is therefore important to continue to subject additional populations to isotope analysis and to examine critically the resulting data, particularly from a humanistic standpoint.

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at Portus, as if the ability to create multiple, and increasingly convoluted, interpretations somehow diminishes the utility of isotope analysis. With the huge potential for travel in the Roman empire, it is not unreasonable to create scenarios such as this for a free immigrant. But scientists tend to adhere to Occam’s razor, or the *lex parsimoniae*, particularly when interpreting pilot data from a new field of inquiry such as isotope analysis of Roman skeletons.⁸ Given the information at hand, the most conservative explanation for the data generated by Prowse *et al.* is that the non-local individuals migrated specifically to Portus and that they arrived there sometime between the ages of 3 and 12. These explanations are sufficient for the data presented; more complicated paths could be found along the lines Bruun suggests, and testing multiple teeth from one individual might help illuminate an individual’s cumulative mobility.

Bruun’s other major concern is Prowse *et al*.’s failure to acknowledge the importance of aqueduct water at Rome, a topic I have discussed at length elsewhere, so here I will only briefly summarize why, although Bruun makes a valid point that the importation of water with significantly different oxygen isotope ratios could affect the ratios found in dental enamel, in the case of Rome it is likely that diet had a greater effect than water on humans’ oxygen isotope ratios. The δ¹⁸O value of water tends to decrease with an increase in elevation, and Bruun concludes that aqueduct water should be about 0.4-0.6‰ lower than the local water found in the low-lying areas of Rome and Portus. If this inverse relationship between elevation and the oxygen isotope value of water is directly applicable to human ratios, we would expect the population of Portus to have somewhat higher oxygen values on the whole compared to the population of Rome, the latter of which probably had greater access to aqueduct water. A histogram of the oxygen values from Portus and Rome,⁹ however, contradicts this hypothesis: the populations overlap, but the median of the Roman samples is higher than the median of the Portus samples. This difference could instead be related to homeland. Prowse and colleagues postulated that many of their non-locals came from the central Italian peninsula. It could also, however, be related to diet. Bruun does not mention diet as a possible contributing factor in understanding the range of oxygen isotope values in Rome or Portus. It is well known that boiling, evaporating or brewing dietary water — as in cooked foods or wine — can inflate a person’s oxygen isotope ratio. Bruun’s peculiar suggestion that “young children living and playing on or near the beach would be exposed to seawater vapour” and thereby would obtain slightly higher oxygen isotope ratios is not the most parsimonious explanation for any of the oxygen isotope ratios measured by Prowse *et al.* at Portus. Differences in diet, as judged by carbon and nitrogen isotope analysis, have been found in the Imperial period throughout the peninsula. More importantly, T. Prowse’s Ph.D. dissertation and her subsequent publications¹⁰

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⁸ K. McDonnell, *A gendered landscape: Roman women’s monuments, patronage, and urban contexts in Pompeii, Isola Sacra, and Aquileia* (Ph.D. diss., Univ. of N. Carolina, Chapel Hill 2005), scenarios like the ones posed by Bruun can be effectively used to illustrate possible life histories and choices (e.g., ibid. 35-40).

⁹ Killgrove (supra n.5) 269, fig. 9.8.

detail the diet of individuals buried at Isola Sacra, and there are striking dietary differences between this population, the ones I examined from Rome,\textsuperscript{11} and those from an Early Christian necropolis at Rome.\textsuperscript{12} Diet can help explain both the oxygen isotope "anomalies" Bruun notes in the modern sample that Prowse \textit{et al.} studied\textsuperscript{13} as well as the differences in oxygen isotope ratios between the populations at Portus and Rome.\textsuperscript{14}

It is, as Bruun writes, "particularly important to integrate the epigraphic evidence with any study of the dental enamel" if such evidence exists. Should there be tombs with both dental remains and inscriptions at the Isola Sacra cemetery, this line of research would be well worth pursuing. Until we find significant skeletal populations linked to reliable funerary inscriptions, however, bioarchaeologists interested in issues of migration to Rome and Portus need to work with the thousands of available skeletons of the nameless lower classes and slaves, and then need to situate the hard data that we create within the framework of what we know of Roman culture in our efforts to contribute to the overall theory of migration in the Roman Empire.

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\item Killgrove (supra n.5) 174-78.
\item Killgrove (supra n.5) 248.
\item Ibid. 269-71.
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