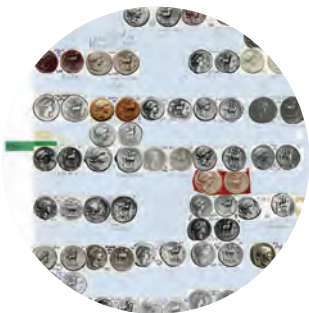




DEPARTMENTS



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Facing Image: A page from Richard “Dick” Schaefer’s binders. The specimens here collected are part of RRC 426/3, one of the issues of 56 BCE under the name of Faustus Cornelius Sulla, son of the dictator.

## OPENING ACCESS TO ROMAN REPUBLICAN DIE STUDIES

*Lucia Carbone and Liv Mariah Yarrow*

*The practical problem is that counting all the dies used to strike during the Republic would be the work of several lifetimes. (M. H. Crawford, Roman Republican Coinage = RRC , 641)*

With these words, M. H. Crawford authoritatively stated the virtual impracticability of comprehensive die studies encompassing the whole of Roman Republican monetary production. About 25 years ago Richard “Dick” Schaefer began to collect systematically images of all struck Roman Republican issues included in Crawford’s *Roman Republican Coinage*. The final result of his Promethean task, an archive including statistically relevant die studies for all these coinages, seems to refute Crawford’s statement. His archive proves that it is indeed possible, even if extremely challenging, to create reliable quantitative data for the monetary production of the Roman Republic. The ANS has now partnered Dick Schaefer in the Roman Republican Die Project (RRDP), aiming at making available to the public what is likely to be the largest die study ever undertaken.

### The Die Study Turns 150!

A hand-carved die leaves a unique and recognizable impression. However, the first systematic analysis of coin specimens at the level of the die was not conducted until 1869 when Sylvester Sage Crosby in collaboration with the collector Joseph N. T. Levick studied the American half cents and cents of 1793. Their initial findings regarding the 1793 issues were published by the *American Journal of Numismatics* in 1869 (figs. 1–3).<sup>1</sup> Remarkably,

the famous Swiss numismatist Friedrich Imhoof-Blumer separately developed the same technique and completed and published his own die study of the coins of Acarnania in 1878 (figs. 4–5).<sup>2</sup> Since the work of Crosby and Imhoof-Blumer the die study has become an essential part of the numismatists’ tool kit and the gold standard for identifying a coin is at the level of the die. Whereas typologies represent a subjective, even if expert judgement about what details construe meaningful intentional differences in design, correct die-identification is always replicable and verifiable by any trained numismatist.

Besides this inherent veracity of identification, there are two major ways that die studies are used by numismatists: 1) to reconstruct striking processes at a mint, especially the sequence in which dies were used and how many work-stations a mint employed, and 2) to quantify the number of dies used to strike an issue. The first is widely accepted; the latter remains controversial.<sup>3</sup> Even those who accept that quantification is possible and useful bemoan the fact that die studies are so laborious that it would be impossible to complete enough die studies of large enough issues to say anything

Boston in 1897 by Crosby himself. Both publications are now in the public domain and fully digitized online at HathiTrust and other digital repositories. On the publication of the first numismatic plate ever for this article on the *American Journal of Numismatics* of 1869, see J. Neiswenter, 2008, “Levick, Crosby, and the Plate,” *American Numismatic Society Magazine* vol. 7, no. 2, 60–69.

2. F. Imhoof-Blumer. 1878. *Die Münzen Akarnaniens*. Vienna: Manz. Although 202 pages and exceptionally detailed, it only includes three plates. This also is now in the public domain and fully digitized online at HathiTrust and other digital repositories.
3. For an introductory overview, see C. Howgego. 1995. *Ancient History from Coins*. London: Routledge, esp. pp. 28–33.

1. S. S. Crosby and J. N. T. Levick. 1869. “Types and varieties of the U.S. Cent 1793,” *American Journal of Numismatics* 3, 93–97. Two hundred copies of a final version, *The United States Coinage of 1793, Cents and Half Cents* (36 pages, 3 plates) were printed in



Figure 1: Sylvester Sage Crosby (1831–1914). A watchmaker and a collector, he published the first die study ever performed on the US cents of 1793, published in April 1869. He further expanded this study into a fuller treatment of the cents and half cents of 1793 in a monograph published in 1897, *The United States Coinage of 1793, Cents and Half Cents*. Crosby’s second major numismatic work, *The Early Coins of America*, was a study of the pre-federal coin issues in what is now the United States, published from 1873 through 1875, which remains an essential source today.



Figure 2: Joseph N. T. Levick (1828–1908). Treasurer of the ANS from 1867 to 1875, Levick helped found the Society’s successful publications program in 1866 when he championed the effort to launch the first American numismatic journal—*The American Journal of Numismatics*.



Figure 3: Type II of the plate included in the Crosby-Levick original publication of 1869. The photographer’s oval shaped trademark, “ROCKWOOD / PHOTOGRAPHER / 839 B’WAY NY,” is only found on Type 2 plates that came from this original run. This trademark is embossed at the bottom of the plate, between obverse 11 and reverse K. However, it’s hard to see unless you tilt the plate so the light hits it at just the right angle (see Neiswinter 2008, Figure 7).

particularly meaningful about the ancient money supply, let alone the ancient economy. Some have sought means of using machine vision or computer-aided measurement akin to facial recognition to speed the die study process. To date no computer-aided die study has been published, although the future possibility cannot be ruled out.<sup>4</sup> Human observation and human verifiable comparisons remain the most reliable means of completing a die study.

### The Largest Die Study to Date: Richard Schaefer’s Archive and the RRDP at the ANS

Now, 150 years after Crosby’s first study, the ANS’s Roman Republican Die Project makes available to the public Dick Schaefer’s archive, likely the largest die study ever undertaken (figs. 6–7). Schaefer’s study encompasses all struck Roman Republican issues included

4. <http://numismatics.org/pocketchange/cads/>.

in Crawford’s *Roman Republican Coinage* with a few logical exceptions, such as the large issue of C. Piso L.f. Frugi (RRC 408, c. 61 BCE re-dated based on the Mesagne hoard) for which Charles Hersh had already produced a complete die study.<sup>5</sup> The goal of this project has been to collect enough images and identify enough dies to achieve 90% or better coverage. Coverage is a

5. C. A. Hersh. 1976. “A Study of the Coinage of the Moneyer C. Calpurnius Piso L. F. Frugi,” *Numismatic Chronicle* 16.136: 7–63. C. A. Hersh and A. Walker. 1984. “The Mesange Hoard,” *American Numismatic Society Museum Notes* 29: 103–34. Some alternate assignments and a useful appendix of different proposed dates is provided by Hollstein, Wilhelm. 1993. *Die stadtrömische Münzprägung der Jahre 78–50 v. Chr. zwischen politischer Aktualität und Familienthematik: Kommentar und Bibliographie*. Munich: Tuduv; see esp. pp. 380–82. Likewise, some alternate interpretations are proposed for the moneyers of the years 58–50 BCE by H. B. Mattingly. 1995. “The Mesagne Hoard and the Coinage of the Late Republic,” *Numismatic Chronicle* 155: 101–08.



Figure 4: Friedrich Imhoof-Blumer (1838–1920).



Figure 6: RRDP in action. Richard “Dick” Schaefer’s working station.



Figure 7: RRDP in action. One of Schaefer’s drawers with clippings.

statistical means of quantifying something most of us can easily intuit: once you’ve seen lots of coins it is less likely that the next coin you see will surprise you with something new. Coverage gives us a prediction of that likelihood. Schaefer regularly explains the principle by using a classic application: “Coverage is the best statistic for analyzing a random sample from a population consisting of types of unequal size. Expressed as a percentage, it is the probability that the next example will be of a type already known.” When the New York City school system was first developing programs for English as a Second Language students, Schaefer explains,

*they needed to know when students learning English had read enough introductory books. The population was the body of English words; each type was a word (including all forms of the word); each word in the book was an example. When coverage became high enough, the students were*

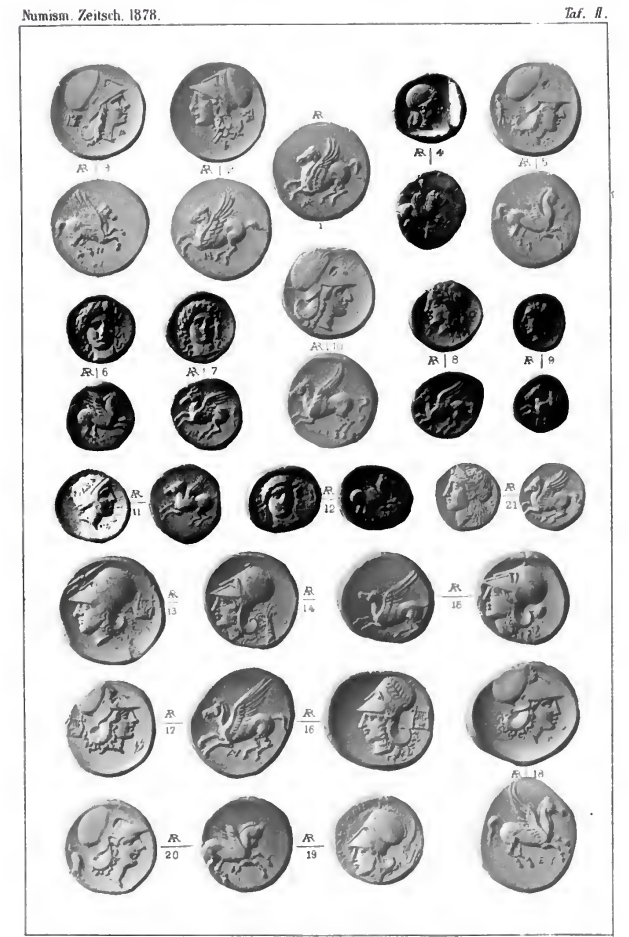


Figure 5: A plate from F. Imhoof-Blumer’s *Die Münzen Akarnaniens* of 1878.

deemed proficient in English and could then read normal books. In numismatics, the population is a coinage; the types are the dies; each coin is an example.

The first part of the RRDP, supervised by Dr. Lucia Carbone (ANS) and Prof. Liv Yarrow (Brooklyn College and Graduate Center, CUNY) consisted in the digital preservation of Schaefer’s prodigious archive, which was completed in June 2019.<sup>6</sup> While we don’t yet have a precise final count, it is estimated that Schaefer has documented and analyzed some 300,000 specimens in the RRDP. Since 1995 he has given the project on average one to two hours of his time each day. This means he has spent more than 13,000 hours collecting and analyzing all this material. For each issue of struck coins, Schaefer determines the die links for either obverse or

6. <http://numismatics.org/rrdp/>.



reverse. Die links for the other die are also noted when observed. He prioritizes the obverse or reverse for an issue by choosing the die easier to identify. For struck AE, for example, the reverse die is usually much easier to identify than the obverse. Colleagues have sent him images from far-flung museums, and he has systematically sought out all illustrated auction catalogues, including those not (yet) digitized by online systems such as coinarchives.com and acsearch.info. Schaefer's meticulous notations on each clipping record the image source, as well as any and all information in the source such as weight, axis, diameter, and his assigned die identifier (a number or a letter) (figs. 8–9).

Schaefer has always been generous in sharing his analyses and images with scholars of all ranks, ages, and affiliations. The goal of the authors and the ANS is to perpetuate this generosity by preserving, sharing, and eventually expanding his Herculean intellectual feat. His master collection of die-sorted image clippings from diverse sources on different paper types in a carefully designed storage system presented a unique archival challenge. Moving the papers risked disturbing the precious order for loose clippings, and would have halted (at least for a time) Schaefer's every constant work expanding RRDP. To overcome these challenges, Schaefer agreed to host full-time image capture in his home. Dr. Erin Richardson, a master archivist with extensive experience in paper conservation and collection digitization for both museums and private holdings, was recruited by the ANS. She devised a scanning system that has meticulously documented Schaefer's work at 600 pixels per inch (ppi). For context, glossy publications (like the one you're reading now) typically print at 300 dots per inch (dpi). For this project, Richardson temporarily relocated to Pennsylvania to spend two months working full-time at image capture with a specialty scanning and computing set-up at the Schaefer residence.

What does this master collection of die-analyzed images look like? Imagine 14 three-inch three-ring binders. These hold at minimum the two best examples of all known dies for all issues covered by RRDP and on occasion additional specimens. Of course, the binder only has one example in cases where a die is only known (so far) from a single coin. Richardson scanned each binder page, often twice if images were overlapping or folded. Further examples of the known dies represented in the binders are stored in die order in small drawers, the kind you might use to sort and store your spare nuts and bolts or other hardware. One drawer can hold up to four hundred images. Richardson laid out the image clippings from the drawers in their precise order in batches typically of about 100 specimens (figs. 6–8). The same type of drawers and the same organization

is used to store a special sub-set of 35 types of particular interest to those interested in the statistical analysis and quantification of surviving dies versus the original number of dies. These types make up a collection called ODEC for short (One Die for Every Control Mark). As Schaefer says, in around 2000 he “realized the ODEC issues could tell us how many dies we know out of the original total; inversely, they tell us how many dies we still have not found. For example, if an ODEC issue has control numbers 1 to 150, the missing numbers give us the number of dies still not found.” Readers familiar with the importance of Theodore “Ted” Buttrey's study of the P. Crepusius denarii will already be acquainted with this type of evidence and how it has taken center stage in debates over quantification.<sup>7</sup> ODEC only includes issues that are large enough to be statistically meaningful; thus it excludes the smaller issues which are treated in the binders as ordinary types (RRC 376, 398, and 399) and issues like RRC 350A/3, which is huge but the control letter is too often off the flan and thus the current number of specimens in RRDP is statistically too small. Schaefer has also documented that not all of the 35 types believed to have only one control mark per die by Crawford actually fit that description; of these, quinarii issued by a P. (Vettius?) Sabinus in c. 99 BCE (RRC 331) (fig. 10) have by far the most symbols repeated on different dies. Another curiosity that Schaefer discovered is the issue of serrated denarii by C. Naevius Balbus (c. 79 BCE, RRC 382); control numbers 1–25 are all represented by two dies, but numbers 26–226 are only represented by one die. Schaefer's work on ODEC will prove invaluable for testing and verifying new and existing statistical models for quantification.

Currently underway, the second part of the RRDP project will deal with the digital transcription of the scanned materials. The focus of this transcription is to record the number of observed dies for all issues and the number of documented specimens for each die. Each Crawford type and subtype included in the RRDP database will then be linked to the Coinage of the Roman Republic Online (CRRO, numismatics.org/crro) and Coin Hoards of the Roman Republic (CHRR, numismatics.org/chrr) databases. This will allow anyone accessing them to immediately see and compare die-counts for each type. It also will allow all users to visually confirm these die links and die counts through the images themselves. Those images clearly capture Schaefer's

7. T. V. Buttrey. 1976. “The denarii of P. Crepusius and the Roman Republican Mint Organization,” *American Numismatic Society Museum Notes* 21: 67–108. For the importance of this study and its positive and negative impact on quantification studies, see discussion below and W. W. Esty 2011. “The Geometric Model for Estimating the Number of Dies” in *Quantifying monetary supplies in Greco-roman times*, edited by F. de Callatay. Bari: Edipuglia, pp. 43–58.





die naming conventions and his use in the binders of two double lines to connect die linked specimens (fig. 11).

The initial transcription is scheduled for completion in late October. Necessary query-checking and creation of a web interface means that a public release is likely to happen late 2019 or early 2020. The synergy of these three online databases—CRRO, CHRR, and RRDP—will provide users with an as-of-yet unknown amount of precise quantitative data for the period of time considered. Therefore, once RRDP goes live anyone interested in a specific issue can consult not only his die analysis but also compare the unanalyzed input specimens to ensure as complete coverage as possible. Likewise Schaefer has kept images of all observed brockages for future study so that potential patterns in that data may also be studied.

RRDP is ripe for further development and expansion. Transcription of the die axis information would allow for an expansion and testing of the work done already being done in this area.<sup>8</sup> Likewise, the transcription of weights for observed specimens could greatly expand the coverage of the metrology data available in CRRO. For this type of information, the project could perhaps use collaborative transcription adapting models used by The National Archive as part of its Citizen Achivist project.<sup>9</sup> A Citizen Numismatist initiative may be just the way to get numismatics into classrooms around the globe. Likewise, as numismatists undertake full die studies of RRDP issues we will need to develop robust means of incorporating that data. These full dies studies—wherein all links between obverse and reverse dies are mapped—can be produced at much swifter speed because of Schaefer’s 25 years of meticulous image collection, analysis, and documentation.

Questionable Quantification?

Will the numbers produce any historically meaningful data? Yes, but all data, numerical or otherwise, demands interpretation. The “holy grail” of numismatists and economic historians would be to reconstruct the exact size of any coin issue and then be able to say something about changes in the volume of production over time. Our ability to estimate this information with any degree of meaningful statistical probability is disputed. The common process for reaching such an estimate involves first calculating the number of original dies used to produce a coinage and then estimating the output of each die. The accuracy and utility of such calculations has remained hotly debated in numismatic circles. In the 1970s and 1980s, a series of statistical

approaches to the problem were proposed; these all sought to estimate the total number of original dies based on the number of dies observed in a die study, taking into account the frequency of their observations in the study. By far the most influential works were those by Carter and Esty.<sup>10</sup> Today Esty’s formulae as refined in later publications are the most-widely used.<sup>11</sup> Buttrey’s die-study of the denarii of P. Crepusius mentioned above with its numbered reverse dies up to 519, was critical as a primary test of the accuracy of any of the proposed methods (figs. 12–13). A few numbers appear to have been accidentally inscribed on more than one die, but nevertheless the numbering system and the die study give our most-accurate die count of any ancient issue. RRDP, especially ODEC, will play a key role in future testing of statistical models and thus help refine and make them yet more accurate.

The output of a single obverse die, i.e., how many coins could be produced by each obverse die, has been for decades a hotly debated issue for numismatists and economic historians. If a fixed number of coins could be expected to have been produced from a certain die, then an almost exact quantification of monetary production could be made possible. In the 1990s, two strong voices emerged in numismatic scholarship on the subject of the calculation of ancient coin production—Buttrey and de Callatay—the former holding to a basically pessimistic position on the speculative nature of such quantification, the latter remaining largely optimistic.<sup>12</sup> These debates culminated in two conferences with corresponding proceedings published just over a decade apart.<sup>13</sup> The forcefulness of the voices in the debate has led many to a conservative “wait and see” perspective on using numismatic quantification in historical studies. Others, while optimistic, see the problem as one of processing a large enough amount

10. G. F. Carter. 1983. “A simplified method for calculating the original number of dies from die link statistics,” *American Numismatic Society Museum Notes* 28: 195–206, and W. W. Esty. 1986. “Estimation of the size of a coinage. A survey and comparison of methods,” *Numismatic Chronicle* 146: 185–215.

11. W. W. Esty. 2006. “How to estimate the original number of dies and the coverage of a sample,” *Numismatic Chronicle* 146: 185–215. Esty 2011, cited above no. 7.

12. T. V. Buttrey. 1993. “Calculating ancient coin production: I. Facts and fantasies,” *Numismatic Chronicle* 153: 335–51; “Calculating ancient coin production: II. Why it cannot be done.” *Numismatic Chronicle* 154 (1994): 341–52; and “Quantification of ancient coin production, the third element.” In *Quantifying monetary supplies in Greco-Roman times*, edited by F. de Callatay, 105–13. F. de Callatay, 1995. “Calculating Ancient Coin Production: Seeking a Balance.” *Numismatic Chronicle* 155: 289–311 and his introduction to *Quantifying monetary supplies in Greco-Roman times*. 2011. Bari: Edipuglia.

13. Respectively, a special journal issue of *Annali dell’Istituto Italiano di Numismatica* 1997 and de Callatay 2011 volume cited in no. 7.

8. C. Parisot-Sillon, A. Suspène, and G. Sarah. 2014. “Patterns in Die Axes on Roman Republican Silver Coinage,” *Numismatic Chronicle* 174: 91–109 with references to earlier studies.

9. <https://www.archives.gov/citizen-archivist>.



Figure 11: RRDP in action. A scanned binder page for RRC 415/1 (Paullus Lepidus, supposedly dated to 62 BCE). Notice the double-line connecting die linked specimens (either obverse or reverse dies).



Fig. 12: RRC 361/1c, denarius, 82 BCE (ANS 1944.100.557); obverse: Laureate head of lightly bearded youth (?Apollo) r., off-flan letter control mark and scepter behind; control mark worn away before; dot border.reverse: P.CREPVSI - Horseman r., brandishing spear; dot border.

Figure 13 (right): Excerpt from T. V. Buttrey’s study on the coinage of P. Crepusius.

T. V. BUTTREY					
Letter	Number	Reference	Letter	Number	Reference
T	105	“O” H*	V	106	H
5. Grasshopper					
N	42	H	R	85	CH
H	47	H	T	85	H*
O	49	ANS	N	86	H*
E	62	H*	(None)	87	H*
E	64	H	I	92	H*
N	66	H*	(None)	98	H*
I	67	H*	I	99	H*
N	69	H	T	99	ANS
L	74	H*	(None)	105	Villa Potenza hoard
K	76	H*	(None)	108	CF-1233
O	76	H*	X	110	CH
S	76	D-8986	X	113	H
T	78	H*	X	117	H*
N	81	H	T	117	H*
(None)*	81	H*	A	[ ]	G. Hirsch sale (1 April 1974), 446
S	82	CH			
T	84	H*			
6. Grapes					
A	82	H	L	113	H*
E	82	H	N	116	H*
F	90	H*	K	117	H*
I	92	Copenhagen	S	125	H*
I	94	H*	X	127	CF-1278
K	104	H*	X	132	H*
R	104	H*	T	135	H
M	107	H*	H	[ ]	ANS
P	111	H*	O	[ ]	Berlin
V	111	H*			

\* The engraver accidentally omitted the control letter. What it ought to have been is uncertain; however it was not E, I, K, N, O, S or T.





Fig. 14: RRC 282/5, Narbo, serrated denarius, c. 118 BCE (?)(ANS 1944.100.567, E. T. Newell bequest); obverse: head of Roma in a Phrygian helmet, LICI X (crossed) behind, L-PORCI before; reverse: naked Gallic warrior with shield, spear, and carnyx (Gallic dragon-shaped war trumpet) driving a biga, L-LIC-CN-DOM in exergue; Moneyers: L. Porcius Licinius, perhaps grandson of cos. of 184 BCE, L. Licinius Crassus, cos. 95 BCE, and Cn. Domitius Ahenobarbus, cos. 96 BCE.



Figure 15: Map showing location of Narbo and Rome, drawn using The Antiquity À-la-carte Application produced by Ancient World Mapping Center (AWMC) at The University of North Carolina, Chapel Hill.

Figure 16: Silvestre David Mirys (1742–1810). Figures de l’histoire de la république romaine accompagnées d’un précis historique. Plate 127. Gaius Gracchus, tribune of the people, presiding over the Plebeian Council.



of data to produce meaningful results.<sup>14</sup> RRDП’s scale and completeness directly addresses this last point.

The most important take-away from the current state of the debate is that we know far more than we did forty years ago, and that we are likely to have even better data in the years to come, especially thanks to Schaefer and RRDП. Based on new data, Esty has revised and improved the available formulas for estimating the original number of dies, and as further studies are produced the validity of our models will continue to be tested.<sup>15</sup> It is very telling that Buttrey’s contribution to the most recent conference was primarily a rebuttal of the assumptions behind Crawford’s approach from the 1970s, not of the present state of scholarship. He is absolutely correct to highlight the danger of enshrining any one such estimation as a new historical truth. Likewise, as with many data sets, non-randomness can make the evidence look more reliable than it is, say if there are far more of one die represented because of its over representation in a particular hoard. Esty himself has regularly advocated for

the thoughtful review of the raw data and in cases where judged necessary the application of data smoothing. He also recommends that die estimates be reported alongside the 95% confidence interval—the smaller the interval, the more likely the estimate is reliable. Readers of such results need a robust measure by which to judge the evidence they are being presented. There is always an onus on the historian to interrogate the logic behind any such estimate before integrating it into any new hypothesis.

In what follows, the quantitative data deriving from RRDП and Crawford’s estimates have been combined with contextual evidence, the so-called ‘third element’ named by T.V. Buttrey in his 2011 rebuke of de Callatay’s quantification approach. In both the case studies here proposed, the data derived from RRDП are closely linked to events well documented in ancient sources.

**Case Study no. 1: Narbo, Funding a Roman Colony**  
The Narbo issue (RRC 282) is one of the earliest issues where historians and numismatists agree that specific coins can be linked to specific event (fig. 14). What is not agreed upon is the exact year the colony was founded, but 118 BCE is likely (fig. 15).<sup>16</sup> To understand the popular

RRC nos.	Dies	Coins	Singles	Die Estimated	plus 95	minus 95	Coverage
282/1	48	127	7	77	94	64	94%
282/2	45	129	15	69	83	58	88%
282/3	42	129	13	62	74	52	90%
282/4	61	230	20	83	93	74	91%
282/5	46	132	14	71	84	59	89%
All together	242	747	69	358	385	333	91%
Sum of separate estimations					362	428	307

Table 1: Narbo issue (RRC 282/1–5). Formulae based on Esty 2006 and 2011. Die counts based on RRDП (denarii).

Possible Outputs	RRDП Die Estimates	Plus 95 (highest)	Minus 95 (lowest)
10,000	3.58 million	3.85 million	3.33 million
20,000	7.16 million	7.7 million	6.66 million
30,000	10.74 million	11.55 million	9.99 million
40,000	14.32 million	15.3 million	13.32 million

Table 2: Possible production output in denarii of RRC 282

RRC nos.	RRDП Dies Observed	RRDП Die Estimates	RRC Die Estimates
282/1	48	77	85
282/2	45	69	37
282/3	42	62	32
282/4	61	83	103
282/5	46	71	48
Total	242	358 (362)	305

Table 3: Comparison between Production Estimates according to RRC and RRDП

dimensions of the foundation of the colony of Narbo, we need to understand how politically fraught issues of food and land were in these years. In 119 BCE Marius, usually assumed to be a popular politician, as tribune of the plebs vetoed a grain distribution bill, and likely that same year a *lex Thoria* discontinued Gracchan land distributions and substituted cash payments instead.<sup>17</sup> Cicero explicitly tells us that Crassus, the future consul of 95 BCE, vigorously supported the foundation of this colony against senatorial opposition and that he did so, at least in Cicero’s mind, in order to be seen to champion a popular cause.<sup>18</sup> Other Ciceronian testimony seems to characterize the foundation as primarily a defensive outpost against the Gallic threat, as does the rather fearsome reverse design.<sup>19</sup> As we’ll see the volume of coinage suggests significant monetary investment, alongside the land distributions expected with the foundation of any colony. The only precedent for a citizen colony was set by C. Gracchus less than five years

earlier (fig. 16). The Gracchan foundations are often interpreted as an acknowledgment that there were insufficient land resources in Italy to meet demand.<sup>20</sup> The handling of the funds associated with colonization was certainly a very politically sensitive matter.

In 1988 Garnsey reported that Crawford estimated that some 9,000,000 denarii were struck as part of the Narbo issue.<sup>21</sup> In RRC, Crawford had estimated a total of 305 dies were used to strike the issue, so his number of 9 million suggests he was assuming a little less than 30,000 coins per die. The counts of observed dies, observed individual coins, and dies only known from a single specimen as recorded in RRDП when entered into Esty’s formulae suggest Crawford wasn’t far off. Instead, we can just be much more confident in the accuracy of our estimates. The biggest improvement is not on the size of the overall issue, but instead of the individual subtypes within the issue. RRDП suggests a much more even distribution of dies over the subtypes, but with RRC 282/4 and 282/1 still have more than the other subtypes, just to a much less extreme degree.

However, the numbers are only really historically meaningful if we can have contextual evidence, the so-called “third element” named by T. V. Buttrey in his 2011

14. C. Howgego. 2009. “Some numismatic approaches to quantifying the Roman economy,” in *Quantifying the Roman economy: methods and problems*, edited by A. K. Bowman and A. I. Wilson, 287–95. Oxford: Oxford University Press.  
15. See Esty 2011 cited in no. 7.

16. Key pieces of evidence include: *Corpus Inscriptionum Latinarum* 17.2, 294 (suggestive of a date before 120 BCE), Vellius Paternus

lus 2.7.8 (118 BCE), Cicero, Brutus 158 (cf. *pro Cluentio* 51 and de *Oratore* 2.223; suggestive of date after 113 BCE). This ambiguity affects how the relative chronology of the Republican coin series in this period is aligned with an absolute chronology. H. B. Mattingly. 2004. *From Coins to History*. Ann Arbor: University of Michigan Press, 130–51 and 210–11; B. M. Levick. 1971. “Cicero, Brutus 43.159 ff., and the foundation of Narbo Martius.” *Classical Quarterly* 21: 170–79.  
17. Appian, *Civil Wars* 1.27; Plutarch, Marius 4. On agrarian legislation in this period, S. T. Roselaar. 2010. *Public land in the Roman Republic: a social and economic history of ager publicus in Italy*, 396–89 B.C. Oxford: Oxford University Press, 261–78.  
18. See Cicero references in no. 16.  
19. Cf. Cicero, *Pro Fonteio* 13.

20. Roselaar 2010 (cit. no. 17), 243.  
21. P. Garnsey. 1988. *Famine and food supply in the Graeco-Roman world: responses to risk and crisis*. Cambridge: Cambridge University Press, 121.





Figure 17: RRC 326/2, quinarius, c. 101 BCE (?) (Bertolami e-auction 68, 16 March 2019, lot 943). Obv.: laureate head of Jupiter, control mark (P) behind. Rev.: Victory crowns a Gallic trophy before which a naked Gallic prisoner of war kneels, C-FUNDA right, Q in exergue. Moneyers: C. Fundanius an otherwise unknown quaestor. Mattingly would redate to c. 97 BCE.



Figure 18: RRC 331/1, quinarius, 99 BCE (Numismatica Ars Classica 92, 23 May 2016, lot 1781). Obv.: laureate head of Jupiter, control mark (S with a dot above and below) behind. Rev.: Victory crowns a Gallic trophy, P-SABIN between figures, Q in exergue, control mark (S with a dot above and below) right. Moneyers: P. (Vettius?) Sabinus is an otherwise unknown quaestor. Mattingly concurs with Crawford on dating.



Figure 19: RRC 332/1a, quinarius, 98 BCE (Bibliothèque nationale de France REP-8606). Obv.: laureate head of Jupiter right with a dot below; behind, control-mark. Border of dots. Rev.: T-CLOVLI. Victory right, crowning trophy, beside which stands a carnyx and before which kneels a captive; between Victory and trophy, inscription. Line border.



Figure 20: RRC 333/1, quinarius, 97 BCE (Rauch E-Auction 27, 2018, lot 244). Obv.: C-EGNATVLEI-C-F-Q. Laureate head of Apollo right. Border of dots. Rev.: Q. Victory left, inscribing shield attached to trophy; beside trophy, carnyx; between Victory and trophy, inscription. Border of dots.

rebutal of de Callataj’s quantification approach. One point of comparison to begin to think about scale might be the state expenditure on grain in 62 BCE after Cato’s controversial proposal. Plutarch in his *Lives* suggests this was considered a very large expenditure and reports it as “twelve hundred and fifty talents” (*Cato the Younger* 26) or “seven million five hundred thousand drachmas” (*Caesar* 8). On the most conservative die output estimates the Narbo issue would represent at least half this amount, most probably was in fact a bit greater, and just might (if our die output estimates are far too low) represent double this amount but certainly not much more.

It would be more meaningful to compare the Narbo die estimates not against literary testimony but about other issues likely associated with colonization. Thus, in future publications we will use RRDP and Esty’s formulae to estimate dies used to strike the quinarii of c. 100 BCE, long associated with the establishment of Marian veteran colonies in the Po Valley (figs. 17–20; RRC 326/2, 331/1, 332/1a–c, and 333/1). Do these issues represent a greater investment in colonization than the Narbo issue? Soon we will likely be able to answer this question.

### Case Study no. 2: Emergency Funding for Rome’s Grain Supply

In April of 56 BCE Caesar, Pompey, and Crassus met at Luca (approximately 12 miles [19 km] northeast of Pisa in Etruria) to re-affirm their alliance (the so-called First Triumvirate) with some 200 senators attending. The same fated meeting decided the election of Pompey and Crassus to the consulship for the following year, the extension of Caesar’s command in Gaul for another five years, and the assignment of Pompey to Spain and Crassus to Syria. Pompey completed his extraordinary command overseeing the grain supply and opened his lavish theater temple complex dedicated to Venus Victrix (fig. 21). On April 8, 56 BCE, Cicero wrote to his brother Quintus about an emergency measure voted by the Senate in order to provide Pompey with the funds necessary for the *annona*, the public grain supply:

*On the 5th of April, by a decree of the senate, a sum of money amounting to 40 million sestertii was voted to Pompey for the business of the grain supply. [...] The shortness of money and the high price of grain increased the exasperation. (Cicero, Letters to his Brother 2.5; Shuckburgh trans., modified)*

According to Crawford in a normal year, the senate would authorize the *quaestor urbanus* to have a certain amount of bullion struck and distributed for specific purposes. The *quaestor urbanus* (“quaestor of the city”) had oversight of the treasury in Rome. The quaestorship was the first step on the *cursus honorum* (literally,

“course of honors”, but better translated “series of public offices”); in the late Republic being elected to this office gave admission to the Senate.<sup>22</sup> Most quaestors were assigned to a senior magistrate, a high office-holder such as a *praetor* or consul to manage their finances and other affairs. The *quaestor urbanus* would turn the bullion over to the *triumviri monetales* (moneyers) for striking, and then he would distribute the funds as instructed (fig. 22). These moneyers were young men at the very beginning of their political careers, three a year, probably elected to the position as a precursor to seeking higher office. On this model, the S-C issues would then be from years where this initial allocation proved insufficient and a special *senatus consultum* was required to authorize a magistrate, usually a moneyer, to strike a sufficient supplement.<sup>23</sup>

The year 56 BCE proved to be one of these years. Faustus, Sulla’s son, struck four coin types, two with no S-C and designs related to his family, presumably prior to April 5, and two others with S-C and with types relating to Pompey, presumably after April 5.<sup>24</sup> The Pompeian coin types nearly all refer to the building and dedication of Pompey’s major complex on the Campus Martius (“Field of Mars”) in name a sanctuary for Venus Victrix (“Venus the Victory-Bringer”) and in practice Rome’s first stone theater with an elaborate integrated portico containing gardens, galleries, and meeting space, including the Curia Pompeia, the senate building in which Caesar would be stabbed on the Ides of March 44 BCE (fig. 23).<sup>25</sup> It seems reasonable to connect the decree to at least the Faustus issues, and, as we shall see, perhaps also to the other two other issues with S C and Pompeian themes

22. J. R. W. Prag. 2014. “The quaestorship in the third and second centuries B.C.”, in J. Dubouloz, S. Pittia, and G. Sabatini (eds.), *L’imperium Romanum en perspective*. Paris: Presses universitaires de Franche-Comté), 193–209.  
23. RRC, 606–609.  
24. No S.C.: RRC 426/3–4; SC: RRC 426/1–2.  
25. John W. Stamper. 2005. *The Architecture of Roman Temples: The Republic to the Middle Empire*. Cambridge: Cambridge University Press, 84–90.

RRC nos.	Dies	Coins	Singles	Die Estimated	Plus 95	Minus 95	Coverage
426/1 (non SC)	55	113	19	88	112	70	89%
426/2 (non SC)	26	57	6	35	48	27	89%
426/3 (SC)	60	125	22	99	124	79	82%
426/4 (SC)	19	82	4	24	29	20	95%
Total	160	377	51	246	313	196	89%

Table 4: Faustus’ issues (RRC 426/1–4). Formulae based on Esty 2006 and 2011. Die Counts based on RRDP (denarii).

Possible Outputs	RRC Die Estimates	RRDP Die Estimates	Plus 95 (highest)	Minus 95 (lowest)
10,000	0.63 million	1.23 million	1.53 million	0.99 million
20,000	1.26 million	2.46 million	3.06 million	1.98 million
30,000	1.89 million	3.69 million	4.59 million	2.97 million
40,000	2.52 million	4.92 million	6.12 million	3.96 million

Table 5: Possible production output in denarii of just SC types of RRC 426

(figs. 24–25).<sup>26</sup> If this is the case, we should expect at least part of the 40 million sestertii mentioned by Cicero as exceptional funding for the *annona* expenditure to be minted in the years of this senatorial decree and in the year immediately following. Since the introduction of the *denarius*-based monetary system, the sestertius was one-fourth of a denarius.<sup>27</sup> Thus if Faustus’ S C issues correspond to the decree mentioned by Cicero then we’d anticipate it have been 10 million denarii. Tables 4 and 5 show die estimates and possible issues sizes for Faustus’ issues.

In sum, here’s what we know: there was a *senatus consultum* in April of 56 BCE authorizing the equivalent of 40 million sestertii for the *annona*. Table 4 demonstrates that Faustus’ SC coinage is insufficient on its own to represent that amount, at most it could represent a third to a half of that amount.

So where did the other one-half to one-third come from? One answer would be already-struck coinage, either struck by Faustus or another money of 56 BCE as part of the original annual allocation of bullion or older

26. Crawford’s chronology for these years has been updated on the basis of the Mesagne hoard, including 5,940 Republican denarii and whose burial is dated to approximately 58 BCE. C. A. Hersh and A. Walker. 1984. “The Mesagne hoard,” *American Numismatic Society Monographs and Notes* 29, 103–34.  
27. Varro, *On the Latin Language* 5.173: “In silver, there are coins called *nummi*, this word from the Sicilians: *denarii*, because they were worth *deni aeris* ‘ten asses of copper’; *quinarii*, because they were worth *quini* ‘five asses each’; and the *sestertius* ‘sesterce,’ so called because it is *semis tertius* ‘the third half-as.’ For the old-time sesterce was a *dupondius* and a *semis*” (transl. Roland G. Kent, adapted). The *sestertius* was then valued at one-fourth of a *denarius* right from the introduction of the *denarius*-based monetary system back in the course of the Second Punic War. After the retariffing of the denarius from 10 to 16 asses in 141 BCE, the sestertius became equivalent to four asses, instead of the previous 2-½, but it remained one quarter of a denarius. On the retariffing of the denarius in 141 BCE, most recently: P. Kay. 2014. *Rome’s Economic Revolution*. Oxford: Oxford University Press, 103–04 (with bibliography).



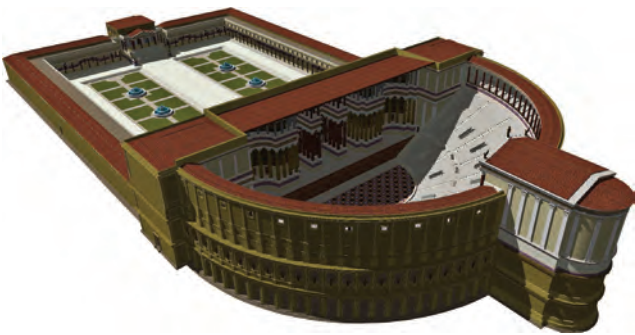


Figure 21: Model of Pompey’s Theater Complex by Lasha Tskhondia.



Figure 23: RRC 426/3, denarius, 56 BCE (Münzkabinett Berlin 18201847); obverse: laureate bust of Venus Victrix wearing stephane (a tiara-like crown) and necklace, S-C behind; reverse: three trophies, flanked by jug and lituus (augur’s staff), FAVSTVS in ligature in exergue; moneyer: Faustus Cornelius Sulla, son of the dictator, quaestor in 54 BCE. Reverse imitates a Sullan type and probably represents one of Pompey’s signet rings.



Figure 24: RRC 424/1, denarius, 56 or 57 BCE (Yale 2001.87.1837); obverse: laureate bust of Venus Victrix wearing stephane (a tiara-like crown) and necklace, C-CONSIDI-NONIANI behind, S-C before; reverse: Temple on top of a mountain surrounded by a wall with a gate, ERVC above gate; moneyer: C. Considius Nonianus is not otherwise known. The reverse shows the sanctuary of Venus at Eryx. In Rome, Venus Erycina had two temples. Mattingly follows Hersh and Walker and dates to 56 BCE; Hollstein follows Crawford and dates to 57 BCE.

struck coin on deposit in the treasury. However, if this is the case it would throw into question a tight connection between the *senatus consultum* and the number of coins issued. This would make the SC on certain coin issues overall less meaningful, saying more about a shortage of coin on deposit in the treasury to meet the Senate’s financial authorizations than that all of the money authorized was represented by the issue.

Another answer is that that missing money wasn’t ever coin, but instead another type of money, possibly credit. Hollander has documented that a vast amount of the late



Figure 22: The Temple of Juno Moneta, the first mint of Rome, as it may have appeared in Rome in AD 312. After a section of a panoramic painting of Rome created by Professor J. Bühlmann and Alexander Wagner and published in leporello, or fold-out, book-form in Munich, 1892, titled *Das Alte Rom mit dem Triumphzuge Kaiser Constantin’s im Jahre 312*. The first temple of Juno Moneta was dedicated on the Arx, one of the two rises on the Capitoline Hill in the center of Rome in 344 B.C. Moneta derives from the Latin verb “to warn” and the sacred geese at the temple warned the Romans of Gallic invaders. In time, the mint was located next to the temple and the epithet “moneta” came to mean “money” and is the root of the English word “money.”



Figure 25: RRC 430/1, 55 (or 56?) BCE, denarius, 3.99 g., Classical Numismatic Group e-auction 385 (26 November 2016), lot 462. Obv.: laureate bust of Venus Victrix wearing stephane (a tiara-like crown) and necklace, S-C behind. Rev.: Amazon holding spear and reins of her horse, cuirass under horse’s torso, shield leaning against Amazon’s left leg, P-CRASSVS-M-F around. Moneyer: P. Licinius Crassus, younger son of the triumvir, M. Licinius Crassus, cos. 55 BCE. The type celebrates Pompey, his father’s co-consul this year.

republican monetary economy operated with monetary instruments other than coin.<sup>28</sup> We could imagine that Pompey was in effect authorized to demand transportation services or even grain itself from private contractors with state accounts and that credit and banking transactions made up the money that Faustus did not coin.

Still another answer is that 40 million sestertii were coined and did have SC on them and our assumptions regarding the college of moneyers for 56 BCE needs

28. Hollander, David B. 2007. *Money in the Late Roman Republic*. Leiden: Brill, 31–57.

RRC nos.	Dies	Coins	Singles	Die Estimated	Plus 95	Minus 95	Coverage
424/1 (SC)	38	100	20	72	92	57	80%
430/1 (SC)	49	127	13	69	83	57	90%
Total	87	227	33	141	175	114	85%

Table 6: C. Considius Nonianus (RRC 424/1) and P. Licinius Crassus’ issues (RRC 430/1). Formulae based on Esty 2006 and 2011. Die counts based on RRDP (denarii).

Possible Outputs	RRC Die Estimates	RRDP Die Estimates	Plus 95 (highest)	Minus 95 (lowest)
10,000	1.36 million	2.64 million	3.28 million	2.13 million
20,000	2.72 million	5.28 million	6.56 million	4.26 million
30,000	4.08 million	7.92 million	9.84 million	6.39 million
40,000	5.44 million	10.56 million	13.12 million	8.52 million

Table 7: Possible production output in denarii of just SC types of RRC 426, 424, and 430

RRC nos.	RRDP Dies Observed	RRDP Die Estimates	RRC Die Estimates
426/1 (non SC)	55	88	< 3
426/2 (non SC)	26	35	< 30
426/3 (SC)	60	99	< 30
426/4 (SC)	19	24	33
424/1 (SC)	38	72	< 10
430/1 (SC)	49	69	63
Complete Total	247	387	196

Table 8: Comparison between Production Estimates according to RRC and RRDP

tweaking. There are two other SC coin issues around the same years, namely the ones produced by C. Considius Nonianus (RRC 424/1) and P. Licinius Crassus’ issues (RRC 430/1), presented in Table 6 (figs. 24–25). Like Faustus’ SC types, those of Nonianus and Crassus also have Venus Victrix on the obverse. Hersh and Walker, as well as Mattingly, would all move Nonianus to 56 BCE. Crassus is usually placed in 55 BCE because that is the year his father was consul, but that type of reasoning can be circular. If we add their issues to Faustus’ SC issues we get closer to 10 million denarii (Table 6). This doesn’t mean that this is the “true” answer, it just means that it is one possible, even plausible, answer. As far as we can tell from Schaefer’s die study, it is possible to convincingly argue that the SC issue of Faustus, Nonianus and Crassus were indeed related to the extraordinary expenditure for the *annona* mentioned by Cicero.

As in the first case study, it is striking to notice that in the cases in which Crawford had at his disposal sufficiently reliable hoard evidence (as in the case of RRC 430/1, Licinius Crassus’ issue) his estimates are very close to the data offered by RRDP. However, for RRC 426 and 424 Crawford’s estimates were hampered by the lack of available evidence (Table 8). The high sample coverage vouchsafes now for most issues the reliability of the study. For RRC 424/1 (80% coverage) and 426/3 (82% coverage), we know that we have more work to do to increase the accuracy of

the estimates and narrow the confidence interval. RRDP data, derived from Schaefer’s invaluable work, allow us to interrogate in new ways the figure offered by Cicero for the extraordinary funding of 56 BCE for the *annona*. It also gives us new ways to think about the production estimates deriving from de Callatay’s quantification approach (20,000–30,000 coins per obverse die) and whether they are the ones most likely to represent the reality of monetary output, as they come closer to the figures in ancient sources. At the same time, the limited evidence provided by these two initial case studies suggests that, when the hoard evidence is reliable enough, Crawford’s estimates are not so distant from the ones verified by the obverse die studies in RRDP.

### Conclusions

The die studies realized by Richard “Dick” Schaefer and now digitized and organized in ANS Roman Republican Die Project (RRDP) are an invaluable asset to the study of Roman Republican history. They could prove instrumental to show 1) the accuracy of the figures provided by ancient sources, as in the two case studies provided in this article, and 2) the reliability (or not) of Crawford (and later) production estimates based on hoard counts. Finally, RRDP also offers an important contribution to the debate about quantification, since it suggests that de Callatay’s quantification approach is the one most likely to tackle the actual monetary output per obverse die.