

The Roman Republican Die Project (RRDP): Phase II

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Section I: Historical and methodological significance of the project

1. Overview

In early 2019 the ANS partnered with Richard 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 first part of this project consisted of the digital preservation of Schaefer's archive and was completed in June 2019. In this initial digitization phase, we aimed to publish the binders and the clippings, assembled as TEI files of facsimile images, published the ANS archival platform, [ARCHER](#) and linked to [CRRO](#). As of the end of August 2020 all this material is [now online and available to the academic community](#).

While it is now possible for individuals to consult the digital images as they would consult the physical materials and find materials relevant to a particular *RRC* number, as of yet there is no standardized tool for searching specific specimens or retrieving the quantitative data and analyses encoded in Schaefer's hand notations on each individual coin image. To date, scholars who have used the physical archive or the newly available digitization, have adopted diverse private systems of transcription which underlay the published accounts in the quantification studies. This makes such studies nearly impossible to cross-check without redoing the whole of the transcription and does not allow the data to be shared, reused, and re-analyzed in further studies.

1.a. Goals

Phase Two of RRDP aims to accomplish the following goals over the course of the next two years:

- Develop a standardized format for the recording of die information, applicable both to the Schaefer material and to die studies in other coinages.
- Transcribe and decode the Schaefer's hand-written annotations for all Crawford types 336-392 (92-75 BCE)
- Annotate all relevant ARCHER Images of specimens to be linked to CRRO with specimen and die transcription
- Publish a guide to the use of the Schaefer materials including a definitive list of abbreviations and source materials with links to DONUM and other online resource
- Create a searchable database extension of CRRO that operates at the level of the die for Crawford types 336-392 and allows for feedback from users on die identification
- Create an interface for uploading new specimens of any Crawford type not yet in RRDP
- Finish scanning the unprocessed clippings from Schaefer paper archive

2. Project Background

Starting in around 1995 Richard Schaefer began to collect systematically images of Roman Republican issues included in Crawford's *Roman Republican. Coinage*. While no precise final count is available yet, it is estimated that Schaefer has documented and analyzed some 300,000 specimens in the Roman Republican Die Project (*RRDP*). This archive proves that it is indeed possible to create reliable quantitative data for the monetary production of the Roman Republic, even if extremely challenging. The study encompasses all

struck issues with a few logical exceptions, like the large issue of C. Piso L.f. Frugi ([RRC 408](#), c. 61 BCE redated based on the Mesagne hoard) for which Charles Hersh had already produced a complete die study.¹ For each issue of struck coins, Schaefer determined the die links for either obverse or reverse. The goal of this project has been to collect enough images and identify enough dies to achieve 90% or better coverage.

The original paper archive comprises a system of drawers and boxes of loosely organized and annotated clippings and 14 three-inch three-ring binders. The binders 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. Further examples of the known dies represented in the binders are stored in die order in small drawers. 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.” In total Schaefer has invested more than 13,000 hours in collecting and analyzing this material.

Schaefer is one of the most experienced numismatist in the field of die studies presently living since the technique was first developed some 150 years ago. RRDP is the largest die study ever undertaken. The goal of this ANS project is to perpetuate this generosity by preserving, sharing, and eventually expanding his Herculean intellectual feat.

Schaefer has always been generous in sharing his analyses and images with scholars of all ranks, ages, and affiliations. 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 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. These images have then been uploaded to ARCHER and made accessible directly from each relevant type in the CRRO database, thus meeting the goals of phase one of the project.²

2.a. Die Studies as Tool for 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

¹ Hersh 1976 and Hersh and Walker 1984.

² A fuller background can be found in Carbone and Yarrow 2019.

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. Today Esty's formulae as refined in later publications are the most-widely used. Buttrey's die-study of the denarii of P. Crepusius its numbered reverse dies up to 519, was critical as a primary test of the accuracy of any of the proposed methods. 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 Callataÿ—the former holding to a basically pessimistic position on the speculative nature of such quantification, the latter remaining largely optimistic.³ Others, like Howgego, while optimistic, see the problem as one of processing a large enough amount of data to produce meaningful results.⁴ RRDP'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 RRDP.

3. Historical Significance of 92-75 BCE

The majority of phase two as outlined above in 1.a will focus on material produced during at an exceptionally fraught moment in Roman history. In 92 BCE Rome's relationship with her Italian allies (*socii*)—the backbone of her fighting force for her conquest and control of the Mediterranean—was in tatters. Many stressors perpetuated conflict, but access to agricultural lands and territorial disputes especially regarding the settlement of veterans were central points of contention. Rome was simultaneously pressed by Mithridates Eupator's advances (both militarily and diplomatically) into regions of Anatolia and the Aegean traditionally controlled by Rome. In 89 BCE Rome hurried to conclude the Social War with an offer of enfranchisement to communities who returned to her side in the conflict, even as pockets of unrest continued throughout the peninsula at least until two years later. Sulla and Marius, both leading generals in the Social War, aimed at leading the campaign against Mithridates. When Marius used the popular vote to strip Sulla of his command of the Mithridatic campaign, the latter marched on Rome in 88 BCE and use military force to return his version of order to the State, before departing for the East. However, during Sulla's time in the East the Marian faction headed by Cinna took control of Rome and of the Roman government, effectively outlawing Sulla. Rushed to return to Rome, in 85 BCE Sulla made a treaty of mutual benefit with Mithridates at Dardanus and marched again on Rome in 82 BCE, this time establishing himself as Dictator. Soon hostilities with Mithridates resumed and now Rome also had to face hold outs of the Marian faction in both North Africa and Spain, all the while adjusting to life under a new conservative constitution. This is the period in which Pompey begins his rise to prominence, breaking all precedence for the holding of commands and assuming honors. Or, to put it another way, new precedents were being made for the type of extraordinary commands that would lead to the principate.⁵

³ Buttrey 1993, 1994, and 2011; de Callataÿ 2006, 2011a, 2011b.

⁴ Howgego 2009

⁵ Modern narrative treatments of this period can be found in Allen 2020 and Steel 2013.

No contemporary, continuous narrative of this period survives as a whole. Sallust's *Histories* would have been our best source had it survived in more than fragments. Appian's *Civil Wars* and *Mithridatic Wars* give insights into specific conflicts but filtered through an imperial lens; the same can be said for Plutarch's highly moralizing *Lives*. Much of the history must be pieced together from allusions in Cicero and elsewhere and constructed from fragments. We are particularly poorly equipped to write a history of the Cinnan regime, given the highly partisan nature of surviving Roman accounts.⁶ Being able to quantify the coinage for this period would provide new historical insights into the funding of different military and domestic projects and allow for a comparison of relative expenditure based on threat or need. It would directly augment and expand the earlier works of de Callatay and Carbone to understand the scale of Roman production in the Greek East.⁷

3.a. Numismatic Significance of RRC 336-392

These issues not only cover the tumultuous years but also exhibit numismatic features that have already attracted intense study and deserve further investigation. Beginning as early as 112 BCE the Roman mint began experimenting with control-marks, these control-marks were unique to the die and sometimes they were not. Much has been written about the possible function of such marks, such as possibly tracking batches of bullion as proposed by Witschonke.⁸ There is however a strong correlation between control marks, serration, and periods of political turmoil and reports about concerns over the currency in our literary sources. As argued elsewhere by Carbone and Yarrow, intense use of visible control marks is a means of demonstrating the care and attention paid to the manufacture and signal that the moneyer is taking extra precautions in the fulfillment of a public duty.⁹ Control mark systems employed a very wide use of numbers, letters, and symbols.¹⁰ More than 34 issues in the time range encompassed by the second phase of the RRDP project use control marks, which make die identification swifter, even when there may be more than one die per symbol. Focusing on this period will allow us to compare control marked to non-control marked issues and also let us compare the result of the Schaefer archive with pre-existing die studies such as those by Hersh, Buttrey, Debernardi and Campana and test existing models of quantification, including that by Esty.¹¹

The work will however also provide further comparative evidence for other studies, such as those based on the metrology and die axis of the coinage, both areas of many recent publication in the field of Roman Republican numismatics.

⁶ On the fragmentary nature of the sources, Yarrow 2006.

⁷ Carbone 2020a-c and de Callatay 1997 and 2016.

⁸ Witschonke 2012.

⁹ Carbone and Yarrow 2020 and Yarrow 2020.

¹⁰ Cf. de Callatay 2012.

¹¹ Buttrey 1976; Debernardi, Campana, et al. 2018; Esty 2006 and 2011; Hersh 1952 and 1975.

Section II: Work Plan

1. Overview

The Roman Republican Die Project is a set of interlinked digital resources:

- Coinage of the Roman Republic Online (CRRO).
- A standalone specimen database for private materials or museum collections that have not already been published to the Nomisma.org Linked Open Data ecosystem (materials already available in CRRO).
- The RRDp project website, publishing, primarily, URIs for each obverse and reverse die connected to RRC/CRRO coin types
- A layer of die attributions, in which die URIs in the RRDp project and linked to URIs for individual specimens, whether those specimens are in the specimen database, the BnF, ANS, or BM, etc. collections. These attributions are linked to individual scholars (e.g., Schaefer) and the model is flexible enough to facilitate the possibility that two authors might assign two different sets of dies to the same coins.

There may be between 200-300,000 total physical specimens distributed between Schaefer's 14 binders (200-300 pages each, on average) and scanned clippings. Some thousands or tens of thousands of these coins might already exist in CRRO because collections such as the BnF and ANS already have public databases. A standalone specimen database should not include these items. ICOM recommends that URIs for cultural objects should be published by the current holding institution, i.e., the ANS URI is canonical and there should ideally be no others on the web that represent the same object.

There are two workflows for publishing the binder and clipping specimens to the specimen database. The public-facing interface for these materials is Numishare, much like MANTIS.

2. Workflow 1 (Binders)

The binders have been assembled in order and published to ARCHER. The high resolution, 600 dpi, images are made available according to the standardized API specifications from IIF (<https://iiif.io/>). These specifications facilitate the annotation of images by drawing boxes around the obverse and reverse images of coins in order to extract the pixel coordinates and height+width dimensions relative to the size of the master jpeg image. Therefore, specimens in the binders do not have separate jpeg files stored on a server, but refer to a region on a large image via a URL: http://images.numismatics.org/archivesimages%2Farchive%2Fschaefer.rrdp.b01_0098.jpg/285,1332,476,515/full/0/default.jpg.

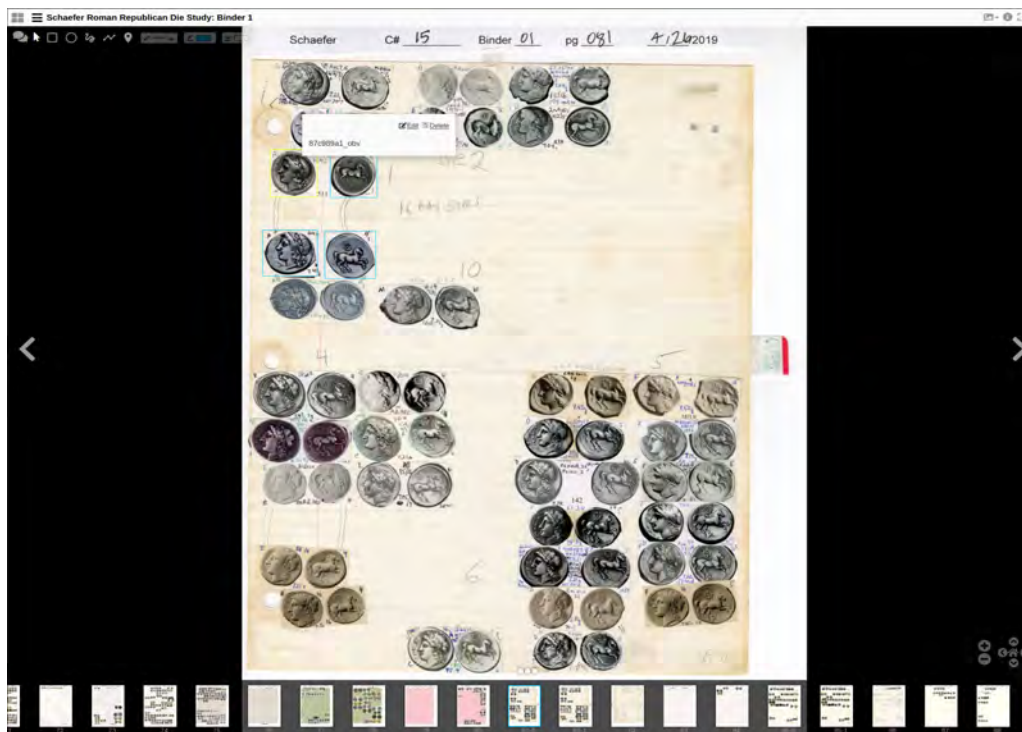
It is important to preserve the Schaefer binders as archival research documents in their own right, complete with notes and labels, and so it will be possible to navigate from a specimen in Numishare to its annotated binder page in ARCHER.

Specimens in the binder workflow are entered into a Google Spreadsheet. The amount of typological metadata that needs to be entered into this spreadsheet is minimal, as type descriptions are derived directly from CRRO. The important information entered here are: measurements, if available, obverse and reverse die ID, title, CRRO URI, and collection/provenance resource (which are linked to DONUM records in a separate bibliographic spreadsheet). Die IDs are entered here, but they are not explicitly inserted into coin metadata upon publication into the specimen database (detailed later).

| 1 | UUID (changes) | ID | Title | Source Ref | Type | Obv. Die ID | Rev. Die ID | Die Attribution | Axis | Weight | Diam |
|---|----------------|----------|----------------------|----------------------------------|---|-------------|-------------|-----------------|------|--------|------|
| 2 | Loading... | 87c989a1 | 24 Sep 97, H196, 513 | Gerhard Hirsch Münzhandlung 1997 | http://numismatics.org/crro/id/rc-15.1b | rc-15.1.o.1 | rc.15.1.r.1 | rschaefer | | | |
| 3 | Loading... | 3eaa983e | AN, 5 | | http://numismatics.org/crro/id/rc-15.1b | rc-15.1.o.1 | rc.15.1.r.1 | rschaefer | | 5 | 7.41 |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |

The ID column is generated dynamically from a Google Sheets script and each will be unique among all specimens in the binders. This is important for the stable linking between specimens and the associated obverse and reverse images.

The image annotation is carried about by an open source IIIF viewer/annotation server called Simple Annotation Server (<https://github.com/glenrobson/SimpleAnnotationServer>). It functions in principle very much like the Newell notebook annotation in the back-end of ARCHER. The ID from the specimen sheet is appended with the `_obv` or `_rev` suffix in the image annotation. A PHP script reads the spreadsheet and queries the annotation datastore in order to combine these data into a NUDS/XML record that includes the stable URL for the obverse and reverse image regions. This PHP script uploads each NUDS record into Numishare and triggers indexing into the Solr search engine that underlies Numishare's search and browse feature, effectively publishing these coins to the web. This PHP script and, thus, this aspect of the data entry workflow is complete. The server can be configured to automatically execute this script weekly, populating the specimen database with new content. A Nomisma.org administrator can initiate an ingestion of the Linked Open Data from this database into its SPARQL endpoint, which will then include these specimens into the relevant type records in CRRO.



3. Workflow 2 (Clippings)

While it is important to preserve the particular order of clippings as they were organized into their respective boxes, this information can be entered into the specimen metadata. Otherwise, the scanned clipping images do not communicate the same semantics of the binder pages. Alan Roche has prototyped a workflow in Adobe Photoshop for batch cropping of the individual cards from the large-scale jpeg images. Therefore, there is no need to implement image annotation implemented for the binders, but rather a similar data entry and image upload workflow that the ANS uses for its curatorial collection.

Here, we will deploy a CollectiveAccess database that features all of the database fields for numismatic metadata, provenance, and other bibliographic references. A key feature in the CollectiveAccess data entry interface is fields for capturing obverse and reverse die URIs and their scholarly attributions.

This database will be separate, but identical in structure, to the CollectiveAccess database the ANS will migrate to for its own collection. Therefore the development of these systems will proceed in parallel. Initially, the RRDP CollectiveAccess database will include specimens that are not currently published in CRRO from existing Nomisma.org contributors, but the database can be expanded to include private materials that need to be aggregated into other online type corpora or similar projects.

The export plugins from the RRDP and the ANS CollectiveAccess databases will be identical, except for their target destinations. The ANS database will export into MANTIS while the RRDP database will export into the Numishare instance deployed for RRDP. The clipping and binder workflows will initially be separate, but will ultimately be published into the same Numishare database. Once the binder workflow has been completed, the data from the RRDP specimen spreadsheet and the IIIF image URLs will be migrated into the CollectiveAccess database established for the clipping workflow for long-term sustainability. The functionality within the public-facing Numishare database for RRDP will be unaffected by this migration.

4. Dies

The primary RRDP website will be <http://numismatics.org/rrdp>. This URL is currently occupied by a page in the ANS Wordpress site, but it will be superseded by a Numishare project that functions somewhat like a type series project, like OCRE or CRRO. Each Republican coin die, whether attributed to Schaefer or another scholar, will have a permanent, stable URI in the following scheme: <http://numismatics.org/rrdp/id/>. The ID portion of the die will be derived from the relevant RRC number, e.g., rrc-15.1.o.1 or rrc-15.1.r.1, corresponding to RRC 15/1, 'o' or 'r' or obverse or reverse, and a digit that increases sequentially. The "label" of the die can effectively be anything. In most cases, obverse dies are labeled with a letter, e.g., "A" or "B." The die metadata will include a scholarly attribution, as it is possible that more than one scholar may identify distinct dies across the same type series. It is apparent that dies in Roman Republican Coinage do not apply beyond a single type. In future die linking projects, it may be necessary to be type-agnostic in the assignment of identifiers, if a die might be used across multiple typologies. As a result, the link between a die and a type is not explicit. There is no reference to the type URI in CRRO within the die metadata. This link is implicit by means of a link between a die to coin and from coin to type. The Nomisma Linked Open Data model can encapsulate this relationship, and a SPARQL query can be constructed to list all dies related to a type and how dies interrelate.

The die metadata are entered into a separate Google spreadsheet. Ideally, the dies for each type should be entered prior to or during the data entry/annotation of the binder pages, as the columns for obverse and reverse die IDs should be filled while working through the binder specimens.

A PHP script has already been written to parse the die spreadsheet and generate NUDS/XML records that are published into the Numishare instance for RRDP. Some minor code updates have been made to the RDF export for dies to distinguish them from coin types, although the underlying data models are fundamentally similar. Once the die data have been published to Numishare, activating their URIs, it will be possible to generate Linked Data to represent the links between specimens and dies.

4.a. Die Linking

Initially, die links are made in the binder data entry workflow by entering die IDs from the die spreadsheet into the binder specimen spreadsheet. Eventually, the CollectiveAccess database for the clipping specimens and the ANS database will incorporate fields that enable the entry of these die IDs. Due to the following complexities, a novel approach to modeling die links must be adopted for this project (and should be replicated in future digital die studies):

- The public-facing Numishare RRDP specimen database should only contain items not already published by Nomisma partners (e.g., the ANS, British Museum, Berlin, BnF, and others), but we still need to make assertions about these coins (represented on the web by their permanent URIs).
- Scholars may have differences in opinion, assigning different die IDs to the same coin, and we need to accommodate two or more attributions without one overwriting the other.
- While the American Numismatic Society's (eventual) CollectiveAccess curatorial database will be able to accommodate the entry of die IDs, it is unrealistic to expect that other Nomisma partners have either the technical capability or the curatorial capacity (with most organizations lacking permanent staff to accommodate narrow research applications rather than broader cataloging priorities) to facilitate granular die cataloging. As a result, it is necessary for third-party scholars to make assertions about these coins that can be used within the Nomisma.org Linked Open Data ecosystem.

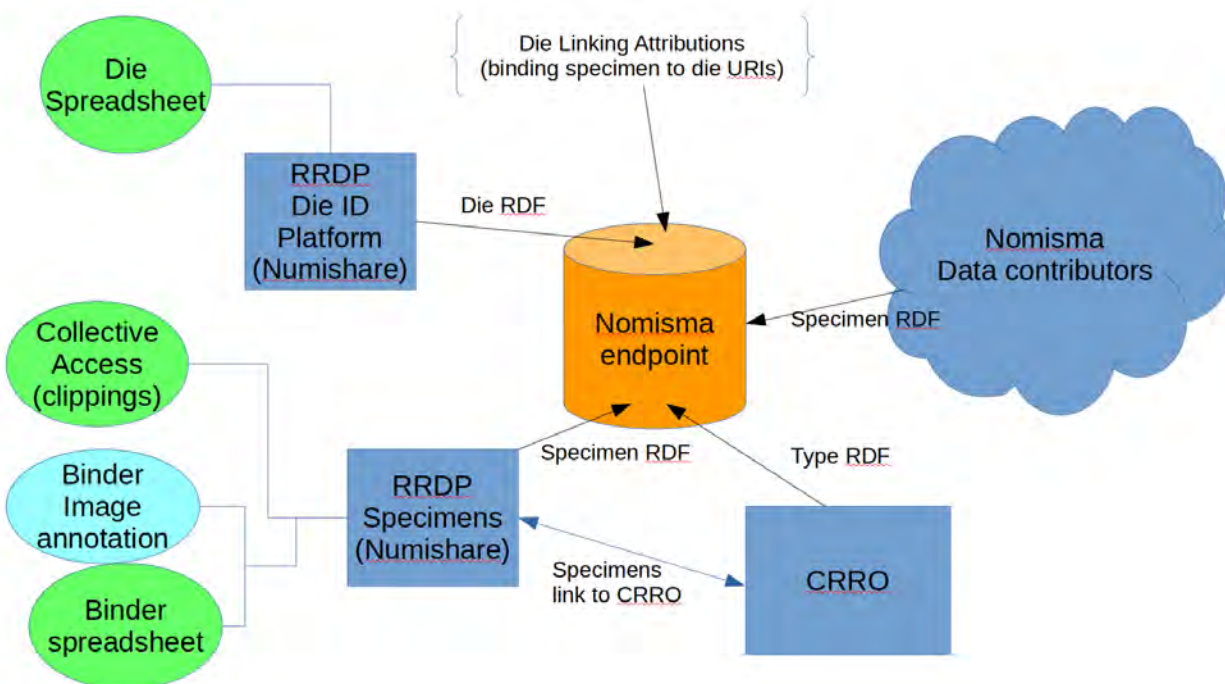
The Nomisma.org scientific committee has agreed upon a data model to meet these demands. It is imperative to insert the canonical URI into the spreadsheet or CollectiveAccess database for coins that already exist in the Nomisma.org ecosystem. The die linking model will be exported into RDF and ingested as a dataset into Nomisma.org's SPARQL endpoint. For example:

```
@prefix nmo: <http://nomisma.org/ontology#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix crm: <http://www.cidoc-crm.org/cidoc-crm/> .
@prefix void: <http://rdfs.org/ns/void#> .

<http://numismatics.org/collection/1969.83.3>
  a <http://nomisma.org/ontology#NumismaticObject> ;
  nmo:hasObverse [ nmo:hasDie [
    rdf:value <http://numismatics.org/rrdp/id/rrc-15.1.o.1> ;
    crm:P141i_was_assigned_by [
      a crm:E13_Attribute_Assignment ;
      crm:P14_carried_out_by <http://nomisma.org/editor/dschaefer>
    ]
  ] ] ;
  nmo:hasReverse [ nmo:hasDie [
    rdf:value <http://numismatics.org/rrdp/id/rrc-15.1.r.1> ;
    crm:P141i_was_assigned_by [
      a crm:E13_Attribute_Assignment ;
      crm:P14_carried_out_by <http://nomisma.org/editor/dschaefer>
    ]
  ] ] ;
  void:inDataset <http://numismatics.org/rrdp/> .
```

The model illustrates that the ANS coin <http://numismatics.org/collection/1969.83.3> has an obverse and a reverse die. These dies link to URIs established in the die identification/publication workflow in the

rdf:value property, with an attribution assigned by Richard Schaefer. The Attribute Assignment node can include more information than just a scholarly ID (e.g., a Nomisma editor, ORCID, or VIAF URI), such as the date of attribution or bibliographic reference.



The Linked Open Data from these individual components (RRDP dies, specimens, CRRO, and the link attributions) are each ingested into the Nomisma.org SPARQL endpoint, which enables the query across these datasets. Once centralized in Nomisma, the public user interfaces of the various components can be updated to execute queries and render the results as HTML or data visualizations in the browser.

5. Front-End Updates for an Integrated Die-Linked Corpus

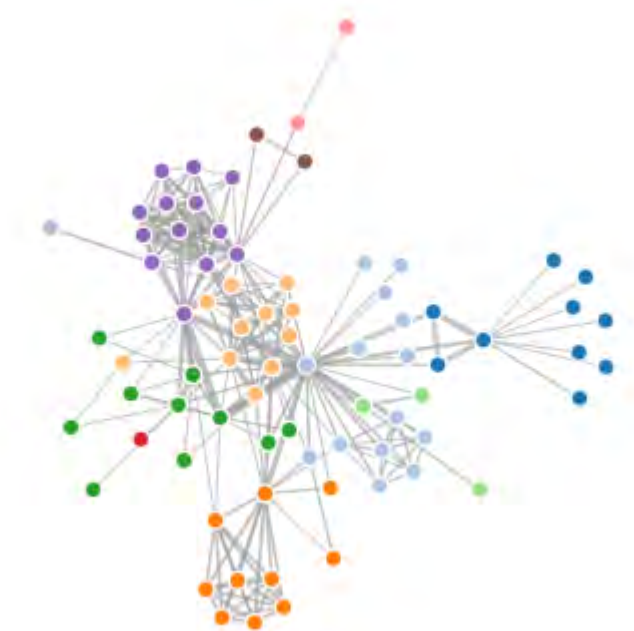
We have demonstrated the underlying workflows for publishing specimens that are interlinked with coin types in CRRO and die IDs in the RRDP die study corpus. In order to exploit these relationships between specimen, die, and type in a usable manner by the general public, some code updates must be made within the Numishare framework in order to generate visualizations.

5.a. CRRO

Presently, the user interface of type records in CRRO includes a typological description, a map showing a point for the mint and distribution of hoards and finds (if applicable), a list of related specimens (extracted from coins harvested into the Nomisma.org SPARQL endpoint), and a simple interface to facilitate the generation of charts for metrical or distribution analysis. Of the more than 2,000 coin-types published in CRRO, more than 90% are linked to at least one photographed specimen. It is already the most comprehensive research platform for Roman Republican coinage. The addition of potentially 200,000 additional specimens from other public or private collections will likely fill in the remaining photographic gaps. Many of Schaefer's specimens include die axes and weights, thus enhancing the research value of CRRO's metrical analysis tools.

Once die data have been harvested into Nomisma, a new interface widget will be developed in the Numishare platform for CRRO (and will be available in other Numishare-based type corpora that are linked to future die studies) that will execute a small series of SPARQL queries in order to extract a list of obverse

and reverse die URIs associated with the type, and through the implicit linking of specimens, how these obverse and reverse dies relate to each other. These results will then be visualized through a Javascript visualization library, D3.js (<https://d3js.org/>: which underlies the existing quantitative analysis features), into a force directed graph. The user will be able to download these die relationships as a simple, two-column CSV file that can be loaded into other statistical analysis platforms, such as R Studio or Jupyter Notebooks, for further inquiry. Additionally, the user will be able to click on links to each of the die URIs represented in the graph, which will direct to the RRDP die platform.



Force directed graph example

5.b. RRDP

The RRDP die platform is mainly a publishing ground for the IDs. Some basic functionality for searching die metadata (e.g., symbols) will be available in the RRDP browse page, but users who wish to query by moneyers, mints, denominations, etc. should use CRRO. Each die URI in RRDP will have a simple record page with metadata (like CRRO) and a widget for the visualization of the relationships between the die URI and other obverse or reverse dies.

The page will also display images associated with that particular die, much like the specimen list in CRRO. However, the images will only be the associated obverse or reverse image; essentially all existing images associated with the die, whether the source be Schaefer's clippings, binders, or better quality or higher resolution images directly from Nomisma partners. These obverse or reverse images will include clickable links back to the specimen records, like CRRO. These links may be URIs in the RRDP specimen database, the ANS' MANTIS, BnF, Berlin, etc.

Therefore, the RRDP die page supersedes the clippings and binders images published in ARCHER. The binders in ARCHER will still be a valuable reference resource, but a centralized die record that links to all possible specimens across many disparate information systems will serve as a single portal for die study in the same manner that CRRO has evolved into the single-most important tool for the study of Republican coinage.

6. Budget

6.a. Estimate of labor

On the software development side, we estimate 20 hours/week of labor for a year to implement die publication facilities in Numishare and the overhaul of IIF annotation for linking die IDs to individual images. The existing annotation system in ARCHER will need to be into a purpose-built image annotator specifically to streamline this project's workflow.

On the data analysis side, ANS will hire a full-time Curatorial assistant for one year (with contract renewable until the completion of the project) with the following tasks:

1. Data transcription (see Work Plan for details)
2. Developing a master list of image sources
3. Developing of a master list of common abbreviations
4. Writing a user guide appropriate to a general audience
5. Writing monthly reports on the work progress

A Research Assistant with similar tasks has already been hired by Prof. Yarrow with CUNY – Brooklyn College funding.

6.b. Timeline

Completion of the whole Phase II should be expected by January 2022.

6.c. Overall costs

Software development: \$40,000 in salary plus 33% in fringe, totaling about \$ 53,200.

Curatorial Assistant (one year): \$ 35,000 in annual salary plus 33% in fringe, totaling about \$ 47,000.

Costs for additional scannings of unprocessed materials form the Schaefer paper archive: \$ 15,000.

Total: \$ 115,200

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