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Prolegomena

Problems and perspectives of historical network research and ancient history

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Abstract

This contribution reviews previous contributions to ancient history by means of social network analysis and historical network research. In trying to ascertain common methodological challenges and identifying strategies of overcoming them, it attempts to provide guidance for future research projects.

1 Introduction*

The last decade or so has seen a steady increase of publications on a number of aspects of Graeco-Roman social and cultural history that have attempted to apply the theories and concepts associated with networks to the ancient world. This is by no means an isolated phenomenon within the field of Classical Studies and Ancient History, but rather part of an ongoing international and cross-disciplinary trend in the Humanities to become more and more open to methods and perspectives offered by neighbouring disciplines, and particularly by the growing field of Digital Humanities. If anything, ancient historians are (fashionably) late to the party: network theory and social network analysis (SNA) methodology have been employed in other historical disciplines for several years now, though studies in mediaeval, (early) modern, and contemporary history have also benefited from the recent upward trends.¹

We should be careful, however, to distinguish between formal social network analysis on the one hand, with its involvement of statistics, mathematical computations undertaken by computer algorithms, and graph visualisations influenced by research in computer science and mathematics,² and what might be called ‘informal’ network research on the other. The latter, which we may also term ‘soft SNA’, eschews what Giovanni Ruffini, among the first ancient historians to employ formal SNA, has called the “heavy industry”³ needed to perform the former. Thus, while a relational approach to themes of ancient social and cultural history has been employed by researchers since the early 1990s and the theoretical underpinnings of network theory have exerted a

* **Acknowledgements:** This chapter was written in 2016 and intermittently updated to reflect emerging work on Historical Network Research in Antiquity. It does not claim to discuss the totality of on-going research projects.

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1 See, e.g., the seminal works of Wolfgang REINHARD (1979) and, more recently, PADGETT / ANSELL (1993). What REINHARD termed *Verflechtungsanalyse* was more traditionally hermeneutic in outlook than historical network research tends to be today, but was inarguably concerned with much the same research subjects. For a helpful review of Historical Network Research, i.e. the investigation of history by means of SNA methodology (also sometimes called HNA – Historical Network Analysis or HNR – Historical Network Research), see now REUPKE / VOLK (2013) and BIXLER (2015). As regards the mounting application of HNR/SNA approaches to history, the mediaeval period seems to be rather the exception to the rule: (formal) network analysis of mediaeval subjects has only seldomly been undertaken; see e.g. ROSÉ 2011. HABERMANN (2011). GRAMSCH (2013). ENGL (2014). On the difficulties of applying SNA to medieval history, see now JULLIEN (2013).

2 See WASSERMAN / FAUST (1994), p. 1-17.

3 RUFFINI (2008), p. 16.

growing influence on studies of ancient connectivity, formal network analysis has, until recently, remained a rather rare phenomenon among classicists. And while the idea of (social) networks has long been popular, it has tended to be used in a primarily metaphorical sense. This too has now begun to change.⁴

As a whole, the traditional approach to ‘soft’ SNA focuses mostly on the individual perspectives of actors and participants within networks, as it attempts to recreate the social structures in which the individual is embedded and then contrast these with larger societal contexts, be it early Christian society or the ancient Rabbinic movement.⁵ Depending on the inclinations of the individual researcher, this could involve smaller or larger doses of network theory and concepts borrowed from SNA to be adapted to the social history of the ancient world (e.g. the notion of ‘cliques’).⁶ An initial hesitation to go beyond networks in a metaphorical sense and move on to formal SNA is noticeable in most of these early studies, though it is worth noting that this may very well have been connected to the contemporary state of SNA software and computing power, which was not yet routinely available and was exceedingly difficult and laborious to use where it was. This is no longer the case.⁷ Thus, in view of the considerable problems attached to a quantitative approach, early researchers focused on attempting to use the concepts and theorems of network theory as analytical tools for understanding ancient societies. In 1992, Michael White called for further research into network theory and its adaptability to the needs of ancient historians: “In this way”, he wrote in one of two introductory essays for a special issue of *Semeia*, a journal focusing on biblical criticism, “the historian can provide fresh insight to the period under consideration but also offer more nuanced or critically evaluated social data to be used in further empirical studies.”⁸ While it is easy, he went on to say, to arrive at a

4 But see recently TAYLOR / VLASSOPOULOS (2015), as well as DAVIES (2015) (therein), esp. p. 245 for network theory being used “more as a metaphor than anything else”.

5 See for instance CHOW (1992). WHITE (1992a). (1992b). CLARK (1990). (1992a). (1992b). HESZER (1997). HARLAND (2002).

6 For elements of network theory underpinning recent studies of ancient history, see. e.g. BROODBANK (2000). EIDINOW (2011). MALKIN (2011) and the essays gathered in MALKIN / CONSTANTAKOPOULOU / PANAGOPOULOU (2009). MCINERNEY (2011). LOMAS (2012). PARNELL (2015). TAYLOR / VLASSOPOULOS (2015). WOOLF (2016).

7 Today, a wide selection of software solutions such as UCINET, Gephi, NodeXL or Visone are available, many as open source freeware. Each comes with its own extensive literature and tutorials, which makes them infinitely easier to use than their antecedents of even a decade ago. Cf. HUISMAN / VAN DUJIN (2011). DÜRING *et al.* (2016), p. 175-179. Concomitantly, because of the rapid development of these applications and the relative ease with which plug-ins and extensions may be created and added, it would be a Sisyphean task to attempt an introduction to their specific workings.

8 WHITE (1992b), p. 31.

metaphorical, almost intuitive sense that “interpersonal relations are key to understanding the social structures”, “a more complete sense of the dynamics of social networks in terms of theoretical orientation and thence in historical application” is needed.⁹ For the most part, it has to be said, this call went unheeded, not least in the aforementioned special issue of *Semeia*, which was devoted to the concept of social networks in early Christianity, but whose individual contributions were of varying quality and methodological rigour.¹⁰

The fundamental problem of treating ‘social networks’ as a ubiquitous metaphor for social structures is that while this approach may seem unimpeachable given all the evidence gathered so far for the dominant position of networks in all societal (and other) matters,¹¹ almost none of the conclusions derived from this theoretical starting point are based on empirical, quantitative evidence – which is the very foundation upon which the methodology of SNA was developed, and lies at the very core of its application. In lieu of quantitative measures extracted from specific evidence, this approach relies on individual and subjective interpretations (and sometimes on little more than educated guesses). The problem, naturally, lies in the availability of sources, as Tom Brughmans has stated in his review of Irad Malkin’s influential study on the Greek Aegean island world, which interprets the archaic Aegean as a “small-world structure, driven by processes of preferential attachment” – two very specific and rather technical concepts derived from network theory that, strictly speaking, can only be proven by mathematical computations¹² – but remarks that “[t]hese network ideas are not expressed and validated in a quantitative manner [...], since historians of antiquity are considered not to possess enough data to identify such patterns and processes with any statistical significance”.¹³ That this is not necessarily true has recently been shown by, among others, Diane and Eric Cline, in a paper devoted to demonstrating how ancient evidence can in fact be used to allow even formal proofs.¹⁴

9 WHITE (1992a), p. 21.

10 Cf. RUFFINI (2008), p. 16: “In [some] contributions, ‘social network analysis’ seems to serve solely as a trendy substitute label for traditional prosopographical methods”.

11 Cf. the popular wide audience monographs by BARABÁSI (2003). WATTS (2003).

12 On ‘small-world’ phenomena see WATTS / STROGATZ (1998). For an introduction to the concepts of *preferential attachment*, see BARABÁSI / ALBERT (1999) for mathematical proofs and BARABÁSI (2003) for a non-specialist overview.

13 BRUGHMANS (2013b), p. 146f.

14 CLINE / CLINE (2015) (particularly p. 37: “it is easy to call something a Small World, but to actually prove that it is one is more difficult”). It should be pointed out, however, that their paper deals with the Amarna Letters, a collection of state correspondence between Egyptian Pharaohs Amenhotep III and Akhenaten and their “fellow Great Kings, ranging from the Hittites and Cypriots to the Babylonians and Assyrians” (*ibid.*, p. 17).

Thus, the ancient historian attempting to apply the paradigm of social networks to the ancient world is faced with a choice: on the one hand, to divorce network theory from quantitative measuring and mathematical proof is, while increasingly common, methodologically at least questionable. However, formal SNA does offer challenges to scholars trained in the classical humanities who are accustomed to the traditional hermeneutics of the discipline. While not requiring any higher-level mathematical skill *per se*, it does demand a working knowledge of a range of sociological theorems and methodology, as well as the different software packages to be utilised and, ideally, at least an appreciation of the origin of SNA in graph theory and the principles it is built on – if only to be able to determine if network theory is applicable to any given subject and whether the results gathered from it are in fact notable.¹⁵ Also, though network concepts such as “six degrees of separation” or the “small-world effect” have by now entered the mainstream language of historians and classicists alike, a more widespread acceptance of formal SNA methods and their usefulness is only beginning to occur, and has been hampered by, among other factors, the absence of a publication devoted to the study of networks in their historical contexts.¹⁶ This is a particular disadvantage for historical studies and a number of seminal early works have by necessity been published in journals that are little used by (ancient) historians, such as *Social Networks*, *The History of the Family* or the *American Journal of Sociology*.¹⁷ Very recently, SNA-heavy papers by ancient historians have also begun to be accepted by ‘mainstream’ ancient historical journals.¹⁸

2 Social Networks and Prosopography

This rather slow pace of change notwithstanding, the realisation is beginning to set in that, despite its not inconsiderable difficulties, SNA has something worthwhile to offer historians of all periods. The most vexing problem is naturally the comparative lack of sources of adequate quality (of information) that are the *sine qua non* of historical network research. But regardless of the relative novelty of SNA to ancient history, one possible remedy for this is in fact to be found in a sub-discipline of historical enquiry that is neither novel nor particularly obscure (at least not for historians of antiquity). In fact, SNA is what

15 On this, see WEINGART (2011). Cf. also the somewhat tongue in cheek but helpful diagram in DÜRING et al. 2016, p. 173. An English language version of the diagram is available at cvcedhlab.hypotheses.org/125 (last accessed on 11.01.2017).

16 The very fact that this present collection of articles could be published in the recently created *Journal of Historical Network Research* (jhnr.uni.lu), of course, shows that progress is being made.

17 ALEXANDER / DANOWSKI (1990). WELLMAN / WETHERELL (1996). PADGETT / ANSELL (1993).

18 E.g. DÜRING et al. (2011), CLINE (2012), and BROEKAERT (2013).

I would term a natural extension of the traditional lines of enquiry that have been pursued for well over a century. As was recently stated, “social networks of various scale, structure and importance permeate every single society and influence its cohesive strength and pervasiveness. Their crucial role in organising virtually every aspect of society has earned networks a prime place among the focal points of social sciences for decades.”¹⁹ Indeed, it can be said that even for ancient historians, neither the basic importance of networks nor the concept of networks in and of itself are particularly new. Networks and ‘networking’ as a means of advancing one’s individual position and interests are a historical phenomenon that can be found, traced, and studied across all historical societies, including the ancient Graeco-Roman world. And while the analysis of networks using quantitative and formal methodology may be a recent addition to the field of Classics and Ancient History, the study of intra-personal networks and their effect on societal cohesion and political history, particularly in Ancient Rome, can in truth look back on a long-standing tradition in that specialised discipline of prosopography, which emerged at the turn of the last century.²⁰

Early prosopographical studies, primarily into the society and aristocracy of republican, imperial, and late antique Rome, have yielded a wealth of information on thousands of individuals: birth dates, titles, positions, career data, relationships and kinship of these persons have been collected into monumental compendia such as the still-unfinished *Prosopographia Imperii Romani* or the *Prosopography of the Later Roman Empire*.²¹ While no comparable publication exists for the period of Republican Rome, the (occasionally book-length) biographical sketches written primarily by Friedrich Münzer, Otto Seeck and others that are assembled in *Paulys Realencyclopädie der classischen Altertumswissenschaft* go a long way towards making up for this gap.²² Matthias Gelzer’s *Die Nobilität der römischen Republik* and Münzer’s own seminal work *Römische Adelsparteien und Adelsfamilien* are both cornerstones of the prosopographical school, which they helped to establish and which went on to include noted ancient historians such as Ronald Syme, Lily Ross Taylor, Thomas

19 BROEKAERT (2013), p. 471.

20 For a definition and a concise account of the development of prosopography in ancient history see VERBOVEN / CARLIER / DUMOLYN (2007), p. 41-43.

21 PIR²: Edmund Groag / Arthur Stei / Leiva Petersen / Klaus Wachtel / Matthäus Heil / Werner Eck / Johannes Heinrichs (edd.), *Prosopographia Imperii Romani saec. I. II. III.* 2nd ed., Berlin 1933ff. PLRE: Arnold Hugh Martin Jones, John Robert Martindale, John Morris et al. (edd.), *The Prosopography of the later Roman Empire*, 3 vols., Cambridge 1971-1992.

22 Georg Wissowa / Wilhelm Kroll / Karl Mittelhaus / Konrat Ziegler / Hans Gärtner (edd.), *Paulys Realencyclopädie der classischen Altertumswissenschaft. Neue Bearbeitung*. Herausgegeben von Georg Wissowa, Wilhelm Kroll u.a., 81 vols., Stuttgart/München 1894-1980. MÜNZER alone contributed thousands of individual entries of greatly differing length.

Broughton, Erich Gruen, and Claude Nicolet, to name but the most eminent scholars.²³

For all the methodological and theoretical differences between the two disciplines, the aims of prosopography are closely related to the aims of contemporary studies employing social network analysis, namely to collect data “on phenomena that transcend individual lives” and to look for “general factors that help to explain the lives of individuals, for what motivates their actions and makes them possible: for example, families, social networks, patrimonies.”²⁴ Just as is the case with SNA, prosopography aims to go beyond individual biographies (indeed it has been described as a form of “collective biography”²⁵), to investigate external and non-personal group features that may shed light on individual motivations and agency, to collect data “on phenomena that transcend individual lives”.²⁶ Like SNA, it is used to identify and analyse the effect of overarching structural elements of society, and while traditional prosopographic research, as its very name already indicates, focuses on persons, this makes it the perfect companion for network research, which focuses on the relations between persons. In fact, I would argue that (historical) network analysis is the logical extension of traditional prosopographical research, as prosopography is the only means by which ancient historians interested in *social* networks may gather enough reliable data with which to gainfully perform network analysis, and is fundamentally indispensable in making it work.²⁷

23 MÜNZER (1920). GELZER (1912). SYME (1939). ROSS TAYLOR (1949). BROUGHTON (1951-52). GRUEN (1974). NICOLET (1974). See also WISEMAN (1971). Werner ECK, one of the most prominent exponents of prosopography in German academia, has rightly expounded on the fundamental connection between epigraphy and prosopography (ECK [2003], p. 16f.: “Prosopography and epigraphy are two sides of one coin for the Roman Empire: they are mutually dependent on each other [...]. This close connection [...] on the one hand offers a rich range of material, but at the same time means that Roman prosopography is often circumscribed by the nature of epigraphic evidence.”). This helps explain why so much less prosopographical data is available for the Republican period, as opposed to Imperial Rome, with its abundance of epigraphic evidence. On the pitfalls of prosopographical studies for the elucidation of ancient politics, see e.g. BRUNT (1988) and the essays collected therein, particularly ‘Factions’ (p. 443-502), though BARNES (2007), p. 84 justly notes “that even those who are professionally hostile to a prosopographical approach perforce use it”.

24 VERBOVEN / CARLIER / DUMOLYN (2007), p. 41.

25 *Ibid.* p. 3, paraphrasing DE RIDDER-SYMOENS (1991).

26 VERBOVEN / CARLIER / DUMOLYN (2007), p. 41.

27 This is not necessarily true for any application of network theory and analysis of the ancient world. As the present volume is focused on the study of ancient politics by way of SNA, the following methodological reflections are for the most part limited to previous studies of ancient *social* networks, that is of networks consisting of specific persons within a given social context. This is by no means the only way to apply SNA methodology to the ancient world,

And yet, a *caveat* formulated by Timothy Barnes on the subject of prosopography is equally (and perhaps more) applicable and relevant for ancient networks and SNA: although it is “an extremely powerful tool and technique in historical research, which can in theory be applied to any period of history or to any historical problem, it will in practice only produce illuminating results if there is enough evidence of the right sort.”²⁸

How do we determine what is evidence of the ‘right sort’? As will be shown later, even where prosopographic data is seemingly readily available, there are methodological difficulties in applying SNA to the ancient world that must be addressed and borne in mind. Wim Broekaert, though remaining optimistic as to the use of SNA in general, has recently warned of its limitations as an analytical tool, rightly asserting that the ancient historian, due to the vagaries of information survival, is always working with fragmentary networks, “isolated glimpses of a wide set of relationships.”²⁹ While this is also fundamentally true for modern sociologists employing SNA in the analysis of contemporary networks, the problem is naturally exacerbated by the nature of the sources the ancient historian finds himself compelled to use *faute de mieux*. Thus, one of the most important (and sometimes most difficult to answer) questions an ancient historian contemplating the use of SNA in his research has to ask himself, is whether or not to try it at all. When and where can SNA be applied as a useful heuristic method? And what are the criteria on which the answer to that question hinges? To provide at least part of an answer, a review of the development of SNA as a heuristic and analytical tool to be used by those who study the ancient world is a necessary and hopefully helpful starting point, particularly as a relatively small number of studies involving formal SNA have had a large influence upon its application to ancient history in general.

as several recent innovative and original applications have shown (e.g. SMITH [2005]. ISAKSEN [2008]. COLLAR *passim*. SELAND *passim*). For a wider perspective on the different applications in ancient history, see ROLLINGER (2014), p. 367-381. NITSCHKE / ROLLINGER (2015). Neighboring disciplines such as classical archaeology also have differing approaches to network analysis, which is one tool among many and which is not primarily used to interpret social networks. This has led to considerable theoretical and methodological advances that also have the potential to inspire historians to engage with the subject matter, as SNA methodology has been used to great effect in recent archaeological studies. Cf., e.g., GRAHAM (2006a). (2006b). (2014). KNAPPETT, EVANS / RIVERS (2008). (2011). BRUGHMANS 2010. ISAKSEN (2013). KNAPPETT (2013). (2014). BLAKE (2014). MÜLLER *passim*. COLLAR *passim*. BRUGHMANS / COLLAR / COWARD (2016). For a review of formal network methods in recent archaeology, which is not the subject of this paper, see BRUGHMANS (2010). (2012). (2013). COLLAR *et al.* (2015). NITSCHKE / ROLLINGER (2015).

28 BARNES (2007), p. 93.

29 BROEKAERT (2013), p. 474.

3 Network Research and the Classical World

As has repeatedly been stated, the primary problem of applying SNA to ancient civilisations is the relative paucity of sources. While this can be true for any historical discipline, it holds a particular relevance for ancient history because so little information is usually readily available. Even in those relatively few cases where ancient historians have an apparent wealth of information at their command, this initial impression is not always correct, as the evidence may prove to be insufficient at second glance, specifically for the purposes of network analysis. Thus, the difficulties that gathering sufficient and suitable historical data for social network analysis presents to historians of any period are exacerbated by the peculiarities of ancient source survival and their transmission.

To illustrate this point, it will be useful to consider three seminal studies that have all been founded on a seemingly exceptionally dense and abundant corpus of sources (abundant that is, by the yardstick of ancient history, where often historians are reduced to (over?)interpreting mere fragments of information). A 1990 paper by ancient historian Michael ALEXANDER and communication researcher James DANOWSKI investigates the epistolary networks of Cicero. Similarly, Adam SCHOR's 2011 study of the clerical network of Theodoret, the 5th c. bishop of Cyrrhus in Syria, uses the extant personal correspondence of Theodoret, while Giovanni RUFFINI bases his research into two settlements in Byzantine Egypt on the large corpus of surviving papyri from Oxyrhynchus, as well as other Egyptian treasure troves. All these case studies differ from other periods and/or research interests in Ancient History in that they provide researchers with a relative abundance of contemporary source material. Cicero's correspondence, for instance, comprises 946 letters which are both written by Cicero himself and addressed to him by a variety of relatives and friends (although the paper mentioned above focuses on a mere 280), while 249 letters survive from Theodoret. For RUFFINI's study, a wealth of papyri and more or less complete documentary archives of individual persons survived, something which is mostly unheard of for any geographical area other than Egypt.

The very first study of an ancient network to employ not only the terminology of networks (in a metaphorical sense) but also the "heavy industry, the quantitative techniques underlying the theory",³⁰ was the research paper published in *Social Networks* as a collaboration between Michael ALEXANDER and James DANOWSKI. It focuses on personal communication during the Late Republic and uses the considerable corpus of letters written by and to Cicero in the years between 68 and 50 BC as source material. For the narrow period

30 RUFFINI (2008), p. 16.

imposed on the study by the authors themselves, the result is a selection of 280 available letters.³¹ A database is constructed on this basis, including each individual named in the letters, as well as the authors and addressees that were in contact with one another. 'Contact' is taken here to mean not only epistolary contact as evidenced in their source sample, but rather 'any interaction between two individuals', including interactions found in sources other than Cicero's letters.³² This results in a study sample of 524 individuals, identified by name and rank, that is by their placement among the *ordines* of the linear-hierarchical scale of Roman society. In total, seven status categories are established, ranked according to a rough definition of closeness to power, with senators at the very top and including "knights", "citizens", "women", "freedmen", "slaves", and "foreigners". While different types of interaction are included in the database, the paper itself focuses solely on communication. In the end, network analysis yields the undoubtedly correct result that there was no structural difference between senators and knights within Cicero's communication network and the authors frame their results within the context of a larger debate about the nature of Roman aristocracy. Their argument is in fundamental agreement with what was (and still is) the prevailing scholarly opinion, that "the two groups were not monolithic blocks in opposition", but rather "interlocked in one social network", and they add that this view had now "obtained quantitative confirmation".³³

While this conclusion was not particularly innovative, as they readily concede, the methodological approach was.³⁴ In applying quantitative methods to the history of the Roman republic, they took the first step towards opening up new avenues of research for later scholars.³⁵ What was lacking from their limited investigation was the corresponding prosopographic research beyond the most basic information and a more precise classification of individuals in their data sample. Included in their database was any type of interaction between any two individuals named in any one letter addressed to or written by Cicero in the space of 18 years – years that, it may be added, saw not only the high point of his own career (the quashing of Catiline's insurrection), but also Pompey's much-anticipated return from his eastern campaigns, the turbulent consulate of Caesar, the so-called first triumvirate, and the hard-fought political

31 ALEXANDER / DANOWSKI (1990), p. 317f.

32 *Ibid.*, p. 320.

33 *Ibid.*, p. 330.

34 For a fuller appreciation of this paper in the context of the development of historical network research see NITSCHKE / ROLLINGER (2015), p. 220-222.

35 *Ibid.*, p. 331. On the conclusions see also VERBOVEN (2002), p. 347: "The main conclusions were that there was no social or economic difference between senators and knights and that Cicero entertained more contacts with senators than with knights. The former is old news, the latter is hardly surprising".

battles of the mid-50s. The social categories employed by ALEXANDER and DANOWSKI, while are overall likely agreeable to a majority of scholars, are by no means beyond criticism. Thus, the artificial dichotomy between “citizens” and “women” does not seem convincing, even if one concedes that it is an attempt to reflect the vastly different agency of women in ancient Rome.³⁶ Beyond that, even basic assumptions, such as a homogenous, more or less clearly defined and delineated *ordo* of knights, are open to scholarly attack, at least for the late Republican period.³⁷

On the other hand, the mingling of vastly different types of interaction is also problematic, as the authors differentiate neither between personal or epistolary contact, nor indeed any other form of contact, such as kinship or adoption, or even between friendship or enmity. But this is crucial. There is obviously a vast difference between, for example, helping a friend and suing an enemy. Even within these smaller, more precise categories, there still exist different types of help, be they ideal (as in moral support), practical (as in loaning money) or political (as support for elections). This criticism may smack of nit-picking, or at least as if it were placing overly rigorous demands on a pioneering study written more than twenty-five years ago. Indeed, it should be repeated that the study has an explicitly stated and limited double aim of advancing the methodology of formal network analysis as such, by applying it to ancient evidence, and of using it to empirically investigate whether senators and knights occupied different positions within the communications network of Cicero. Their main conclusions, both the strictly historical and the more far-reaching methodological (which essentially consists of the assertion that network analysis is a viable means of illuminating historical questions), still hold true today.

The real problem lies not solely in the methodology adopted by the authors, but rather (again) in the nature of our sources and the specific approach chosen by the authors for dealing with them. Since the letters of Cicero are the only real source available for reconstructing the communication networks of the late Republic, they must be utilised. However, as the authors rightly stress, this undoubtedly distorts any results, as they are inherently dependent on Cicero’s view of events. The paper attempts to remedy this by analysing two versions of the network, one including, the other one excluding the person of Cicero himself, but even then, the authors remain cautious: “Even with him out of the network, one could argue that the remaining interactions studies were from his

36 Cf. HALLETT (1984). LEVICK (2012).

37 The problems inherent in categorising the Roman population in this fashion are acknowledged by ALEXANDER / DANOWSKI (1990), p. 319.

vantage-point only.”³⁸ Such an objection can indeed be made, though it would have the particular disadvantage of being absolutely true and remarkably unhelpful at the same time, as the distortion is a consequence of being heavily reliant on one of the most productive sources in all of ancient history! To discard it would be to deny ourselves a major resource, to the point of no longer being able to say very much at all.³⁹ That being said, there remains the elementary difficulty of trying to analyse general societal structures based mostly (if not exclusively) on the private correspondence of a single person. But at its core, this is a very common problem for historians and particularly for historians of the Late Republic. Cicero’s letters dominate the analysis of much of the 50s and 40s BC. Their bias is well-known and they must be analysed and interpreted with care.⁴⁰ The same care in interpretation must be applied to the results of SNA. This is a problem that we shall have to return to later.

As the first book-length treatment by an ancient historian using formal SNA, Giovanni RUFFINI’s 2008 monograph was extremely influential as a model for later analyses and was (and is) frequently cited as an inspiration for similar enterprises.⁴¹ It comprises two more or less separate studies and relies heavily on an earlier prosopographical work for part of his network construction. While this prosopography of the Egyptian village of Aphrodito is itself based on the thousands of papyri recovered in and around Oxyrhynchus, it is both dated and incomplete. As RUFFINI acknowledges, he was forced to rely on it for want of an alternative.⁴² His aim is to study both the society and the structure of social networks in two Egyptian locales, the administrative district (*nomos*) of Oxyrhynchus and the village of Aphrodito. In particular, he is looking to unveil the structural characteristics of the aristocratic elite of landowners, though his methodology at times exacerbates the problems of both a lack of sources and an incomplete prosopography. His methodological approach is two-pronged: for his *nome*-wide research into the landowners of Oxyrhynchus, he focuses on the house of the wealthy Flavii Apiones. Lacking a coherent prosopography of Oxyrhynchus from which to draw sufficient information for social network analysis, he instead decides

“to treat topographical network analysis as an analogue for real social analysis. By treating each settlement as a social unit, and by analysing the attested ties between those settlements, [I intend to] use the topographical evidence in Paola

38 *Ibid.*, p. 320 (quote at p. 329).

39 Or, as ALEXANDER / DANOWSKI (1990), p. 329 put it: “The same caution would apply to any statements about Roman society based on the *Letters*.”

40 Cf. LINTOTT (2008).

41 See most recently SELAND (2016a). (2016c).

42 The work is GIRGIS (1938). See O’CONNELL (2010) for some of the problems, which RUFFINI is aware of and attempts to compensate for (RUFFINI [2008], p. 199-201 and p. 210f.).

Pruneti's register of the Oxyrhynchite *nome* as a substitute for the social connectivity of the *nome* as a whole."⁴³

He goes on to use network analysis to "map the connections between the Apionic toponyms [i.e. sites which belong to that house] and other sites in the Oxyrhynchite *nome*", so as to determine "whether Apionic jurisdiction [i.e. the reach of their domains] spread organically from an original rural site, or grew in a more haphazard fashion, directed by [absent] landowners".⁴⁴ To map the coordinates of individual properties, he asserts that the frequency with which they were simultaneously mentioned in any given papyrus was a function of their geographical closeness, and this frequency is thus the defining characteristic of his network:

"If the Apionic holdings were physically proximate, they would show a pattern of connectivity different from other settlements in the *nome*. They would have more connections to each other than to non-Apionic settlements. The network density of the Apionic holdings would be higher than the network density of the rest of the network."⁴⁵

If this is true, RUFFINI asserts, then it is a strong indication of a 'worm's-eye view' of expansion by the house of Apion, meaning that it would have continuously bought properties adjacent to each other, thus expanding their land-holdings outwards. By comparing the resultant network to a random network generated for this purpose, RUFFINI concludes that no substantial differences in network density could be found and that this hypothesis is to be discarded.⁴⁶ This matches earlier conclusions reached by more traditional research.

The second part of his analysis, dealing with the settlement of Aphrodito, is more problematic. While the analysis performed on the holdings of Apion and his house was not *per se* that of a *social* network, this is exactly what he now attempts for Aphrodito, a fair-sized city and the home of noted poet and notary Dioscurus. On the assumption that two individuals named in any given papyrus must have known each other, he codes a connection between them. In doing so, however, social differences are blurred, and this methodology ignores the

43 RUFFINI (2008), p. 95.

44 *Ibid.*, p. 4.

45 *Ibid.*, p. 129. For a similar approach see GRAHAM (2006a) and (2008), as well as MÜLLER *passim*. While network analysis is RUFFINI's main heuristic tool, both GRAHAM and MÜLLER also employ a wide array of methodologies borrowed from the archaeological disciplines, such as Multidimensional Scaling (MDS) and Monte-Carlo-Simulations (MCS). A combination of SNA and MDS is also utilised by COLLAR *passim*, particularly in her 2014 study on *Religious Networks in the Roman Empire*.

46 *Ibid.*, p. 133-138.

specific nature of the connection, since it does not differentiate between even such basic and fundamentally opposed categories as ‘friendship’ and ‘enmity’. The subsequent analysis and interpretation of his results is thus of more limited use, since those difficulties are not always sufficiently reflected in the conclusions.⁴⁷ This is particularly surprising as they are preceded by a number of chapters devoted to prosopographical enquiries, which attest to the wealth of information available from the thousands of archival papyri. Curiously, though, the prosopographic data is not brought to bear on the presuppositions and results of the network analysis.⁴⁸ Thus his basic conclusion that the decentralised social network of Aphrodito (displaying “strong, multiplex, evenly distributed social ties”⁴⁹) was both enduring and robust, and remained structurally unchanged during the 6th century,⁵⁰ is based on the uncertain premise of a network reconstructed from criteria that is all too vague – how can a network which does not differentiate between friendship and enmity be called robust?⁵¹

In contrast, Adam SCHOR, in his study of the Antiochene theologian Theodoret of Cyrrihus and religious networks in late Roman *Syria*,⁵² proposes viewing the religious dispute between dyophysites and miaphysites before the Council of Chalcedon through the prism of the social networks of the theologians involved in it. He must first search for “signals of doctrinal affinity” and the “language of clerical affection”, i.e. linguistic cues by which he identifies membership in a specific doctrinal school.⁵³ He devotes an entire chapter to establishing analytical criteria for which relationships to code and is rigorous in applying them to his data sample. Thus,

“for a relationship to be considered Antiochene [and thus eligible for his analysis], a sender and recipient must share (that is, either personally exchange, collaboratively produce, or recall past instances when they exchanged or co-produced) at least

47 But see his acknowledgment of this at RUFFINI (2008), p. 25.

48 It bears repeating that the information database used by RUFFINI is in and of itself already problematic: PRUNETT’s Oxyrhynchite register dates back to 1981, since when twenty-three additional volumes of the Oxyrhynchus Papyri have been published, and GIRGIS’ prosopography, published as far back as the 1930s, has variously been deemed unreliable by papyrologists. See RUFFINI (2008,) p. 199-201 and 210f., as well as O’CONNELL (2010). It should also be mentioned that RUFFINI has since published his own extensive prosopography of Aphrodito (RUFFINI [2011]).

49 RUFFINI (2008), p. 149.

50 *Ibid.*

51 Cf. JÖRDENS (2011).

52 SCHOR (2011).

53 For the precise criteria, see SCHOR (2011), p. 20-25 and p. 42.

three different cues or habits out of those listed in the first chapter, on more than one occasion, *including at least one specifically doctrinal cue*" (author's italics).⁵⁴

SCHOR also sets precise chronological and regional limitations, and his interpretation of the data produces a number of individual snapshot-networks, picturing Theodoret's network at different moments in time. Yet, in a testament to his intellectual honesty, he also remains aware that his reconstructed networks are doubly interpretative. Firstly, as he acknowledges, "Theodoret's network could have been an illusion of his pen, which dissolves when viewed through different writings".⁵⁵ In other words he is faced with the same problem that bedevilled the short study on Cicero's network, i.e. the overpowering presence of his primary source. A second difficulty lies in the core conclusion that SCHOR reaches, namely the allegation that the social network of Theodoret had an actual and substantive influence on the theology he espoused.⁵⁶ This may have been the case, and his argument is certainly convincing.⁵⁷ But it should always be kept in mind that the network SCHOR reconstructs is strictly limited to social ties as they relate to a specific theological debate and a specific group of like-minded individuals, i.e. the so-called School of Antioch. For the main part, this may be due to the nature of Theodoret's correspondence, as it has survived to this day, but it is also a consequence of the criteria settled upon by SCHOR. It rests on his interpretation of a network that is defined according to the linguistic cues he identified earlier, and we should always be aware that these clues are an artificial limitation of his data sample – in other words, he is sampling the sample. While it is true that among the roughly 250 extant epistles we primarily find letters dealing with matters of theology (along with festal letters), there are also recommendations and letters of patronage as well as 'business' correspondence with state officials. The concentration on dogmatic clues inevitably means that Theodoret's network, as reconstructed by SCHOR, is but an extract and very likely incomplete, as individual letters and contents that do not conform to SCHOR's criteria are by definition excluded from his analysis. But is this to say that, for example, notions of reciprocity implicit in patronal relationships as described by letters of recommendation definitively played no role in the formation of his theology? To reiterate: the case SCHOR makes is sound. But, if Theodoret's theology was indeed influenced by – and is perhaps

54 SCHOR (2011), p. 42.

55 *Ibid.*, p. 129.

56 *Ibid.*, p. 181.

57 See the review by RUFFINI (2012), p. 175f.: "Theodoret, he argues, saw a dyophysite Christ as a necessary mediator between God and man because of his own network experience as a patron and mediator between the Roman world's elite and its more humble."

even a reflection of – his social embeddedness, then it is precisely his social embeddedness that would bear further scrutiny.

As commendable and rigorous as SCHOR's handling of the sources and his employment of SNA methodology otherwise is, a final point should be made regarding transparency, or rather his lack thereof. RUFFINI rightly says in his review of SCHOR: "For network analysis to thrive in ancient studies, and for further studies to build on earlier conclusions, its supporters must demystify its quantitative side."⁵⁸ This is crucial. Demystification requires transparency about which methods were employed, what software was utilised, and which measures were taken. Above all, however, it requires total transparency concerning what criteria were used to construct the network under scrutiny. Indeed, this is a great strength of RUFFINI's own book-length treatment: in his introduction he not only provides the reader with a concise summation of research into ancient networks undertaken up to 2008, but also with a 20 page 'users guide' on *Starting from scratch: How to make and analyse a network data set* that, for all the changes that have come about in the software available for SNA, has not yet been surpassed.⁵⁹ In his interpretation of network structures, he is equally forthcoming. SCHOR, on the other hand, unfortunately obfuscates: "He describes his Antiochene episcopal network as dense ('an overall density of 0.131') but does not tell us what it is dense in relation to, or what software he used to get this result [...]. He gives centrality scores [...] but does not tell us which of the several standard centrality measures he has used."⁶⁰ In the years since SCHOR's book was published, this has increasingly been handled differently, with a greater emphasis placed on methodological transparency, both in the criteria for network construction and in the use of software, and statistical calculations and algorithms.

Ideally, however, complete transparency would include the publication of the complete database used in any given study. Since SNA relies on empirical measures, the scientific standard of repeatability should be applied; this can only be done when researchers are able to access the original data files, or at least are provided with the necessary information to quickly assemble similar datasets. In a best-case scenario, this could for instance occur through uploading the databases to institutional repositories and making them available to researchers wishing to recreate or falsify the results of a study, or indeed to build upon them. This is not happening yet (even in this publication⁶¹). Part of the reason for this

58 RUFFINI (2012), p. 175.

59 RUFFINI (2008), p. 20-40.

60 RUFFINI (2012), p. 175.

61 The editors of *The Journal of Historical Network Research* (including the author of this chapter), a Gold Open Access publication hosted by the Centre for Contemporary and Digital History

is the largely traditional means of publishing still employed in most cases (i.e. print media). It is simply not feasible to include either voluminous lists of encoded data or tables of raw data including actor designations, attributes, connections, types of connections, etc. in printed studies, be they monographs or research articles. In light of recent efforts to promote Open Access and Open Science, as well as their reliance on comparatively large amounts of data that are at the core of their research, HNR practitioners should embrace the possibilities afforded by Open Access publications and databases to include data sets with their publications. In the meantime, however, practitioners should consider providing at least an approximation of such a database, e.g. in the form of prosopographic appendixes/tables to their studies.

In two book-length studies of the aristocratic society of late republican Rome, in which I have endeavoured to provide an updated and detailed best-practice application of SNA methodology to this period, such appendixes were included and provide at least the basic tools for recreating the networks discussed in both monographs.⁶² Building on the initial approach of ALEXANDER and DANOWSKY, both studies attempted to combine all available historical sources on late Republican Rome into a coherent picture of Roman elite society, and specifically of the social networks of the two highest *ordines*, the senatorial and equestrian orders. As Roman society was widely permeated by and structured along social relations and ties of friendship and patronage, these relationships formed the basis for assembling a database of upper class network connections. These connections were based on the Roman concept of friendship (*amicitia*), which came with a precisely defined set of conditions and expectations for everyone involved, which were in turn based on and laid down, among others, in philosophical treatises such as Cicero's *Laelius / De amicitia* and *De officiis*, or Seneca's *De beneficiis*. At its core, then, *amicitia* was based on *fides*, a term whose broad range of meanings is not matched by its English translation of 'loyalty'.⁶³ *Fides* figures prominently in Latin literature and is inextricably

at the University of Luxembourg, intend to implement a model for hosting relevant data sets in addition to original publications in the medium term, but this is still in development.

- 62 Though I readily acknowledge that in the age of online databases and repositories, this method may seem quaintly old-fashioned. Cf. BROEKAERT (2015), p. 160 n.21 ("[...] associated tables and graphs [...] are available on request from the author."). ROLLINGER (2009) should very much be seen as a limited and preliminary foray into the possibilities of applying SNA methods to this subject, with a fuller investigation later following in ROLLINGER (2014) (see especially p. 353-391 for some further methodological *prolegomena*). For a more detailed English language outline specifically of the SNA methodology employed therein, see now also ROLLINGER (2020).
- 63 *Fides* could also mean 'trustworthiness', 'promise' or 'credit', to name but a few possibilities. For a full semantic range, see HELLEGOUARC'H (1963), p. 23-40. (FREYBURGER) 1986.

linked with the other core elements of *amicitia: benevolentia* and *gratia*.⁶⁴ The latter two are simultaneously individual virtues and operational principles. The *mutua benevolentia* leads to a desire among friends to do favours for one another (*beneficia*), which is one of the main duties (*officia*) of friendship. Each *beneficium* elicits *gratia* on the part of the beneficiary, whose fides in turn assures a counter-favour.⁶⁵ Thus, each relation of *amicitia* is not only founded on a general feeling of benevolence, but manifests itself in the regular and routine exchange of *beneficia*. Furthermore, the aristocratic code of conduct dictated that each counter-favour had to be at least of equal value as the original *beneficium*, and preferably of higher value, thus setting in motion what may be termed a 'virtuous circle'.⁶⁶

This, at least, was the theory. But information gathered from historical sources such as the biographies of Plutarch, the historiographical narratives of Cassius Dio and Appian, and (above all) from Cicero's extensive personal correspondence shows that these expectations of friendship were not limited to philosophical theory. Rather, the moral precepts associated with *amicitia* proved to be an effective means of regulating aristocratic society, forcing (as they did) even the most powerful aristocrats into a universally accepted orthopraxy of friendly relations.⁶⁷ The social structure resulting from this habit of *amicitia* can thus be extracted from our sources, if precise criteria for what actions constituted (or were part of) friendship relations can be defined. In this case, the following actions were understood to be indicative of an *amicitia* relationship: mutual dinner invitations, attendance at morning greetings (*salutationes*), a specific kind of military service under the direct command of a senator, service as a lawyer or character witness for another aristocrat, financial loans and other services, the inclusion of another aristocrat in one's will, the naming to a tutorship for the under-age descendants of aristocratic peers, writing, requesting or acquiescing to letters of recommendation or introduction.⁶⁸ For each pair or triad (in the case

64 On *benevolentia*, see Cic. *Lael.* 22 and *off.* 2.31f., with HELLEGOUARC'H (1963), 150. The Greek equivalent of εὐνοία is equally important in Aristotle (*eth. Nic.* 1167a3–a11). On *gratia*, see Cic. *inv.* 2.66 (*gratia* as that *quae in memoria et remuneration officiorum et honoris et amicitiarum observantiam tenet*). See also *ibid.*, 161.

65 ROLLINGER (2014), p. 101–121.

66 SEN. *ben.* 5.2.1 (*turpe esse beneficiis uinci*). The notion of *beneficia* leading to a moral indebtedness is ubiquitous in Latin literature; see for instance the aphorism attributed to Publilius Syrus, a late republican mime (PUB. SYR. 48 F): *beneficium accipere libertatem est vendere*.

67 Naturally, there were situations (e.g. of great personal or political stress, during violent unrest or civil war) where the aristocratic adherence to a habitual code of conduct was put to the test and found to be less than absolute. This should not surprise anyone. As a general principle, however, Roman friendship ideals and their effect on the day to day interactions between members of the aristocracy proved to be remarkably resilient.

68 For a full justification of these categories, see ROLLINGER (2014), p. 133–352.

of letters of recommendation) for which one of the aforementioned actions of connections is attested in the period of 78–43 BC (roughly a generational cycle of Roman politics, from the death of Sulla to the beginning of the ‘second’ Triumvirate, though, as I pointed out in the discussion of the paper by ALEXANDER and DANOWSKI, it was certainly a crucial period in Republican history), an *amicitia* relationship is assumed and coded.⁶⁹ The resultant database includes a total of 490 named persons, interconnected by 842 distinct ties.⁷⁰

Though the numbers may seem impressive at first glance, further analysis of this network was hampered by many of the same difficulties faced by ALEXANDER and DANOWSKI. Since much of the information on which the network was based was extracted from Cicero’s letters, his perspective was dominant and, naturally, in attempting to establish further criteria, I was also sampling the sample. In order to minimise Cicero’s distortive influence, I followed ALEXANDER and DANOWSKI in drawing up an alternative network without Cicero, to check against.⁷¹ This network was then subjected to a number of statistical and mathematical analyses, which, gratifyingly, yielded similar results as the original. Quantitative measures such as network density, centrality (both ‘degree’ and ‘betweenness’ centrality) were taken and correlated with modern theories and notions of Roman aristocratic society.⁷² While the network itself proved to be not exceedingly dense (only 0.7 % of possible ties were realised), its connectivity was nevertheless high, with the average distance between nodes being ~3 (thus three, not six, degrees of separation). Furthermore, the network fulfilled all empirical criteria of being a Small World.⁷³ Small World networks are structured as a number of dense clusters (i.e. with a high degree of connectivity within themselves) connected by relatively few connecting bridges. This fits well within modern views of Roman society as

69 The software package used was UCINET: Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. *Ucinet for Windows: Software for Social Network Analysis*. Harvard, MA: Analytic Technologies.

70 The total is made up of 220 senators and 191 knights, the balance being constituted by persons belonging to other strata of Roman society, as well as non-citizens. Ties are represented as generalised and undirected, i.e. no distinction is made between the different kinds of friendly actions and the direction of the service rendered.

71 ALEXANDER / DANOWSKI (1990), p. 320.

72 For an overview of relevant quantitative measures, especially for centrality and prestige measures, see BORGATTI / EVERETT / JOHNSON (2013), p. 163-180. WASSERMAN / FAUST (1994), p. 167-219). But cf. BORGATTI / CARLEY / KRACKHARDT (2006) and STARK (2016) for the limits of quantitative measures and their uses for the historian.

73 Cf. CLINE / CLINE (2015), p. 34: “a small average path length or Average Geodesic Distance; a ‘power law’ distribution; and a high clustering coefficient that is greater than a random network [...], all three must be present in a network or else one ought not call it a Small World.”

being structured by brokerage (including *amicitia*) and patronage relationships, for which empirical, quantitative proof is thus secured.⁷⁴

Several other recent, smaller studies are noteworthy not only for their analytical content, but also for both their protreptic value and their methodological transparency. Mention has already been made of Diane and Eric CLINE'S analysis of the Amarna Letters, a remarkable paper that rigorously applies scientific standards of proof to categories and terms that, for the most part, have been used rather lightly by other ancient historians, both in general and those engaged in SNA.⁷⁵ Thus, for example, the by now very widespread epitheton of the 'small world' is here also shown to be justified for the Near Eastern world, as represented in the Amarna Letters by means of mathematical proofs (which are easily and readily available even to the non-specialist, as the relevant algorithms are included in most modern SNA software; the mathematically uninitiated can run them with a simple click of the mouse) instead of mere intuition.⁷⁶

In what she herself has termed a previous "experiment"⁷⁷ into ancient networks, Diane CLINE has endeavoured to show the utility and potential of this methodology as applied to, mainly, Classical and Hellenistic Greece. Using Waldemar HECKEL'S prosopographic work on Philip II and Alexander III of Macedon, she reconstructs their personal networks, encompassing 113 individual actors linked by 232 separate ties for Philip, and 404 named individuals for Alexander, including not only Macedonians and Greeks but also conquered ethnicities.⁷⁸ This network is then subjected to various computational analyses, and CLINE is particularly interested in subgroups identified by the Clauset-Newman-Moore cluster algorithm, whose composition and relation to the general network are then analysed in light of modern scholarship and research into the history of Alexander's campaign.⁷⁹ CLINE readily admits that, for example, the notion that "the more interconnected the Macedonian officers were to other ethnic groups, the less likely they were to have been participants

74 See, e.g., SALLER (1982) as a *locus classicus* for this assertion and now compare GANTER (2015).

75 CLINE / CLINE (2015).

76 For a particularly egregious example of 'networks-by-intuition', see now KRÜPE (2016), who seems unaware of the development of historical network research of the last decade.

77 CLINE (2012), p. 63.

78 *Ibid.*, p. 62-68. The prosopographic works are HECKEL (1992). (2006).

79 Cf. CLAUSET / NEWMAN / MOORE (2004). It should be pointed out that this is characterised as a work in progress (CLINE [2012], p. 66f.) and that a "more comprehensive study is now underway, using the primary sources [...] to flesh out the relationships and uncover more interrelationships than are mentioned in the brief biographies in HECKEL'S *Who's Who* which was used for this prototype."

in the mutiny on the Hyphasis River of the Opis mutiny⁸⁰ is still a mere hypothesis that necessitates further research. But this conclusion, reached from the results of computational analyses of network data, is a good example of how SNA methodology may point ancient historians in the direction of further research and offer them fresh perspectives on seemingly well-known and thoroughly researched areas. In a second experimental case study in the same paper, Cline also laid some of the groundwork for investigating Athenian society of the 5th century by attempting to recreate the personal network of Pericles of Athens, based primarily on information gathered from Plutarch's *Life* and resulting in a network of 49 named individuals connected by 72 ties.⁸¹ She has taken up this subject again in her contribution to this volume, which follows through on the initial work undertaken in 2012.

While Cline (and the majority of other ancient historians) have so far primarily used literary sources and ancient letter collections as sources for analysing ancient networks, Wim BROEKAERT has exploited particularly rich and comprehensive epigraphic evidence in two extensive case studies on Roman economic history. In the first paper, BROEKAERT performs SNA on two important Roman banking families, the Sulpicii from Puteoli and the family of Caecilius Iucundus of Pompeii, which have been primarily selected because, unusually, a part of their business archive was preserved in the form of wax tablets during the cataclysmic eruption of Vesuvius in AD 79.⁸² Using the information contained therein, he establishes two networks by including "those persons somehow related to the Sulpicii and Caecilius Iucundus and thus mentioned in the archives"⁸³, pointing out that additional information on the relationships of both bankers (and on relationships not mentioned in the tablets) is available elsewhere. While this additional information informs his interpretation of the networks, the latter themselves consist only of individuals named in the extant archival evidence.⁸⁴

The resultant network visualisations are contrasted and, in a first step, interpreted visually. While this may sound banal, actually looking at network graphs drawn up from collected data must always be the first step towards their interpretation, as it is often by the very act of observing unexpected connections (or lack thereof), that the historian is pointed in the direction of further

80 CLINE (2012), p. 68.

81 For her heuristic approach and criteria for the inclusion of persons in the network database, see CLINE (2012), p. 64f.

82 BROEKAERT (2013).

83 *Ibid.*, p. 473.

84 For the methodological limitations, of which BROEKAERT is aware, see *ibid.*, p. 473-475.

reflection.⁸⁵ BROEKAERT then goes on to collapse the networks, limiting the visual representation to *gentes* (families) instead of individuals, in order to reduce the interference by relationships attested in the tablets (such as master-servant) that is irrelevant to his main line of enquiry, which is to analyse how both entrepreneurial families “created trust” within their business communities and how they selected witnesses to their business deals. He then introduces several aspects of network metrics, measuring network cohesion (density, degree), locates subgroups, and offers three different centrality measures (degree, closeness, betweenness) both for individuals and for family subgroups as a means of identifying important nodes. The detailed results of quantitative analyses are presented in extensive tables, wherein each measurement is accompanied by a prosopographical analysis of selected individuals as well as an interpretation of the quantitative measurements. His interpretation of two clearly different network structures leads BROEKAERT to conclude that two different processes of selecting witnesses were used. The more

“‘international’ business community in Puteoli necessitated the careful selection of witnesses among colleagues in trade, who were acquainted with someone’s reputation and trustworthiness. In Pompeii on the other hand, the local level of exchange allowed bankers and businessmen to operate in a face-to-face community, where experience in trade was not considered to be a vital criterion to be selected as a witness.”⁸⁶

A second paper adopts much of the same rigorous methodology for a study of religious associations formed by Italian businessmen on Delos during the era of the Roman Republic.⁸⁷ Based on the epigraphic evidence of these associations, BROEKAERT here attempts to resolve an on-going debate about their nature by using SNA to show how “the background of the individual *magistreis*, the ties connecting them to each other and their place in the fabric of the Italian community on Delos helped to determine the role, or roles, of the Italian associations.”⁸⁸

In constructing the Italian network on Delos, he excludes much evidence that yielded only fragmentary identification in favour of named and identifiable persons and distinguishes between different ties (short-term vs. long-term, i.e. kinship, marriage, etc.) as referred to in the epigraphic record.⁸⁹ As in the

85 For the ‘visual culture’ of HNR, see MAYER (2016) with EUMANN (2016) for reflections on the heuristic value of visualisations.

86 BROEKAERT (2013), p. 508.

87 BROEKAERT (2015).

88 *Ibid.*, p. 144.

89 On his methodology cf. *ibid.*, p. 145 (“Ties were added between all nodes present in an inscription. I assume that the occurrence of two or more nodes in a single inscription identifies

previous paper, he is aware of the methodological limitations that the nature of our sources force on him and, since evidence for individual networks is lacking, he shifts his attention from intrafamily (connections between people belonging to the same family) to interfamily networks (connections between families). The resultant network size is thus reduced from 546 nodes to 187. He then performs the standard quantitative measurements (viz. density and centrality measures) to identify the most important families within the Delos-wide network. The added value of the SNA approach, however, becomes clear only after SNA proper is applied and BROEKAERT combines its results with further statistical analysis of the epigraphic material and historical interpretation. He is able to show that the leading magistrates of Delian associations were open to most Italian families on Delos, which had no monopoly on leadership, while on the other hand it was precisely (and exclusively) members of these families that could lay claim to multiple terms of office. It is thus precisely the combination of traditional hermeneutics with SNA methodology that leads him to a better understanding of Italian associations.

4 Conclusions

It has hopefully become obvious that recent attempts at introducing SNA perspectives and methodologies into the study of the ancient world have both yielded specific results and carry the promise of still further insights. One thing should always be borne in mind, however, and this point cannot be stressed enough: in and of itself, SNA seldom produces results. Or, to put it another way, the results of SNA, be they network graphs, centrality measures, or even the simple re-thinking of existing presuppositions, must necessarily be combined with, preceded *and* followed by a careful interpretation of historical context, sources and source biases. This final heuristic step is of utmost importance.

The availability of high-quality sources is obviously of crucial importance to employing quantitative analyses such as SNA, a methodology which was after all developed with a relative abundance of data in mind. This is not to say that sociological network studies, which rely on questionnaires and / or personal interviews, always provide researchers with complete data sets – as a matter of fact, they do not.⁹⁰ But it is undeniable that historical studies face different

at least some kind of connection, however momentary or casual. To contemporary SNA, this may be a rather crude measure, but probably one of the very few available to ancient historians.”) and compare his remarks in BROEKAERT (2013).

90 BORGATTI / CARLEY / KRACKHARDT (2006). But see LEMERCIER (2015), p. 285 and p. 287, who asserts that “written sources altogether tend to offer more opportunities to observe actual, precisely dated and qualified exchanges than fieldwork in contemporary societies.” (p. 287) While this may be true for some aspects of modern history, it is generally not the case for the ancient world.

challenges, and even within that category there are significant differences between discrete historical periods. The ancient world, it must be admitted, least lends itself to a ready adoption of SNA, because here the missing data problem looms largest.⁹¹ But, as shown by the exemplary studies above, there are exceptions, individual cases and time periods, in which a relative abundance of sources makes SNA a possibility. Typically, this is most often the case when personal correspondence has survived, or when epigraphic or papyrological evidence can be used. Thus, in addition to Cicero's and Theodoret's epistles, it should be possible to use the equally famous correspondence of Pliny the Younger, of late antique aristocrats such as Libanius⁹², Cassiodorus and Q. Aurelius Symmachus⁹³, or of church fathers and bishops, such as Sts. Augustine, Ambrose, Jerome, Paulinus of Nola⁹⁴, Sidonius Apollinaris, Avitus of Vienne and Magnus Felix Ennodius. Similarly, the many tens of thousands of surviving papyri can likely provide enough information for a wide array of SNA/HNR-related investigations, for example into economic and social history⁹⁵, as can the hundreds of thousands of Greek and Latin inscriptions from all over the Mediterranean world. Using some of these source materials, exciting work is being done at this very moment, particularly in the context of ongoing projects such as *Migration of Faith* (University of Sheffield)⁹⁶, which attempts to use SNA/HNR methods to better understand the social and geographical dimensions of clerical exile in Late Antiquity, *Trismegistos* (KU Leuven) and the *Networks in the Roman Near East* project (NeRoNE, University of Bergen).⁹⁷

91 ENDERS (2006).

92 Cf. SANDWELL (2007), who does not use formal methods. Lieve van Hoof (Ghent) is currently undertaking formal SNA research into Libanius' social network, the results of which have not yet been published.

93 Cf. SIEDOW (2014).

94 Cf. GHETTA (2014).

95 On this, see the abstracts of papers presented at the October 2015 conference *Papyri / Social networks* held at the University of Leiden (NL), available at <http://media.leidenuniv.nl/leg-acy/abstracts-papyri-%26-social-networks-2015.pdf> (accessed on February 8, 2017).

96 Project homepages are <https://www.clericalexile.org> (accessed on September 2, 2019), which includes a publicly available interactive network map and database, and <https://blog.clericalexile.org> (accessed on September 2, 2019), which includes blog posts and discussions of methodology. Network-heavy papers dealing with aspects of the project have now been published as part of a special issue of *Studies in Late Antiquity* (vol. 3, no. 3), in particular BARRY (2019).

97 See the respective project homepages at <http://trismegistos.org> and <http://neroneproject.blogspot.de> (accessed on February 8, 2017). *Trismegistos* intends to collect all available personal names and prosopographic data gathered from all texts published in Egypt from 800 BC to AD 800. For a variety of SNA applications within the *Trismegistos* framework, see e.g. BROUX (2015). (2016). BROUX / DEPAUX (2015). The NeRoNE project is smaller in scale but

For the moment, though, there is still a marked preponderance among those historians tempted to use or already using SNA to focus on a relatively narrow selection of sources, i.e. the well-researched, comparatively ample and easy to access correspondences of Cicero and Pliny.⁹⁸ This is understandable. But as recent work has shown, it certainly is possible to mine other sources, notably epigraphic and papyrological ones, for data in order to undertake SNA. However, there are difficulties as well, as Diane Cline remarks:

“[...] while SNA thrives on prosopographical studies, not every such study will be suitable. For example, consider the epigraphical records of manumissions which are inscribed on walls at Delphi. Other than visiting the same site, the named individuals do not have enough in common to be viewed as a network, since they didn't know each other.”⁹⁹

This, then, is the rub: the problem of incomplete sources bedevils any historical network research, regardless of which genre of sources s/he bases his research on. Thus, the historian of the ancient world must invariably at least partly be guided by the availability of such source material when deciding whether or not to 'do' SNA. As was recently noted, “sampling has already been done by accident of survival.”¹⁰⁰ It should be obvious by now that, precisely because of the disparate and fragmentary nature of ancient sources, no universally applicable solution to the problem of data gathering can be proposed.¹⁰¹ Dealing with a corpus of personal letters from members of the Roman elite (which communicated constantly and routinely across the whole range of the Mediterranean) is inherently different from, for example, examining the epigraphic record of a single Italian town, such as Pompeii, or the archival records of one particular family. In other words, there is no secret recipe for SNA in ancient history that would fit all needs and eventualities. Instead, both the heuristic criteria for network construction and the analyses that the reconstructed network is then subjected to must be a consequence of a particular research interest and, no less importantly, of the distinguishing characteristics of whatever source tradition is available. One should not be discouraged by

no less productive and uses a wide variety of sources (including papyri) to study religious and trade networks in the Roman Near East; see e.g. SELAND (2013). (2015). (2016a). (2016b). (2016c). SELAND / TEIGEN (forthcoming). For religious networks, see the ongoing work of Håkon Teigen (<http://neroneproject.blogspot.de/2013/12/a-manichaeen-web.html>, accessed on February 8, 2017).

98 See, for instance, the papers collected in this volume: of nine chapters attempting original SNA, three (VOGEL, ROSILLO-LÓPEZ, GILLES) are based on Cicero's letters and one on Pliny's correspondence (GERMERODT).

99 CLINE (2012), p. 69.

100 BROEKAERT (2013), p. 474.

101 Cf. BIXLER / REUPKE (2016).

incomplete data, as long as this weakness is kept in mind and addressed. Historical network research into the ancient world will probably never (or only in very exceptional cases) be able to present analyses as detailed or encompassing as much information as network analysis is able to in contemporary sociological research or even in SNA of the early modern and modern period. Both network researchers and ancient historians should accept this. That being said, it must not bother us unduly, since “the notion that even the incompleteness of contemporary data sets SNA is working with has never made the method obsolete, [and this] must be comforting for ancient historians.”¹⁰²

This specific problem means, however, that the ancient historian is obligated to exercise his own judgment in interpreting the sources and in deciding on the criteria for his analysis, both formal (e.g. discrete time periods) and on a hermeneutic level (e.g., which relationships should be coded). Indeed, this is essential, and though the long tradition of prosopographic research in Ancient History can be very helpful in this regard (at least when analysing *social* networks), it is still paramount to exercise due caution. Historical Network Research has to vest itself in a rigorous methodological framework, particularly in the field of ancient history, where much depends on exacting standards in source criticism, for the simple reason that ancient historians are not blessed with an abundance of source material. Furthermore, if SNA is to be more than a fad in the historical sciences, it is incumbent upon the individual researchers to be as transparent and open in their methodology as possible: what criteria were used in the construction of the network? Which actors and what types of connections and relationships do the intricate (and often visually overwhelming) network graphs represent? What is their analytical value? What software was used in drawing them up, and what algorithms and software functions were employed to take quantitative measures? If SNA is to be taken seriously, these questions have to be addressed and answers provided, ideally by making the corresponding data sets publicly available.

As I have stated previously, since the proof of networks is, at this point, neither revolutionary nor their existence a surprise (although it is deeply meaningful), Historical Network Research should be all about what happens *after*.¹⁰³ To this may be added: and *before*. In order to lead the historian to new insights (or to new questions), SNA has to be done in a methodologically sound, well thought-out and self-conscious fashion, taking into account the vicissitudes and imponderables of source tradition and survival. In light of the labour-intensive nature of SNA, it can also realistically only be applied to specific

102 BROEKAERT (2013), p. 475.

103 ROLLINGER (2020).

research interests and historical questions, and only after ascertaining that the source material is adequate for the task. SNA for SNA's sake is rarely able to supply any benefit to historical enquiries. In a way, then, SNA is dependent on the Goldilocks principle: if the right questions are asked of the right kind of sources by means of the right methodology, then (and only then) does SNA have the potential to advance historical enquiry—and to provide the right kind of answers.

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