

**Title: Networking *Paulys Realencyclopädie*: Exploring Relations in the Ancient World through Wikisource-interlinks**

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## **Introduction**

*Paulys Realencyclopädie der classischen Altertumswissenschaft (RE)* is a comprehensive encyclopedia covering antiquity until the time of Cassiodorus and Justinian aiming to encompass “all events and names of people of some importance” (Classen 2010, 4). It is used by scholars interested in antiquity around the world as an authoritative reference work. This paper explores and analyzes the *RE* from a network perspective. The computational application of Network Theory has been gaining in traction in the humanities over the past few decades (Ahnert et al. 2021) and the study of antiquity more specifically (Broekaert, Köstner, and Rollinger 2020; Broux and Depauw 2015; Brughmans, Collar, and Coward 2016; Collar 2022; Malkin 2011). Our goal is to demonstrate how Network Analysis can enhance our understanding of the complex structure of such a monumental reference work as the *RE*. We aim, first, to describe and analyse the network of people from antiquity that emerges from the *RE* using standard Social Network Analysis (SNA) methods, and second, to qualitatively analyse the results by comparing them to broad trends in traditional scholarship. Given its comprehensive nature and leading role in studies of antiquity, the *RE* is well-suited for this. This research is part of the *NIKAW* project (*Networks of Ideas and Knowledge in the Ancient World*), that aims to explore relations between individuals in Greek and Roman antiquity through the use of Natural Language Processing and SNA on literary texts. The *RE* will serve as a basis for identifying individuals in texts, thus this contribution reflects the early stages of this ongoing research.

## **Methodology**

This data-driven approach to the *RE* has been made possible due to the ongoing effort to establish an online Wikisource edition. This open edition allows unprecedented access to the *RE*, facilitating easy search through simple queries. For all entries in the physical edition the online edition includes a webpage, a short summarizing description (*Kurztext*), links to the entry’s pages in the physical edition, and for [public domain](#) entries, the complete text from the physical edition (*Volltext*). As of 05-01-2024, they report that 63.69% of partial articles have been created. Completed entries contain, where possible, links to the corresponding entry on Wikipedia and Wikidata. In the *Volltext* references to other entities in the *RE* are interlinked to either their corresponding webpage or position in the register, which is complete and contains all *RE* keywords (*Stichwörter*). Figure 1 exemplifies a completed entry, highlighting *Volltext* in red and *Kurztext* in green.

3) Eponymer Heros des Volksstammes der Abanten, gewöhnlich S. des Lynkeus und der Hypermnestra genannt (vgl. den Artikel *Abantes*). Vater des Akrisios Proitos Kanethos und der Eidomene (Schol. Eur. Or. 965. Apollod. II 2, 1), sowie des Chalkodon (Schol. Eurip. Hec. 125). Grossvater der Danae, Urgrossvater des Perseus, Gemahl der Aglaia, der Tochter des Mantineus (Apoll. II 2, 1. Schol. Eur. Or. 965). Er gründete die Stadt Abai in Phokis (Steph. Byz. s. Ἀβαί. Paus. X 35, 1), eine Niederlassung in Thessalien (Ἄργος πελασγικόν Strabon IX 431) und unterwarf sich die Insel Euböia, über die er als König herrschte (Steph. Byz. s. Ἀβαντικός. Schol. II. II 536. Pind. Pyth. VIII 73, vgl. *Bursian* Quaest. Euboicar. cap. selecta Lpz. 1856, 11). Grosser Berühmtheit erfreute sich der Schild des Abas, den einst sein Grossvater Danaos in das Heraion von Argos geweiht hatte. Servius Aen. III 286 erzählt: als nach dem Tode des A. die von ihm unterworfenen Völker sich empörten und gegen Argos heranrückten, wurden sie durch den blossen Anblick seines Schildes, den ein Jüngling in die Schlacht trug, so erschreckt, dass sie flohen und sich zur Ruhe gaben. A. hatte den Schild von seinem Vater Lynkeus erhalten, als er diesem den Tod seines Grossvaters Danaos im Tempel der Hera zu Argos meldete. Lynkeus hob den Schild von der Wand des Tempels und schenkte ihn seinem Sohne (Hygin fab. 170. 273. Ov. Met. XV 164). An diese Schenkung knüpfte vermutlich die Ursprungssage eines argivischen Festes an, bei welchem der Sieger ausser einem Kranz einen Schild als Preis empfing (ἀσπίς ἐξ Ἀργού. CIG 234. 1068. 2810. 3208. Hesych. s. Ἀγών χαλκείος. Vgl. das Sprichwort bei Zenob. VI 52 ὡς τὴν ἐν Ἀργεὶ ἀσπίδα καθελών σερμύνηται. Plut. Kleom. 17. Boeckh Expl. Pind. p. 175). Nach Verg. Aen. III 286ff. soll Aeneas den Schild des Abas als eine von den Danaern erbeutete Waffe zu Actium am Eingange des Apollotempels aufgehängt haben. Abas spielte im Lynkeus des Tragödiendichters Theodectes [19] eine hervorragende Rolle (Aristot. Poet. 11. 18).

Paulys Realencyclopädie der classischen Altertumswissenschaft

fertig [\[Ausklappen\]](#)

( [Abas 2](#) ) [Abas 4](#) )

Eponymos der Abantes, Sohn von Lynkeus und Hypermnestra

Band I,1 (1893) S. 18 (IA <sup>☞</sup>)–19 (IA <sup>☞</sup>)

[Abas \(Argos\) in der Wikipedia](#)

[Abas in Wikidata](#)

[Bildergalerie im Original <sup>☞</sup>](#)

[Register I,1](#) [Alle Register](#)

[Linkvorlage für WP <sup>☞</sup>](#) [\[Ausklappen\]](#)

[Toepffer.]

Figure 1: "[Abas 3](#)" in the Wikisource edition of the RE.

This Wikisource interlink structure lends itself well for a network approach, as links can be automatically extracted and modelled into a network. Entries serve as nodes and interlinks as edges that represent a multitude of different potential connections. Table 1 illustrates this, showing the edges extracted from the *Volltext* of figure 1, supplemented with manually added relationship types. Relationships range from familial to contextual mentions and more object oriented relations in the last link, posing challenges in accurately defining edges as representations of real-world relationships.

Table 1: *Outgoing links from Abas 3.*

Target	Type of relationship
RE-Akrisios_1	Father_Son
RE-Proitos_2	Father_Son
RE-Eidomene	Father_Daughter
RE-Euripides_4	Mentioned_by
RE-Apollodoros_61	Mentioned_by
RE-Danaë_2	Grandfather_Granddaugther
RE-Perseus_1	Great-Grandfather_Great-Grandson
RE-Aglaia_3	Husband_Wife
RE-Mantineus_2	Son-in-law_Father-in-law
RE-Danaos_1	Grandson_Grandfather
RE-Aineias_2	Hung the shield of Abas in temple

### Analysis and Preliminary Results

Crucial for the interpretation of SNA metrics is a clear understanding of the information encoded in the edges. The paper's initial focus is on a critical evaluation of variation of potential (real-world) relations represented by interlinks, as already exemplified in table 1. After establishing a clear picture of the abstraction from interlinks to a network, we will employ classical SNA methods (degree, connectedness, centrality, and clustering) to analyse the network. Results will be evaluated by comparing them to trends in traditional scholarship.

The current network comprises 22.309 nodes, representing unique *RE* entries, and 51.482 edges. The largest connected component, depicted in figure 2, contains 19.325 nodes and 49.617 edges. The colours in this visualisation correspond to dates associated with the persons in the *RE* entry, ranging from dark purple for the earliest and light orange for the latest, with white nodes lacking dates.



Figure 2: Network visualisation of largest connected component of persons in *RE*; colour based on associated date; visualisation algorithm: DrL.

Within this component, the top 5 nodes with the highest degree are notorious figures such as author and statesman Cicero ([Tullius 29](#), 732 interlinks), Pliny the Elder ([Plinius 5](#), 500 interlinks), the Greek philosopher Plutarch ([Plutarchos 2](#), 474 interlinks), emperor Augustus ([Iulius 132](#), 450 interlinks), and historian and statesman Cassius Dio ([Cassius 40](#), 443 interlinks). These represent entities that are either often linked to or linked from or both. When focusing specifically on nodes that link to many other people (high outdegree), the top 5 looks significantly different, with just emperor Augustus remaining at fifth place with 99 outgoing links. He is joined by other central figures such as emperor Vespasian ([Flavius 206](#), 108 outgoing links), Greek polymath Eratosthenes ([Eratosthenes 4](#), 107 outgoing links), emperor Domitian ([Flavius 77](#), 105 outgoing links), and emperor Claudius ([Claudius 256](#), 103 outgoing links). The discrepancy between top 5 in total degree and outdegree can be explained by the fact that all but Augustus of top 5 total degree are authors, often quoted throughout the *RE* as sources for information on the people in question (see the mentioned\_by relation in Table 1). These first metrics already show a correlation between high-degree nodes and figures deemed historically important such as emperors and influential authors and philosophers.

## Conclusion

The presentation will focus on describing the creation and conceptualization of the network and discuss the results of the first exploration of the metrics. Overall, this paper contributes to the overarching discussions of DH Benelux 2024 on data reuse and transformation, as it centers around transforming the *RE*-data into a re-usable network of individuals. We will also touch on challenges

encountered during the transformation process, such as the delicate balance between automatic and manual processing and clear documentation on transformation steps.

## **Bibliography**

- Ahnert, Ruth, Sebastian E. Ahnert, Catherine Nicole Coleman, and Scott B. Weingart. 2021. *The Network Turn: Changing Perspectives in the Humanities*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/9781108866804>.
- Broekaert, Wim, Elena Köstner, and Christian Rollinger, eds. 2020. "The Ties That Bind. Ancient Politics and Network Research." *Journal of Historical Network Research* 4. <https://doi.org/10.25517/JHNR.V4I0>.
- Broux, Yanne, and Mark Depauw. 2015. "Developing Onomastic Gazetteers and Prosopographies for the Ancient World Through Named Entity Recognition and Graph Visualization: Some Examples from Trismegistos People." In *Social Informatics*, edited by Luca Maria Aiello and Daniel McFarland, 304–313. Cham: Springer International Publishing. [https://doi.org/10.1007/978-3-319-15168-7\\_38](https://doi.org/10.1007/978-3-319-15168-7_38).
- Brughmans, Tom, Anna Collar, and Fiona Coward. 2016. *The Connected Past: Challenges to Network Studies in Archaeology and History*. Oxford: Oxford University Press.
- Classen, Carl Joachim. 2010. "«Vita Brevis – Ars Longa»: Pauly's Beginnings and Wissowa-Kroll-Ziegler's Monumental Achievement." *Eikasmós* 21: 423–37.
- Collar, Anna, ed. 2022. *Networks and the Spread of Ideas in the Past: Strong Ties, Innovation and Knowledge Exchange*. London: Routledge. <https://doi.org/10.4324/9780429429217>.
- Malkin, Irad. 2011. *A Small Greek World: Networks in the Ancient Mediterranean*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199734818.001.0001>.
- Martin, Shawn Bryan, Brown, William Michael, Klavans, Richard, and Boyack, Kevin W. 2008. *DrL: Distributed Recursive (Graph) Layout*. Algorithm.