

Finding Early Modern Women's Agency Through Network Analysis

Social, religious, and political networks were an important part of the early modern world and women's lives and experiences. Network analysis techniques can show women's participation and place in these networks in ways that have been overlooked in other interpretations of such networks. The developing field of network analysis has shown the power of this type of modeling to for highlighting relationships, which can show the women and other lesser known figures within networks. Work by historian Ruth Ahnert and literature scholar Evan Bourke demonstrates how network analysis can illuminate women's participation and central place in these networks.

Network analysis algorithms allow examination of and focus on figures that may be important hubs or connectors in networks that have remained invisible or only hinted at with traditional methods. Network analysis methods reveal a wealth of data about individuals and their importance in a network based on their relationships using betweenness and eigenvector centrality measures. In addition, network analysis can expose the infrastructure of networks as well as the strength of ties between individuals in the network. Often, these methods can make the invisible, visible. This workshop will examine the way that we can recover and recognize early modern women's agency in an important aspect of early modern life: through the informal networks of affiliation through which women moved. This workshop speaks directly to the collectivity sub-theme of Agency and Action, promoting new methods to examine women's networks.

The workshop presenters will spend the first 20 minutes discussing the possibilities network analysis provides. Discussion will be based on the information in the readings that include discussion of network analysis as a methodology and specific findings that can come

from its use. The presenters will also show how their projects use network analysis to find women's agency in early modern England. Wood's work uses a wide variety of sources to recover the role of women in the network of early modern English printers. Medici uses a printed collection of letters from the Sidney family to reconstruct an early modern political network and examine the role of women within it. Gertz examines the reach and influence of Anne Barton and her visions during the reign of Henry VIII using arrest and inquisition records.

Presenters will then lead an activity that demonstrates the basic principles of network analysis. Participants will work in small groups to create a dataset of relationships drawn from a legal case that is part of the reading. Presenters will give groups a basic spreadsheet and then each group will customize the spreadsheet identifying the individuals and their relationships found in the source. Customizations will include decisions about how to categorize the relationships and what information about the relationship they deem important to include in their dataset. Groups will then import their information into Palladio to get a basic visualization of their network. Discussion of the various outcomes of the activity will examine the ways that decisions throughout the data collection and curation process affect visualizations and the information gained from network analysis.

The final portion of the workshop will be a discussion of how network analysis may be useful to participants' own work. This will include things like the various types of sources that can be used, considerations of what network analysis can and cannot tell you, resource suggestions, and other questions raised by participants.

Workshop Leaders

Catherine Medici, University of Nebraska-Lincoln, Women's and Gender Studies

Tara Wood, Ball State University, History

Genelle Gertz, Washington and Lee University, English

Readings

Evan Bourke, 'Female Involvement, Membership, and Centrality: A Social Network Analysis of the Hartlib Circle', *Literature Compass* 14:4 (2017) (17 pages)

"A Brief Abstract of the Arraignment of Nine Witches at Northampton: July 21th 1612" in *Witchcraft and Society in England and America, 1550-1750*, ed. Marion Gibson, (Ithaca: Cornell University Press, 2003) 54-59.

Suggested Reading

Ruth Ahnert and Sebastian E. Ahnert, 'Protestant Letter networks in the Reign of Mary I: A Quantitative Approach', *English Literary Heritage* 82:1 (2015) 1-33.

Christopher Warren et al., "Six Degrees of Francis Bacon: A Statistical Method for Reconstructing Large Historical Social Networks," *Digital Humanities Quarterly* 10, no. 3 (July 2016): <http://digitalhumanities.org/dhq/vol/10/3/000244/000244.html> (16 pages)

Female Involvement, Membership, and Centrality: A Social Network Analysis of the Hartlib Circle

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Abstract

This article builds upon the pioneering work of Carol Pal, Lynette Hunter, Ruth Connolly and Michelle DiMeo by carrying out an extensive social network analysis of the Hartlib Papers. By adapting the methodology recently developed by Ruth Ahnert and Sebastian E. Ahnert to analyse Protestant letter networks memorialised in Foxe's *Acts and Monuments*, this article uses digital and visual tools to assess the importance of female involvement in the Hartlib Circle. It examines how integral female members were to the information flow of this network and the degree to which their positions in the network granted them influence over other members. Through this computational approach, this article also challenges the view that at its core the Hartlib Circle was made up of a group of male friends, arguing that Dorothy Moore Dury and Katherine Jones, Viscountess Ranelagh need to be recognised as integral elements of this network's core.

The Hartlib circle was an intellectual correspondence network that was formed in London in 1641, centred around Samuel Hartlib, John Dury and Jan Amos Kaminski (Comenius). This group was mainly active between 1641 and 1661 and included well-known figures such as Robert Boyle, Henry Oldenburg, Benjamin Worsley and the Boate brothers. As shown by Mark Greengrass, Toby Barnard, Charles Webster, George Turnbull and others, its overarching aim was universal knowledge; thus members corresponded on various topics including politics, religious conversion, educational reform, science and medicine. It was an extensive network of correspondents and in his book *Faith, Alchemy and Natural Philosophy: Johann Moriaen, Reformed Intelligencer, and the Hartlib Circle*, John Young writes:

at its nexus, [the Hartlib Circle] was an association of personal friends. Hartlib and Dury were the two key figures: Comenius, despite their best efforts, always remained a cause they were supporting rather than a fellow co-ordinator. Around them were Hubner, Haak, Pell, Moriaen, Rulice, Hotton and Appellius, later to be joined by Sadler, Culpeper, Worsley, Boyle and Clodius (248).

This description of the social network is notable for being entirely male in its membership. This structural bias in scholarship has recently been challenged by the likes of Carol Pal, Michelle DiMeo, Lynette Hunter, and Connolly, who have sought to show the important roles played by women such as Dorothy Moore Dury and Katherine Jones, Viscountess Ranelagh. While it is possible to suggest that the recent scholarship, in trying to compensate for bias, has over-inflated the significance of these women, this article uses quantitative methods to not only show why past scholarship has overlooked the female membership of this social network, but also why this picture is over-simplistic. By using certain centrality measures, we can see how Moore Dury and Ranelagh were at the very centre of this network.

In an article of this type, the word centrality can have several meanings. On the one hand, it can be expressed to mean importance or significance, which is the instinctive way those of us in the humanities tend to use the word. On the other hand, it is a mathematical property, which can be calculated by various operations from the dataset. While, the humanities usage of the word strongly overlaps with its mathematical meaning, the use of mathematical tools does often yield surprising results, which can challenge our received notions of what 'central' means. For further complication of matters, the momentum behind the article can also be said to be drawing on yet another connotation of the word, in that it is part of the movement within scholarship to redress gender bias by moving women from the margins to the centre of critical attention. Therefore, in order to avoid confusion, the term 'centrality' will be used in its mathematical sense, and other terms will be used for the non-mathematical senses. The same can also be said of the term network in that it too has mathematical and metaphorical connotations. While it can refer to the mathematico-geometrical entity produced by various operations from the dataset, it is often instinctively used to describe the ensemble of relations between actual historical people. Again, this article mainly refers to the mathematico-geometrical entity; however, throughout there will be examples, which highlight how the historical network worked along the lines suggested by the mathematical operations.

Mark E. Newman, describes a social network as a system of 'social interactions' (*Introduction*, 36). Over the last two decades, scholars have analysed a wide range of real-world networks – including transport networks, criminal networks and social media networks. These tools and models have long been used in various disciplines, such as sociology, mathematics and physics, but they are only recently making an impact on the disciplines of history and English.

While social network visualisation is a useful tool in the analysis of many forms of literature, it is especially useful in the analysis of correspondence.¹ Gary Schneider describes early modern letters as 'sociotexts,' they are 'material evidence of social connectedness' (6). Thus, social network visualisation is an effective way of highlighting and drawing attention to the social ties that letters 'initiated, negotiated, and consolidated' (Schneider, 6). Two scholars to use this approach with regard to correspondence are Ruth Ahnert and Sebastian E. Ahnert. They used quantitative network analysis to visualise and analyse the Protestant letter network memorialised in John Foxe's *Acts and Monuments*, or the 'Book of Martyrs' as it is more popularly known. In order to do this, they analysed 289 letters 'that were written either by or to Protestants residing in England during Mary's reign' (Ahnert and Ahnert, 3-4). They recorded who the letters were from and to, the location of the sender and recipient, the date of composition, and any other social links (commendations, spousal links and familial links) before running this information through a Python code to analyse the network. They then used various mathematical tools to measure the centrality of each of its members. The results of this analysis brought their attention to people who have been traditionally overlooked by other scholars, including various female members such as Joyce Hales and Margery Cooke (Ahnert and Ahnert, 15 and elsewhere Freeman, 13). It also highlighted that letter carriers and financial sustainers (people who held the network together) were more important than they suspected; and 'that their significance increased as the martyrs died' (Ahnert and Ahnert, 3-4). As the model used by Ahnert and Ahnert allowed them to explore the unexpected role played by women, the same model has been adapted here in order to measure the centrality of women in the Hartlib network.

The material I have drawn upon includes all the letters accessible through the Hartlib Papers Online database (HPO), along with letters classed as 'Hartlib catalogue' by Early Modern Letters Online (EMLO). I have set these parameters because there is no other way to contain the network; as John Young has argued, 'it is a circle with a definable centre but an almost infinitely extendable periphery' (248). Limiting this paper to this material affects the results as it is an

analysis of the Hartlib Circle as represented by letters preserved in the Hartlib Papers and associated collections included in HPO and EMLO, rather than the full correspondence of all members. However, this is not an uncommon problem with correspondence, and Ahnert and Ahnert note that the ‘vast majority of network analysis deals with incomplete networks in the real world.’ They argue that ‘any statistical treatment of biases has to make assumptions about the distribution of missing links or nodes’ (Ahnert and Ahnert, 2015). The analysis that follows is aware of the bias of the collection and its knock-on effects. Historic letter collections may exaggerate the prominence of certain members, due to a large body of their work surviving; and undervalue other members, due to their works being lost over time. However, this analysis corrects for such a bias in many ways: 1) through analytical commentary and corrective reading of results; 2) through the incorporating of mentions, as it corrects for biases of letter collection and survival rates by capturing some of the world beyond the archive; 3) through the use of algorithms that reject quantity as a marker of significance, and instead highlight infrastructural significance.

First, I searched through the Hartlib database, recording who the letters are to and from, before performing a transtext search (full-text search for specific words) of these names to find any commendations or reported contacts between a mentioned person and the sender, and/or recipient of a specific letter. I then searched through every letter classified as ‘Hartlib Catalogue’ on EMLO and recorded any new links, before doing a second transtext search of these new names to pick up on any of these people’s commendations or reported contacts not included on EMLO. During this process, I excluded letters where the sender or recipient is anonymous, except where EMLO has discerned authorship or a letter highlights other social links. I also excluded petitions and mentions where the person mentioned plays no active role in the network, as the aim of this paper is to focus on the internal workings of the circle. For example, several political and martial leaders such as the ‘Duke of Savoy’ or ‘General Blake’ have been excluded as all mentions about these people focus on the delivery of petitions, or relaying news about their actions (HP 1/3/1A–4B). On the other hand, people like Mary Hartlib and Georg Fridrics are included, as it is stated that they actively engaged with another member, or that a certain sender actively wants their commendations passed on to a specific person. Overall, I searched 4708 letters, found 766 different people and 2476 different edges, and separated the connections between these people into letter links (between sender and recipient) and social links (between mentioned and sender, or, between mentioned and recipient). This data was then gathered and organised into a Comma Separated Values (.csv) file in Excel, before inputting the data into Gephi – an open-source network analysis and visualisation software package – to analyse the network.

Using Gephi, I have been able to generate various visualisations of the Hartlib Circle as a network. In the visualisations, each person is represented by a node (here a person in the network) and their connections are represented by edges (a relationship between these people, marked by a letter or a mention within the letter). The first visualisation created was based purely on senders and receivers, i.e. the image of the network when one does not account for mentions (Fig. 1).

In Fig. 1, Hartlib and Dury are the large nodes right at the centre, as both men have many edges radiating from them. While this is the expected result, with a network of this size the visualisation is difficult to read and can often be manipulated, and thus one needs to rely on more statistical evidence.

One such measure is degree centrality, which measures the total number of edges connected to a particular node, or in the case of a social network, the total number of separate people a particular person has connections to. Degree centrality is a useful measurement as it can be broken down into in-degree and out-degree. In-degree measures how many connections a

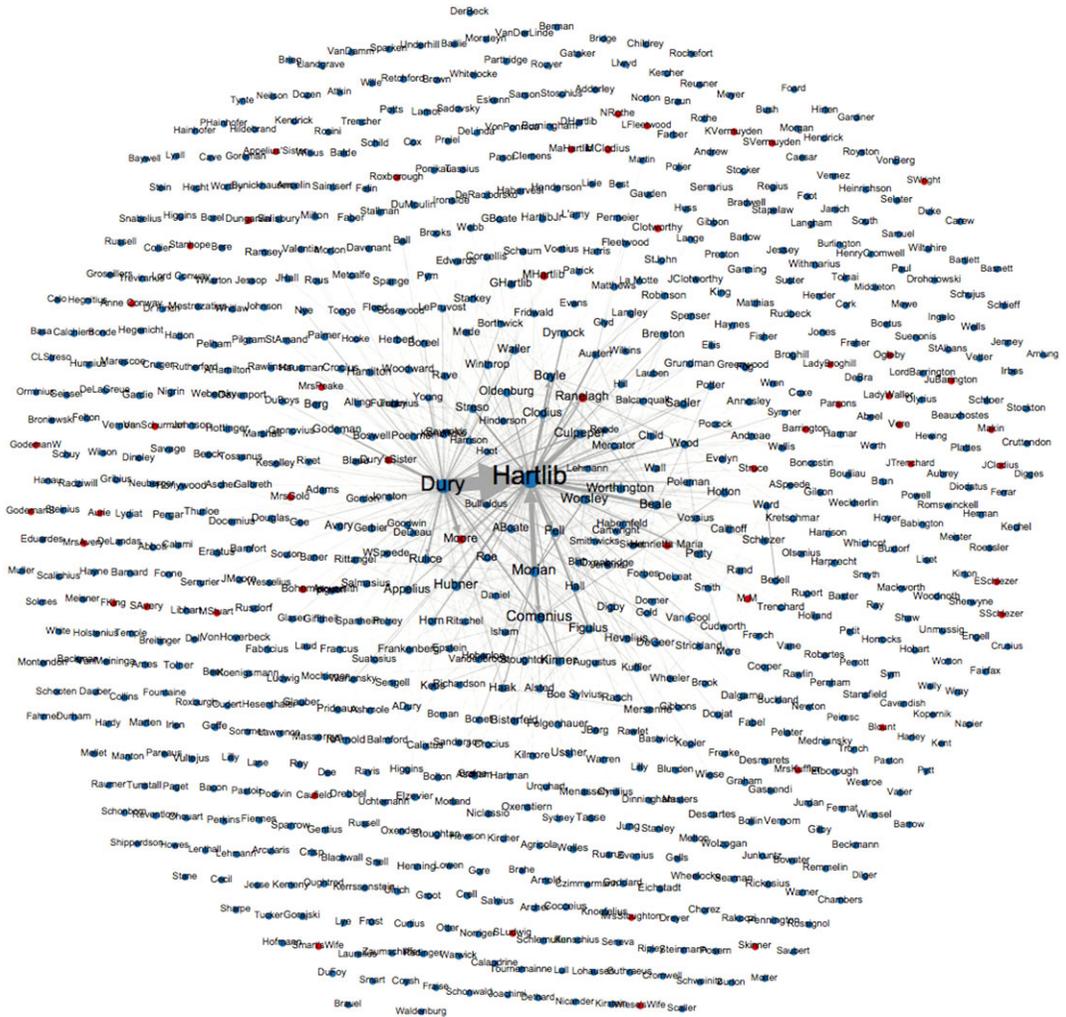


Figure 1. The network of letter interactions.

person has from receiving letters, while out-degree measures how many connections a person has from sending letters. Unsurprisingly, Hartlib has the largest in-degree, in that he is connected to 267 other people through them sending letters to him. The next highest in-degree is Dury's, who receives letters from 108 other people. This shows that while Hartlib received letters from the most people, Dury also received letters from a wider range of people when compared to the rest of the network. This becomes even clearer when one factors in that there are 280 instances of a node having an in-degree value of 0, and over 175 instances of a node only having an in-degree value of 1. This means that nearly 355 people either didn't receive letters, or only received letters from one person. A similar trend occurs when we look at the out-degree. Dury has the largest out-degree as he is connected to 118 different people through sending correspondence to these people. Again, this is in stark contrast to the 125 people who have an out-degree value of 0, and the 320 people who only have an out-degree value of 1. This is especially the case with women; Ranelagh and Moore Dury have an in-degree of 8 and 3, and an out-degree of 2 and 5, respectively. This means that Moore Dury received letters

from only three people, while Ranelagh only sent letters to two people. We might assume from this result that these two women did not have a big impact on the network.

A truer and more accurate representation is only possible when one also includes the social links described above. This is because this approach counteracts the biases of letter collection and survival rates by capturing some of the social world beyond the archive. For example Dorothy Moore Dury did not have any direct correspondence with Sir Cheney Culpeper. However, we know that the two were connected socially as in several letters to Hartlib, Culpeper asked Hartlib to pass on his regards to her: ‘my faythfulleste wishes to yours: Mrs Dury & all yours’ (HP 13/123A-124B). If one was to just look at direct correspondence this connection would be missed as it is the social world of epistolary etiquette that makes this connection visible. Thus, by incorporating the traceable social world for the entire network, one can get a more accurate sense of who is at the network’s core (Fig. 2).²

However, the full value of adding social connections can only be seen when one delves deeper into the underlying statistics. The following graph distinguishes between the two types of links (letter links and social links), allowing a more nuanced picture of the epistolary community to emerge, a picture that highlights the assorted roles played by individuals. In Fig. 3, the Y-axis represents letter degree, meaning the higher one goes, the more a node is involved in direct correspondence, and the X-axis represents social degree, meaning the further horizontally one goes, the more a node is connected to people socially.

Thus, this graph plots a given individual’s letter connections against the individual’s other social connections to determine whether the said individual is more involved via letter connections or

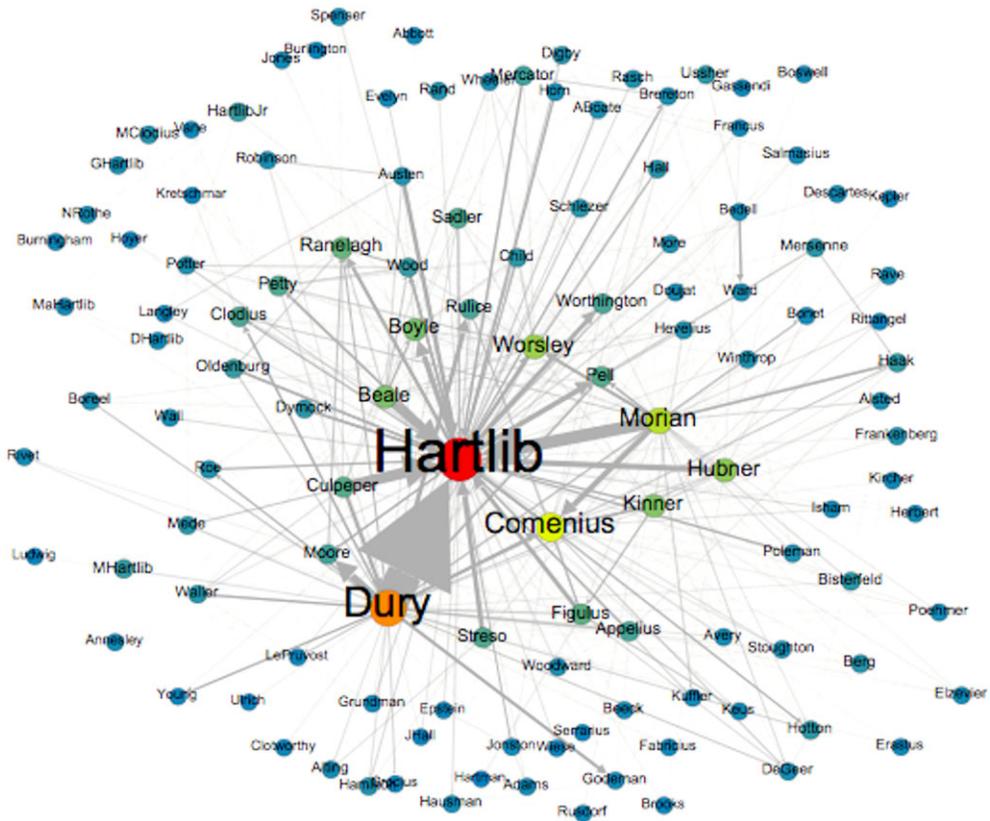


Figure 2. The network of social interactions excluding every member with a Z-score of -1 or below.

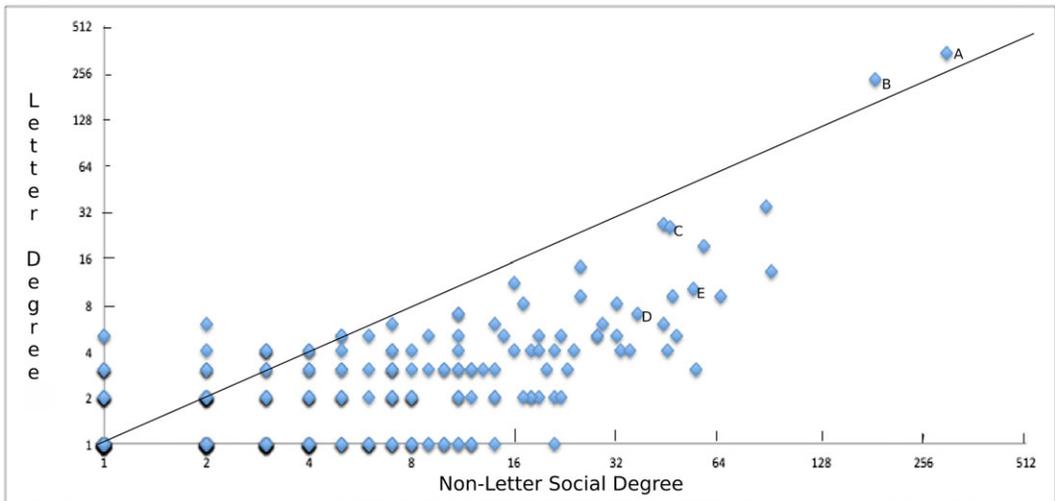


Figure 3. Letter degree versus non-letter social degree. Samuel Hartlib (A), John Dury (B), Cyprian Kinner (C), Dorothy Moore Dury (D), Lady Ranelagh (E) are highlighted.

social connections. When this is performed for all 766 nodes in this social network, the graph reveals a very large cluster of nodes close to the X-axis, meaning that these nodes do not take part in many letter exchanges. Additionally, the closer the node is to the Y-axis the lower the social degree, which means that few of their edges represent social connections (i.e. very few of their edges come from commendations, mentions, spousal links and familial links). The majority of the nodes are those that have both low letter and social connections. These nodes tend to be very close to the diagonal line, which means the number of people they corresponded with is similar to the number of people they were connected to by other means.

The only nodes of any significance above the diagonal line are Dury and Hartlib. One reason for this is that they were either writing to or receiving letters from a wide range of people. Samuel Hartlib is the outlier as he was in contact with the widest range of people. What his position on the graph shows is that his interactions with other people in the network was heavily conducted through correspondence, but that he also had a very broad network of social interactions that he built up through this correspondence, evident from him being far from the origin on both the X-axis and Y-axis. One learns about these additional social links from reported conversations, from greetings or messages either passed on to Hartlib from the sender, or passed on to the commendeo from the recipient, or from references to Hartlib acting as a messenger between two people. It is Hartlib's role as messenger that most accurately represents his high number of social links as, on a number of occasions, the sender would tell the recipient that he has sent this through Mr Hartlib, or requests that the recipient sends his reply through Hartlib. For example, in a letter dated 24 July 1642, Dury asked Sir Michael Wharton: 'If yow will vouchsafe an answer send it I pray to Mr Samuel Hartlib' (HP 6/4/ 148A-B). Thus, while Hartlib did not directly write to Wharton, we know he is connected to him socially through Dury's request. Similarly, in a letter dated 4 August 1655 Dury tells Sir George Fleetwood: 'Having understood by my Friend Mr Hartlib, by whom I make this addresse unto you' (HP 4/3/115A-116B). Again, no evidence exists in the database of Hartlib directly writing to Fleetwood, but we know they were linked socially, as it is through Hartlib that Dury was able to get a letter to Fleetwood. In total, Hartlib is connected to 636 of the 766 people in the network, 336 through direct correspondence, and a further 300 through other social means. This means that for every 2 people Hartlib is in direct correspondence with, he is connected to 1.8

additional people socially. Thus, his position as the outlier on both axes highlights his important role in sustaining both the correspondence network and the social network.

What does this graph show about women's involvement in the network? The woman furthest out from the main cluster is Lady Ranelagh (label (E)). However, another woman – Dorothy Moore Dury (label (D)) – is also further to the right of this main cluster. This suggests that, apart from these two women, women in general were connected only to one or two other people, whether through direct letter links, social links, or a mix of the two. Both Moore Dury and Ranelagh's nodes are lower on the Y-axis, but much further out along the X-axis. This shows that the biggest impact they had on the network was through social means rather than through direct correspondence. These connections occurred as various other members frequently mentioned them in their letters. In Ranelagh's case a wide range of people including John Beale, Cheney Culpeper, John Dury, Peter Figulus, Samuel Hartlib, Henry Oldenburg, William Petty and Robert Wood wrote about her in their letters. In the cases of Beale, Dury and Hartlib, evidence of direct correspondence has survived, but in the other instances, we only know of Ranelagh's interactions with these men through what they said about her. One such connection is with Henry Oldenburg. While it is unclear how Oldenburg and Ranelagh met, Marie Boas Hall argues that John Dury may have introduced them, as Dury and Oldenburg met while the former was living in The Hague in the early 1640s (Hall, xi). Regardless, this connection was important to Oldenburg, as Jordan Avramov suggests that it was Lady Ranelagh 'who introduced Oldenburg to Hartlib and to Robert Boyle' (Avramov, 190). Through this connection, and her subsequent employment of Oldenburg as a tutor in the mid 1650s, the pair developed a friendship that focused on discussions of natural philosophy (DiMeo, 84–5 & 96–7).

This connection flourished upon Oldenburg accompanying Ranelagh's son (Richard Jones) on his Grand Tour of Europe. During this same trip Oldenburg also kept in frequent contact with Hartlib and Boyle, and wrote about Ranelagh in his letters. In these letters to Hartlib, Oldenburg referred to Ranelagh when discussing finance, the distribution of textual material, and announcing that he received letters from her. For example, in a letter dated 1 August 1658, Oldenburg told Hartlib that, 'I haue desired My Lady Ranalagh to pay you againe in England, as soon she can; in which I am confident she will not faile' (HP 39/3/17A–B).

Lady Ranelagh formed a similar type of connection with Robert Wood and Miles Symner upon returning to Ireland between 1656 and 1659 in order to help with the reclaiming of Boyle estates as part of the Cromwellian resettlement of Ireland (DiMeo, 50). Wood and Symner referred to her when discussing the distribution of textual material among the members of the circle in Ireland, when discussing letters being sent to or received from various members, and when discussing the various Hartlibian projects they were undertaking in the country. The way in which these members wrote about Ranelagh is epitomised by Robert Wood. In a letter to Hartlib dated 13 May 1656, Wood lauded Ranelagh as a kind, intelligent and accomplished woman:

this I can say that I do really honour her from the bottome of my heart; not only for her owne vertues & rare accomplishments, which I know not where to match, but for some kind of agreeableness which I more & more discover of her genius & spirit with mine (HP 33/1/1A–B).

While it is clear that Wood started out by emphasising his deference towards Ranelagh, he became more sincere as he attempted to formulate and express the connection he felt he shared with her. While he struggled to accurately verbalise what this bond was, he was able to express his belief that the more he 'discover[ed]' about Ranelagh, the more he realised that their personalities were one and the same. For Wood, this personality was both intellectual and spiritual in nature, and in a way, he was suggesting that in Ranelagh he found a fellow scholarly traveller and kindred spirit.

However, while degree centrality can bring attention to various social connections like the connection Ranelagh shared with Oldenburg and Wood, alone it is not enough to understand *how* the network works. Other measures are necessary to detect the relative connectedness of each member and, thus, find out who has a vital infrastructural role within the network. One way of doing this is through other centrality measurements.

The first of these centrality measurements is known as ‘betweenness.’ In a recent paper, Ruth Ahnert concisely describes this measurement as follows:

‘For any two nodes in a network, there is a shortest path between them, and betweenness tells us how many of these shortest paths go through a given node. This measurement shows us how significant a node is to the overall structure and flow of the network, and how integral the node is in connecting other people. If you imagine a network that is made up of two sub-communities (A and B) that only share one member, that individual will have a very high betweenness ranking because they are the only person via which news can travel between those two sub-communities’ (Ahnert, ‘Maps Versus Networks,’ p.134–5).

I took two measurements of betweenness – one of the letter network and one of the entire social network – and made a list of the top twenty nodes in each. These two measurements are integral: one (Table 1) shows how information could travel, if it flowed through direct correspondence (letter betweenness), while the other (Table 2) shows how information could travel, if it flowed through all possible avenues (social betweenness).

Table 1. Top 20 letter betweenness.

1) Samuel Hartlib	11) George Abbot
2) John Dury	12) Israel Tonge
3) Cyprian Kinner	13) Johann Ulrich
4) Jan Amos Kaminski	14) Marin Mersenne
5) John Beale	15) Dorothy Moore Dury
6) Benjamin Worsley	16) Caspar Streso
7) Johann Moriaen	17) Thomas Morton
8) Fredrick Clodius	18) George Tunstall
9) Thomas Roe	19) Caspar Godeman
10) Cheney Culpeper	20) André Rivet

Table 2. Top 20 social betweenness.

1) Samuel Hartlib	11) John Worthington
2) John Dury	12) Cheney Culpeper
3) Jan Amos Kaminski	13) Fredrick Clodius
4) John Beale	14) Heinrich Appelius
5) Johann Moriaen	15) Petr Figulus
6) Katherine Jones	16) Nicolaus Mercator
7) Caspar Godeman	17) Robert Wood
8) Cyprian Kinner	18) Robert Boyle
9) Benjamin Worsley	19) Dorothy Moore Dury
10) Joachim Hubner	20) Johann Friedrich Schlezer

There are ten names that appear on both lists. Some of these are to be expected: Hartlib, Dury, Hubner, Moriaen, Worsley and Boyle are all names mentioned by Young in his description of the Hartlib Circle. For the purposes of this paper, what is interesting is that only two women appear on these lists: Lady Ranelagh and Dorothy Moore Dury. Ranelagh's name is 6th on the social betweenness list, while Moore Dury's name is ranked 15th on the letter betweenness list and 19th on the social betweenness list. However, while Moore Dury makes both lists, Ranelagh is much further down the letter betweenness rankings, ranking 49th. Thus, it is evident that Moore Dury's involvement in ensuring the flow of information across the network can be seen, regardless of whether one looks at the flow of information using only direct correspondence links (letter betweenness), or the flow of information through all known social channels (social betweenness), as she ranks in the top 20 of both lists. In contrast, Ranelagh's presence is only seen when one looks at the flow of information through all known social channels. Yet, when one looks at the network this way, Ranelagh not only bypasses Moore Dury to become the highest-ranking woman, but she rises an amazing 43 places to take her place in the top 10 out of 766. This leads to two integral questions: why does Ranelagh's betweenness rating significantly increase when one looks at social connections? And which of these lists gives a more realistic view of the potential flow of information?

With regard to the first question, Ranelagh's betweenness ranking significantly increases when one looks at the entire social network because she is connected to 54 different people socially – an increase of 44 when compared with the 10 people with whom she had direct correspondence links. This means that traffic multiplies fivefold when one considers social interactions, significantly increasing the number of shortest paths (shortest distance between any two points in the network) that would pass through her node, causing her betweenness score to rise. With this increased traffic in mind, it is not a surprise to see Ranelagh rise from 49th in terms of letter betweenness to 6th in terms of social betweenness. Furthermore, this rise is supported by that of her brother, Robert Boyle – who would have known several of the same people as his sister. He ranks 18th in terms of social betweenness, despite ranking 62nd in terms of letter betweenness. In total, they share 29 out of Ranelagh's 54 connections, including all of the people that Ranelagh is in direct contact with. These include overlapping direct correspondents like Hartlib, Dymock and Worsley but also include various overlapping social connections like Gerard and Arnold Boate, Henry Oldenburg, George Starkey, William Petty and John Worthington. Of their unshared social connections, the most integral are Miles Symner, whom Ranelagh came into contact with upon returning to Ireland in the mid 1650s, and Petr Figulus, who engages with a series of letters Ranelagh wrote to an unknown recipient in the late 1650s (Connolly, 'Godly Sybilla, p.285–306). What stands out most from this list of people is the inclusion of Henry Oldenburg and William Petty as social connections rather than direct correspondents. If one examines Michael Hunter et al's multi-volume *Boyle Correspondence*, one sees several examples of Boyle engaging in direct correspondence with both Oldenburg and Petty (Michael Hunter et al, 2001), while the British Library holds several extant letters sent between Ranelagh and Petty (Petty Papers Vol. XXXV, Add. Ms 72884. British Library). Despite both of these collections being outside the remit of this paper, this information validates the dataset, as it highlights that the inclusion of mentions is a valuable and successful corrective.

This brings me onto the second question; social betweenness gives the more accurate picture, as the above examples have shown that embedded social connections can pick up on links between people when direct evidence has been excluded from the parameters of a paper or is no longer extant. Furthermore, these examples have shown that a person's betweenness can radically increase or decrease when social interactions are incorporated. This is in part due to the nature of early modern correspondence, in that letters didn't always follow direct

correspondence routes. They were given to messengers to deliver; they were left with family and friends to pass on. This must be accounted for to fully understand the potential flow of information. The social betweenness ranking is integral, as it shows that Ranelagh was one of the best-connected people for flow of information around this network. In fact, this level of importance can be seen even more clearly when you consider that only 44% (336 people) of the network have a non-zero betweenness ranking and can effect the flow of the network in any way. This means that the other 56% (430 people) have no shortest paths going through them and are not integral to the flow of information. Furthermore, of these 336 people, Ranelagh being ranked in the top 2% granted her a level of prestige.

However, 'betweenness is not the measure usually employed to ascertain prestige or influence' (Ahnert, 137). Rather, in order to establish this, one must look at eigenvector centrality. A node that ranks highly in this measurement is one that is adjacent to other nodes that rank highly. Stephen Borgatti elaborates on this measurement's importance: 'if a node influences just one other node, who subsequently influences many other nodes (who themselves influence still more others),' this measurement will capture the integral role played by the first node in the chain (55-71). Thus, in this measurement a node's centrality is dependent on the centrality of its neighbouring nodes. Therefore, this measurement is different from betweenness in that betweenness assumes that one path must be taken over another, while eigenvector assumes the movement will occur along several paths simultaneously. As with betweenness, several of the people we would expect do indeed appear in the social eigenvector top twenty (Table 3), including Samuel Hartlib, John Dury and Benjamin Worsley.

In terms of social eigenvector centrality, both women take up a similar rank to that of their social betweenness, where Ranelagh ranks 6th out of 766 and Moore Dury ranks 19th. So far, these measurements have shown that Ranelagh and Moore Dury – women who have not been shown much interest by scholars in the past – played a significant role in the infrastructure of the network because they were important to the flow of information across the network.

What the two measures used above (betweenness and eigenvector centrality) highlight, are what Ahnert and Ahnert describe as infrastructural figures; figures that have a crucial role in ensuring the network looks and works the way it does. One way to test the different roles these members play is to use various algorithms to determine whether a specific person could be considered to be in the core, semi-periphery, or periphery of the Hartlib network. By calculating the Z-score of every member for five different network measures, I was able to determine if a specific person had a high or low ranking in each of the measures: social betweenness, eigenvector

Table 3. Top 20 social eigenvector.

1) Samuel Hartlib	11) John Worthington
2) John Dury	12) John Beale
3) Jan Amos Kaminski	13) Petr Figulus
4) Johann Moriaen	14) Heinrich Appelius
5) Joachim Hubner	15) John Pell
6) Benjamin Worsley	16) Dorothy Moore Dury
7) Robert Boyle	17) John Sadler
8) Cyprian Kinner	18) Fredrick Clodius
9) Cheney Culpeper	19) Johann Rulice
10) Katherine Jones	20) Henry Oldenburg

centrality, letter degree (the number of different senders and recipients connected to a specific person), letter strength (the total number of letters received and sent by a specific person) and non-letter social degree (the number of social links created by means other than letters) (Ahnert and Ahnert, p.17). A person ranked highly if their Z-score was 1+ (i.e. one standard deviation above the mean), and lowly if their Z-score was -1 (i.e. one standard deviation below the mean).

Four distinct levels emerge from this analysis: core members, major members, minor members and peripheral members. Core members are figures who ranked highly in all five measures, and 31 out of 766 people (the top 4.05%) fall into this category: Heinrich Appellius, Ralph Austen, John Beale, Robert Boyle, Jan Amos Comenius, Cheney Culpeper, John Dury, Petr Figulus, Joseph Hall, John Hall, William Hamilton, Samuel Hartlib, Johannes Hevelius, Joachim Hubner, Katherine Jones, Cyprian Kinner, Nicolaus Mercator, Marin Mersenne, Dorothy Moore Dury, Johann Moriaen, Henry Oldenburg, John Pell, William Petty, Thomas Roe, Johann Rulice, John Sadler, Johann Friedrich Schlezer, Caspar Streso, Robert Wood, Benjamin Worsley and John Worthington. None of these names are too surprising in that they all feature as senders or recipients of correspondence within the database, and they all feature to varying degrees in previous scholarship on the Hartlib circle. Furthermore, all except one of these names rank in the top 30 in one or more of the measures used throughout this paper. This exception is Joseph Hall, but while he does not rank in the top 30 of any measurement, he ranks highly across the board due to his frequent correspondence with Hartlib and Dury, and his collaboration with Dury, John Davenant, Thomas Morton and James Ussher on *Good counsellors for the peace of reformed churches* (1641).

By contrast, major members rank highly in four measures, and in total 20 out of 766 people (2.61%) are in this category. These members can be grouped into three sub-categories: 1) those with low letter strength (e.g. Frederick Clodius and Johann Heinrich Bisterfeld), 2) those with low betweenness (e.g. Joseph Avery and Cressy Dymock), 3) those with low letter degree (e.g. Robert Child, and Theodor Haak). From this, one can see that major members tended to either engage in high amounts of correspondence in sections of the network where clustering is high and thus there are more people with similar infrastructural significance surrounding them; or they tended to engage in less correspondence but are at a point in the network where clustering is low, and thus they are an important conduit through which information flows. Thus, the main difference between core members and major members is the core members' ability to engage in extensive amounts of correspondence with a wide range of people, while also being important conduits through which information flows out to the periphery. A good example of this is Hartlib himself who, as already shown, was able to consistently engage in correspondence with an exponentially large base of people, while also managing to develop social ties by acting as a messenger for several of his correspondents.

The rest of the network is divided into the periphery and minor members. In total 39 out of 766 (5.09%) are minor members. These members stand out as they have high eigenvector scores and a high non-letter social degree. Additionally, they have only one of the following: high letter strength, high letter degree or high betweenness. The people who fulfil these criteria include well-known figures like Arnold Boate, Robert Child, Samuel Hartlib Jr., Georg Horn, Goddofred Hotton, Joseph Mede, William Rand, André Rivet and James Ussher. Ussher and Boate are classed as minor members as they have high eigenvector, meaning they played an influential role in the flow of information around the network. They also have a high letter degree and a high non-letter social degree, meaning they managed to write to a wide range of people while also developing extra social connections. What separates them from the major members is that they have low betweenness and low letter strength. Therefore, like Cressy Dymock, William Hamilton and Henry More, they are located where clustering is high, but

unlike these men, Ussher and Boate did not send frequent enough correspondence that has been incorporated into the Hartlib catalogue to classify as major members.

Overall, 90 out of 766 people (11.75%) can be considered core, major, or minor members. This means that the vast majority of the network was on the periphery. In fact, apart from Ranelagh and Moore Dury, all 51 other women are a part of the wider network. The only other women to rank highly in more than one measurement are Mary Hartlib, Maria Hartlib, Mary Clodius, Anna Rothe, Margaret Clotworthy, Elizabeth of Bohemia and Henrietta-Maria, all of whom rank highly for eigenvector and non-letter social degree. These women divide into two distinct groupings. Some women are mainly connected to other nodes through familial connections, while also being connected to a small number of extra nodes through other social connections. These women mainly have familial edges, as they were related to Samuel Hartlib: Mary Hartlib was his wife, Maria Hartlib was his sister-in-law, and Mary Clodius and Anna Rothe were his daughters. Thus, these four women were connected to each other, various other family members, and correspondents of Hartlib who asked for their regards to be passed on to his family. By contrast, Margaret Clotworthy, Elizabeth of Bohemia and Henrietta Maria are mainly connected to other nodes through social connections. These women were all connected to Dorothy Moore Dury, and were involved in some capacity in the attempts to get Moore Dury a position a court position serving the younger English royal children.³ However, the large statistical gap between these women and Ranelagh and Moore Dury means a larger question must be asked: How did Moore Dury and Ranelagh come to play such an important and intellectually active role in this network? This is an extremely complex question, which requires further research. However, one important factor is that both Moore Dury and Ranelagh had already developed reputations as intellectual women before their involvement in this network. Lady Ranelagh was associated with The Great Tew Circle, evidenced by her close friendships with Lucius Cary and Edward Hyde. While there is no evidence of when she visited Great Tew, evidence of her involvement in intellectual discourse remains extant. The clearest example of this is a letter Ranelagh sent to Hyde in 1644 in which she gave her opinion on how she thought Charles I and Parliament could come to an agreement. Importantly, it is clear that Hyde respected the opinions put forward in the letter, evidenced by the fact that he not only kept the letter, but endorsed it: 'A very sensible letter from Lady Ranelagh' (Clarendon MSS, Vol. 23, fols. 113-15).⁴ Similarly, in 1640, Anna-Maria van Schurman wrote to Moore Dury: 'I am delighted to have heard about you and your reputation ... I thought that no clever woman had remained in England after the death of Jane Grey and Queen Elizabeth' (Hunter, 1). The important element of this letter is that van Schurman was clearly emphasising that Moore Dury's reputation was an intellectual one through the use of the word 'clever.' Thus, when both of these women became involved in the Hartlib Circle, they did so with their political, religious and scientific interests preformed, and thus were able to make intellectual connections with other members that shared these interests.

While this paper has so far shown that Ranelagh and Moore Dury were a part of the core of this network, this core consists of 31 people. Thus, there are questions still to be asked; did they have a high degree of independence within the core, or were they reliant on specific connections for information, and would this network look much different without them? A quantitative way of analysing these questions is possible through statistical measures including closeness. Closeness is a measurement that calculates the independence of a node. It determines whether an individual node needs another particular node to receive information, or whether the node can receive this information from various sources. It is a measurement that can be interpreted as an index of how long it takes a node to receive new information. Borgatti states that 'nodes with low raw closeness scores have short distances from others, and so will tend to receive flows sooner, assuming that whatever is flowing manages to travel along shortest paths' (59). In the

case of information flows (like the Hartlib Circle), perhaps counter-intuitively nodes with low closeness scores are well placed to receive information early, when it is still new. This is because Hartlib copied information and sent multiple copies, the circle operated by means of parallel duplication, which is when information flows through several paths simultaneously. As a result, those closest to Hartlib would have been more likely to receive this information early. When we look at Table 4, the 20 people with the lowest raw closeness are those with high eigenvector scores (Table 3).

In fact, 18 names appear on both lists, highlighting that the most influential members of the network were also those who were closest to the core and thus received information early. Interestingly, more than one woman appears in the top twenty: Ranelagh ranks 9th, and Moore Dury ranks 14th.

While the closeness measure shows us who could potentially receive information at an early stage, the clustering measure can be used to validate a member's raw closeness. In a network like the Hartlib Circle, in which there were only two interconnected hubs, those that cluster around these two hubs are more likely to be at the core of the network. A way to measure clustering is to measure the number of triangles a particular node can make. As Newman states, 'If vertex A is connected to vertex B and vertex B to vertex C, then there is a heightened probability that vertex A will also be connected to vertex C' ('Structure', 178). Thus, if vertex A and vertex C connect, triadic closure occurs, and the resilience or sustainability of that part of the network increases (Huang et al, p. 3374). As this process continues, a large number of overlapping triangles begin to emerge, creating a strong cluster. This process occurred at the core of the Hartlib Circle, as all the core members knew each other because 'friends of friends ... bec[a]me friends themselves (Huang et al, p. 3374).' Thus, those with the highest number of triangles are also those with high raw closeness scores. This is because they were able to form triangles with all the other members of this cluster. When we look at the top twenty people in terms of number of triangles (Table 5), we see the same names that have been produced with the other centrality measurements (Tables 1-4).

Like all the other social measurements, Ranelagh ranks within the top fourteen, this time ranking 8th while Moore Dury ranks 18th. From measurements of closeness and number of triangles, it becomes clear that both women were near the centre of the network, and thus were positioned where the network is most resilient. This means that they did not have to depend on one particular person in order to get access to information. One example of this can be seen in a letter from Wood to Hartlib dated February 1659, in which Woods stated that:

Table 4. Top 20 authority.

1) Samuel Hartlib	11) Cyprian Kinner
2) John Dury	12) Petr Figulus
3) Jan Amos Kaminski	13) Heinrich Appelius
4) Johann Moriaen	14) Dorothy Moore Dury
5) Benjamin Worsley	15) Fredrick Clodius
6) Joachim Hubner	16) John Pell
7) Robert Boyle	17) John Sadler
8) John Worthington	18) Henry Oldenburg
9) Katherine Jones	19) William Petty
10) Cheney Culpeper	20) Thomas Roe

Table 5. Top 20 closeness.

1) Samuel Hartlib	11) Cheney Culpeper
2) John Dury	12) John Worthington
3) Jan Amos Kaminski	13) Petr Figulus
4) Johann Moriaen	14) John Sadler
5) Joachim Hubner	15) John Pell
6) Benjamin Worsley	16) Fredrick Clodius
7) Robert Boyle	17) Heinrich Appelius
8) Katherine Jones	18) Dorothy Moore Dury
9) John Beale	19) Henry Oldenburg
10) Cyprian Kinner	20) Johann Rulice

My Lady Ranalaugh writes that her brother our noble friend at Oxford having with some earnestnes desired *what* information she could get in this country about *the* generation of Barnicles, & her selfe having tried to get some here with little successe by reason of the generall unobservance of the workes of God, desires me to speake to Major Symner for *what* either of us know therein (HP 33/1/44A-44B).

From this letter one can see that Ranelagh was actively trying to get information by researching the generation of barnacles herself, but when her research failed she used her connections in order to see if she could get information from either Wood or Miles Symner. This 'either' is important, as while she is using Wood as the main point of contact, she is not reliant on him knowing the answer, in that she explicitly guides him to another possible source of information, if need be. In fact, it is likely that this ability to draw on a wider social connection was important, as Symner was the more probable of the two to have the needed information. This is because he had researched the topic in the past; Michael Hunter et al have noted that Symner wrote an undated letter to an unknown recipient who desired 'an account concerning Barnacles that you might present it to the truly honourable & by me ever honored person' (Hunter et al, p.170n).⁵

However, because these women are located at a part of the network where clustering is high, removing them has little effect on the overall structure. This can be seen by comparing certain statistical traits of the actual network, which includes Moore Dury and Ranelagh, to the same traits in the network if they were removed from it. In the entire network (i.e. the network with every member included), the diameter, or longest path length (longest distance between any two points in the network) is 6. Additionally, the average path length (average distance between any two points in the network) is 2.3924. In comparison, the network without Lady Ranelagh has a diameter of 6 and an average path length of 2.3910. This is only a difference of 0.0014, which is so small it can be considered negligible. The same results occur when one takes Moore Dury out of the network, as the diameter of the network stays at 6, and the average path length changes to 2.3916, a difference of 0.0008.

This lack of structural change when Ranelagh or Moore Dury is removed helps us understand why these two women have been forgotten over time. It helps us see that, while these two women did not alter the overall make-up of the network, they were at the centre. In fact, it was this very centrality, where social clusters were most dense, that hid them from view. While there is evidence of them acting as messengers, distributors of material etc., Hartlib's ability to disseminate information through several channels at once meant that the removal of one single person other than Hartlib and Dury, does not dramatically affect the overall network.

However, this does not excuse their exclusion from most previous scholarship on the Hartlib Circle, as the same can also be said of male members with similar centrality measurements to Moore Dury and Ranelagh. For example, when one removes Benjamin Worsley from the network, the diameter stays the same, and the average path length changes to 2.3910, a negligible difference of 0.0014. This means that like Moore Dury and Ranelagh, the removal of Worsley does not change the shape of the overall network. In fact, the only major difference is that Benjamin Worsley never needed to be brought back 'from the margins.' Worsley's involvement in the Hartlib Circle has been well documented since Charles Webster's *The Great Instauration: Science, Medicine and Reform, 1626-1660* (1976). Furthermore, over the last two decades, there have been many excellent studies in which Worsley's life and activities have begun to be explored in further detail. These include two chapters in Greengrass, Leslie and Raylor's *Samuel Hartlib and Universal Reformation* (1994), extensive coverage Newman and Principe's *Alchemy Tried in the Fire: Starkey, Boyle, and the Fate of Helmontian Chymistry* (2005) and Thomas Leng's monograph, *Benjamin Worsley (1618-1677): Trade, Interest and the Spirit in Revolutionary England* (2008). During the same period, analysis of Ranelagh and Moore Dury's activities were in a recovery phase, in that they were touched upon in these wider studies (especially by Leng who discusses Worsley's connection to Ranelagh throughout), while singular extensive attention to their activities within the Hartlib Circle was beginning to be undertaken by Hunter, Pal, Connolly, and DiMeo.

The quantitative results of this paper have shown that this scholarship is important, as it reveals just how illogical the exclusion of Lady Ranelagh and Dorothy Moore Dury from scholarship really is. Unfortunately, because of gender blindness, these two women must be brought back 'from the margins' and recognised as integral elements of the Hartlib Circle's core. While these findings, alongside events like the 'Networking Early Modern Women' add-athon by *Six Degrees of Francis Bacon* emphasise the positive ways in which quantitative research can correct the historical record, more qualitative work needs to be done in order for us to fully understand the impact Lady Ranelagh and Dorothy Moore Dury had on this particular network.

Short Biography

Evan Bourke is a PhD researcher. His doctoral project is entitled 'Godly Sybilla, Erudite Wives and Burdensome Sisters: The formation and representation of women's reputations within the Hartlib Circle 1641-1661.' Evan is examining Katherine Jones and Dorothy Moore-Dury's position and reception within the Hartlib Circle, as well as how they forged reputations as intellectual women within this network. He completed his BA in English and History at University College Dublin in 2013 and his MA in Renaissance Literature and Culture at the same institution in 2014. He is affiliated with the ERC-funded project 'RECIRC: The Reception and Circulation of Early Modern Women's Writing, 1550-1700,' directed by Marie-Louise Coolahan.

Notes

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¹ Over the last number of years there have been several projects to analyse and visualise correspondence networks. These include *Mapping the Republic of Letters*, <http://republicofletters.stanford.edu/>; *ePistolarium* <http://ckcc.huylgens.knaw.nl/epistolarium/>; and *Reassembling the Republic of Letters*, <http://www.republicofletters.net/>. There is also the *Six Degrees of Francis*

Bacon project, <http://www.sixdegreesoffrancisbacon.com/>, which in its first phase drew on information from the *Oxford Dictionary of National Biography*, <http://www.oxforddnb.com/n>

² In this visualisation, I have calculated the Z-Score of every member's social degree and excluded every member with a Z-score of -1 (i.e. one standard deviation below the mean) or below as to make it easier for the core of the network to be seen. However, as with Fig. 1, this visualisation can often be manipulated, and thus one still needs to rely on statistical evidence.

³ For more, see Felicity Maxwell, 'Calling for Collaboration: Women and Public Service in Dorothy Moore's Transnational Protestant Correspondence,' also in this issue.

⁴ For more on this letter and Ranelagh's connection to Falkland and Hyde, see Michelle DiMeo, 'Katherine Jones, Lady Ranelagh: Science and Medicine in a Seventeenth Century Englishwoman's Writing.' Diss. U of Warwick, 2009, p.33-38 & Ruth Connolly, 'A Proselytising Protestant Commonwealth: The Religious and Political Ideas of Katherine Jones, Viscountess Ranelagh (1614-1691)', *The Seventeenth Century*, 23 (2008), 244-64.

⁵ In their edition, Hunter et al suggest that this letter was written in 1654 and addressed to Boyle. However, as it is an undated letter to an unknown recipient, it may be possible that the letter could have been written in 1659 and a response to Ranelagh's request. However, at time of writing, I have not been able to research this possibility fully.

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A Brief abstract of the Arraignment of nine Witches at Northampton: July 21th¹⁴⁴ 1612.

Inditements: The witches names: 1 Jane Lucas. 2 Alce Harrys. 3 Catherine Gardiner. 4 Agnes Brown. 5 Jone Brown. 6 Alce Abbott.

There were two bills on Inditement: the one for torturing Eliz. Belcher wife to Dabriscourt Belcher Esquier,¹⁴⁵ and Wil. Avery her own Brother, for wch enchantments were six accused. 1 Jane Lucas. 2 Alce Harrys. 3 Katherine Gardiner. 4 Agnes Brown. 5 Jone Brown. 6 Alce Abbot. The other for killing two porkets, & one Cow & for bewitching a Mare for wch facts there stood three arraigned. 1 Agnes Wilson widow. 2 Alce Wilson her daughter. 3 Jane Wilson her sonns wife or daughter in law. The evidences are these.

The Evidences: Mrs Belcher.

1 That Mrs Belcher had bene strangely afflicted and tormented in al her body for the space of a yeare and quarter, & using all lawful meanes of phisick could find no ease, neither did any purgation were it never so forcible work upon her or doo her any good. So it was generally suspected to bee witchcraft, but shee would never bee so perswaded by any of her friends for almost a yeares space, till March¹⁴⁶ 15th last past, when being in her fit, some spectators by nominated sundry suspected parties, wch shee still disclaimed, & at last naming Jone Brown daughter to Agnes Brown, shee replied, hath shee done it, then they named her again, & Mrs Belcher answered again, did shee & so from that time forth persisted to accuse Jone Brown, & being in her fits seemed still to see her tormenting her, and would presently recover out of her fits, if shee could touch her or draw blood of her.¹⁴⁷

144. *Sic*.

145. Dabriscourt Belcher (variously spelt Dabrisecourt, Daubridgcourt Belchier (in his *DNB* entry) and Dawbridge-court) was a country gentleman, traveller and a dabbler in literature. He is completely absent from both accounts of his wife's illness, and the fact that he settled in Utrecht around 1600, and that his wife's brother is the one who assists her in 1612, suggests that he lived apart from Elizabeth Belcher for at least part of the time.

146. This word has clearly been overwritten and is unclear.

147. *The Witches of Northamptonshire* gives a history of the accusation on B2v-B3: 'This Joane Vaughan, whether of purpose to give occasion of anger to the said Mistris Belcher, or but to continue her vilde, and ordinary custome of behaviour, committed something either in speech, or gesture, so unfitting, and unseeming the nature of woman-hood, that it displeased the most that were there present: But especially it touched the modesty of this Gentlewoman, who was so much mooved with her bold, and impudent demeanor, that shee could not containe her selfe, but sodainely rose up and strooke her, howbeit hurt her not, but forced her to avoide the company: which this Chicken of her Damnes hatching, taking disdainefully and beeing also enraged (as they that in this kind having power to harme, have never patience to beare) at her going out told the Gentlewoman that shee would remember this injury, and revenge it: To whom Mistris Belcher answered, that shee neither feared her nor her mother: but bad her doe her worst . . . being alone in her

Mr Avery.

Mr Avery her Brother moved to revenge went toward Agnes Browns house to beate her & her daughter, but by the way was so confounded that he could not goe forward, but went back very well, then hee assaied again, and coming to the same place had no power to goe forth, but returned & so wthin 2 daies after April 6th fell into strange fits and convulsions having sundry visions and apparitions of divers, witches & such like.¹⁴⁸

1 hee saw Agnes Brown bring a molewarp,¹⁴⁹ and perswaded him to let it suck his toe, but hee defied them both & would not suffer it, wth many godly prayers & meditations in his fit.

2 Agnes Brown appeared to him naked above the middle wth a knife in ech hand, inciting him to deliver the one to his Sister Belcher to kill herself, & to murther himself wth the other in wch fit hee so diligently observed her, that hee detected a black wart as big as a fetch under left arm,¹⁵⁰ wch upon search was found & seen by many: yea, though hee never saw nor knew the woman by face, yet by the apparitions hee being brought where shee was amongst other women, instantly said this is shee who hath wrongd my sister & mee.

3 Sundry other witches appeared to him in his fits, whome hee exhorted to repent in time, for the divel their master would bring them to a shameful end: some hee called novices in the trade, & wisht them to desist from those abhominable practises, & to ask god forgiveness &c.

4 hee heard many of them railing at Jane Lucas, laying the fault on her that they were thus accused: and hee saw Alce Abbot, Cath: Gardiner & Alce Harrys riding on one walkers sow: and there appeared to him a bloody man desiring him to have mercy on his Mistris Agnes Brown and to cease from impeaching of her.¹⁵¹

cont.

house, she was sodainely taken with such a griping, and gnawing in her body, that shee cried out, and could scarce bee held by such as came unto her, And being carried to her bed her face was many times so disfigured by beeing drawn awrie that it bred both feare, and astonishment to all the beholders, and ever as shee had breath, shee cried, Heere comes Joane Vaughan, away with Joane Vaughan ...'

148. The pamphlet confirms this story and Avery's subsequent decline into illness.

149. A mole.

150. *Sic.*

151. The pamphlet treats the sow story as fact, not a vision on signature C: 'It was credibly reported that some fortnight before their apprehension, this Agnes Browne, one Ratherine [Katherine] Gardiner, and one Joane Lucas, all birds of a winge, and all abydng in the Towne of Gilsborough did ride one night to a place (not above a mile off) called Ravenstrop [Ravensthorpe, 2 miles from Guilsborough] all upou a Soves backe, to see one mother Rhoades, an old Witch that dwelt there, but before they came to her house the old Witch died, and in her last cast cried out, that there were three of her old friends comming to see her, but they came too late. Howbeit shee would meete with them in another place within a month after.'

5 Being at Northampton in his fit he said that the witches in prison were at variance & that if any one would goe down hee should heare their voices, but would not understand a word distinctly whereupon Mr Brown a Mr¹⁵² of Arts of Trinity College Oxford went to the prison being about two a clock in the morning, & heard a confused noise of much chattering & chiding but could not discern a ready word.

6 when he was caried from Northampton in a Coch, hee said if they did not take him out of the coch, hee should break his neck at such a place in the high way, and that such a mans mare fell dead in the said place at that very instant wch was two miles of and as they rode on, the man met them wth saddle & bridle on his back, and affirmd so much of the strange & soudain death of his mare: whereat Mr Avery being come out of his fit, stept forth and on his knees gave god thanks for his delivery wch the mans wife seeing thought to join wth him in prayer, but was soudainly taken in the same maner as Mr Avery had bene, & so after being in a house & put into a chaire, the very chaire danced exceedingly to the admiration of all the beholders: so the woman continueth still bewitched.¹⁵³

7 Hee saw a black ugly villain in his fit daring him to come down to the yard, but hee would not, yet still defied him & Agnes Brown wch sent him, wth such like words:, thou divell! thou filthy black rogue! thou damned whore! thou hast done thy worst to my sister, & brought knives to mee to kill my sister & my child that I might be damned as thou art, but I care not for thee, & thou ugly fiend wouldst have mee come down to thee, but I care not for thee. thou filthy whore thou hast committed 14 murthers sparing nor young nor old women nor children: and thou hast gotten a swift page that will run 24 miles in a moment, & will follow thee to the gallows. then hee said, look how the black rogue comes stealing up the staires & peeps into the dore, & now hee comes creeping in by the walls to my bedside: but let him doo his worst, hee cannot doo mee harm: my saviour doth still defend mee &c.

All these visions and speaches delivered in his fits wth many others of like nature were ratified and confirmed by sundry persons there present of good credite, and reputation.

152. Master.

153. The pamphlet tells a different version of the story on B4-B4v: 'Not long after Maister Avery and his Sister having beene both in Northampton and having drawne blood of the Witches, Ryding both homewards in one Coach, there appeared to their view a man and a woman ryding both upon a blacke horse, M. Avery having spyed them a farre off, and noting many strange gestures from them, sodainely spake to them that were by, and (as it were Prophetically) cryed out in these words, That either they or their Horses should presently miscarry, And imediately the horses fell downe dead. Whereupon Maister Avery rose up praying ye grace and mercies of God, that he had so powerfully delivered them . . .'

8 There appeared to him Agnes Browns spirit, & hee said what art thou? art thou Arouta, or Cramega, or Arachne? no thou art Cramega with a pox I know thee too well.

9 being in a fit at Northampton hee desired to goe to the prison, & there amongst others pickt out Agnes Brown, threw her down on the ground, & so the blood sprung out of her eye wth the fall, whereat hee presently recovered.

10 Hee was once stricken on the eyes & his heeles tript up & so cast into his fit: & another time hee was thrown from his horse twenty paces of without any harme at all.

There were others who accused some of those witches, as one Hugh Lucas a youth of 12 yeares who looking stark¹⁵⁴ on Jane Lucas at the Church, shee askt him whether hee would outface her, but the boy being afraid replied not but went home, & being on a wall fell into a trance, & so continued 12 houres, & in his fit said hee saw J: Lucas come to his bed side 4 times: but the next day hee met wth her, tript up her heeles, beate her, and so had never any more fits. also John Walker being stricken very lame in all his limbs & suspecting Alce Harrys desired to scratch her, but being brought to her could not a long time draw any blood from her hands or face, yet at length wth much adoo got a little & so recovered instantly & cast away his crutches. All these women were searcht by women sworn,¹⁵⁵ who found marks or teates on some of them but on some none: and Alce Abbot being for trial cast into the water wth her hands & feete bound could not sink to bottome by any meanes.

Mrs Belcher being in the castle yard amongst the people before the arraignment began fell into a strange fit, & desired to have Jone Brown brought to her, wch the Judg granted, & so touching her did partly recover, yet was not able to deliver her mind fully at barr, but made signs for pen and inck & wrote these words (Jone Brown.) & so being brought before her shee started back shrikt wept & presently came to her perfect senses & shee then spake very modestly & would accuse none but Jone Brown, whome in her conscience shee thought had bene the instrument to afflict her in that strange fashion.

Mr Avery having bene all night grievously tormented & very sore in his body was sent for to the bench: but when hee alighted out of the coch at castle gate, hee fell into his fit & so was brought in that case to the bench, where all the witches were brought to touch him, yet hee recovered not but was carried forth & at last came to his perfect understanding, & so

154. Boldly.

155. The team of women employed to search suspects for suspicious marks and deliver their opinion on oath.

being brought to barr spake very discreetly, christianly & charitably to every point.

The witches: 1 Agnes Wilson. 2 Alce Wilson. 3 Jane Wilson.

The second inditement touched 3 others for killing cattle: who had bene long suspected of witchcraft, so about Easter last Mr Harrison minister of their parish¹⁵⁶ examined and catechised them 3 or 4 times before witnessed, who answered most blasphemously.

1 Agnes Wilson the mother saying her Creed would leave out I beleeve in Jesus Christ & could not bee induced to say it after the Minister: then hee askt her, how many gods shee did acknowledg, who answered two, god the father and the divell.¹⁵⁷

2 Alce Wilson being demanded what her godfathers promised for her in baptism, shee said 3 things. 1 to forsake the world. 2 the pomp & vanity thereof. 3 the lusts of the flesh: but shee would by no meanes say, I forsake the divell & all his works, being askt the reason, because (said shee) the divell never did mee harme. Then being urged to say after the minister, shee would still say, I forsake god and all his works. When shee was brought before the Justices & threatned wth death except shee would say I forsake the divell &c shee would strive to say it, but a thing did rise & swell up in her throat ready to choke her. but since shee will say it and saith shee could not then for want of grace.¹⁵⁸

The minister caused them to bee sercht, especially in their mouths, where in ech of them were found teats, wch being toucht presently yeelded blood: but wthin two daies after dried up & could not bee seen.

The facts laid to their charge were only 3: 1 that March 10. 1612 two porkets fell into strange fits, ran mad & died. 2 that March 20th 1612, a Cow of the same parties¹⁵⁹ fell into like passions & so languished,

156. This nonspecificity suggests that the writer is uncertain about where the Wilson family lived, suggesting that he only encountered them at the Assize stage of their prosecution.

157. This ranking of the devil alongside God corresponds with the heresy of Manichaeism, justifying the writer's opinion that the women answered questions 'most blasphemously'. Manichaean beliefs, which stated that the devil ruled over the world in parity with God who ruled the heavens, were held by some of the early Medieval European sects accused of witchcraft. However, the emphasis on the devil in English Catholic and Protestant teaching could easily lead an innocently conformist parishioner to the conclusion that the devil rivalled God in his omnipotence. The interest in the Wilson women displayed by their minister suggests that he perceived in them either great ignorance or equally unwelcome free thinking (see John Cotta, below, for further comment).

158. Clearly this woman was not executed, as her crimes were not serious enough even if she was convicted. After her trial, the writer shows her producing a properly godly response. The verdicts of the Wilsons' trials are not known.

159. The victim is not named, suggesting little familiarity with pre-trial documents from the

consumed & died. 3 that a Mare of the same mans was in like case, & being mad brake down a wall, came into the house & being caried away, ran in again bounct at dore, & so being let into the hall ran to the chimney, put her head into the chimney where a wad of straw was put into the fire, & so held her head in the smoke til the fire kindled, singed her haire in the flame, & afterward being burnt rubd his¹⁶⁰ head in the ashes, & so perfectly recovered & went away very sound.