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PROTESTANT LETTER NETWORKS IN THE REIGN OF MARY I: A QUANTITATIVE APPROACH

BY RUTH AHNERT AND SEBASTIAN E. AHNERT

In 1533 Thomas More took possession of a manuscript containing an evangelical tract on the topic of transubstantiation written by John Frith. Despite being unpublished at this time, More felt this text required refutation and penned *A Letter [...] impugnynge the erronyouse wrytyng of John Fryth*. More's concern was the potential dissemination of the work. By the time his answer to Frith's tract was published he had been able to acquire three manuscript copies, which confirmed to him that the text was being copied, and led him to fear an organised network of evangelicals working together to produce and disseminate texts. He imagined this model of dissemination as a canker spreading through a body:

For as saynte Poule sayth, the contagyon of heresy crepeth on lyke a canker. For as the canker corrupteth the body ferther and ferther, and turneth the hole partes into the same dedely sykenesse: so do these heretykes crepe forth among good symple soulys / and vnder a vayn hope of some hygh secrete lernynge, whych other men abrode eyther wyllyngly dyd kepe from them, or ellys coulde not teche theym / they dayly wyth suche abomynable bokes corrupte and destroye in corners very many before those wrytynges comme vnto light[.]¹

St. Paul's canker metaphor (2 Timothy 2:17) is used here by More as a rhetorical device to alarm his readers about the way that he perceived heresy spreading throughout England, largely undetected. But this metaphor also shows striking insight about the ways that underground religious movements work, prefiguring discoveries about the structure of social networks by some five centuries. Recent research in the field of quantitative network analysis has shown that viruses and epidemics share key patterns of dissemination and growth with religious ideas, innovations, viral internet phenomena, or new products.

In a series of key publications in the 1990s and early 2000s, scholars such as Albert-László Barabási, Reka Albert, Duncan J. Watts, and Steven Strogatz showed that a huge variety of real-world networks—such as, for example, neural networks, transport networks, biological

regulatory networks, and social networks—share an underlying order and follow simple laws, and therefore can be analyzed using the same mathematical tools and models.² These publications build on work from various different disciplines, such as sociology, mathematics, and physics, which stretches back some decades. The theoretical approaches of social network analysis have already made an impact in the fields of historical corpus linguistics, coterie studies, and the history of science, amongst others; but the application of mathematical and computational techniques developed by scientists working in the field of complex networks to the arts and humanities is a relatively recent development, and one that is gaining increasing traction, offering as it does both technical tools and a sense of contemporaneity in a world now dominated by social networking platforms. Despite these developments, however, there is still much work to be done before these statistical methods are embedded within the literary historian's toolbox. All too often the word "network" is used by scholars in this field as a useful metaphor—in much the way that Thomas More wielded the word "canker." This article will demonstrate how the mathematical tools employed by network scientists offer valuable ways of understanding the development of underground religious communities in the sixteenth century, as well as providing different approaches for historians and literary scholars working in archives.

While it is not possible to corroborate More's fears about the extent and organization of evangelical communities in England during the 1530s due to lack of documentation, considerable evidence for the structure of the underground Protestant communities functioning in the Catholic reign of Mary I survives in collections of correspondence. Early modern correspondence provides a unique textual witness to social relations and structures. Gary Schneider has described Renaissance letters as "sociotexts": as "crucial material bearers of social connection, instruments by which social ties were initiated, negotiated, and consolidated."³ Letters were the method by which people sought patronage, garnered favor, and engineered their social mobility; they were a means of communicating alliance, fidelity, and homage; and they could be used "as testimonies, as material evidence of social connectedness."⁴ The modern perception of private correspondence was one that simply did not exist in the early modern period. Instead, epistolary conventions implicated multiple parties in the composition, transmission, and reception of letters. Common letters (intended for more than one recipient or written by more than one sender) most clearly demarcate the idea of an epistolary community, but senders also

extended the reach of their correspondence by directing the recipient to pass the letter on to other people, by enclosing commendations, additional messages, tokens, and even letters for other recipients, and by entrusting additional oral messages to the letters' carriers. Carriers or bearers were vital members of epistolary communities, described by Alan Stewart and Heather Wolfe as the "lifeline" between families and friends, court and country.⁵

Letters, then, can tell modern scholars about the working of specific social groups: who its members were, and how they related to one another. Thanks to the efforts of the famous martyrologist John Foxe and his associates, 289 unique letters survive in print and manuscript that were written either by or to Protestants residing in England during Mary's reign. These letters provide crucial evidence for the social organization of the Protestant community in England at that time. The letters from Protestant leaders—former bishops and archbishops such as Hugh Latimer, Nicholas Ridley, and John Hooper—show that they continued to shape the Protestant movement from their prison cells, providing pastoral guidance and doctrinal instruction for co-religionists inside and outside the prison, as well as coaching other prisoners for martyrdom. The correspondence also outlines the infrastructure that enabled these leaders to write and their letters to be disseminated, including a system of financial sustainers outside the prisons, of copyists and amanuenses in and between prisons, and a supply of carriers who enabled the prisoners' letters and enclosed writings to reach recipients across England and the continent.

Quantitative network analysis allows us both to visually map the social network implicated in this body of surviving correspondence, and to measure the relative centrality of each of its members using a range of different mathematical tools. These methods allow the kind of large-scale picture Franco Moretti describes as "distant reading" and Matthew Jockers refers to as "macroanalysis."⁶ These terms describe a whole variety of different statistical and digital methods, but what they all have in common is that they allow "for both zooming in and zooming out" (what Martin Mueller has termed "scalable reading").⁷ Network analysis is one such tool: it allows us both to see the entire Protestant community implicated in this body of correspondence, and to identify the individual people and letters that require localized attention and close reading. Our analysis reveals not only expected patterns—that martyrs are central to the organization of this community—but also some surprising facts: that letter carriers and financial sustainers (especially female sustainers) are more important than we

may have previously suspected; and that their significance increased as the martyrs died. The techniques of network analysis, therefore, help us to counterbalance the spectacular bias of John Foxe's *Acts and Monuments*, popularly known as the "Book of Martyrs," which is the main contemporary source for documents on the persecution of the Protestant church, but which almost exclusively celebrates those who lost their lives at the hands of the Catholic state. As Thomas S. Freeman has remarked, "to ignore the majority of Marian Protestants who did not die for the gospel is to study the steeple and believe that you have examined the entire church."⁸

I. RECONSTRUCTING AN EPISTOLARY COMMUNITY

Reconstructing the church beneath the steeple requires a combination of archival work and computational analysis. The 289 letters that form the basis of this study are scattered throughout Foxe's papers and publications, and two further print sources: many of the letters were printed in Foxe's "Book of Martyrs," first published in 1563, and the associated publication *Certain Most Godly, Fruitful, and Comfortable Letters of ... True Saintes and Holy Martyrs of God*, edited by Henry Bull but issued under Miles Coverdale's name and printed in 1564; three letters by John Careless are printed at the end of Nicholas Ridley's *A pituious lamentation of the miserable estate of the churche of Christ in Englande* in 1566; twelve letters are made available in a Victorian anthology; and several further letters survive which exist in manuscript only.⁹ Many of the printed letters also survive in manuscript and holograph versions in Foxe's papers, held in the British Library and Emmanuel College Library, Cambridge. These copies have been crucial to this study as many of them contain material edited out of the printed versions, including information about the Protestant community, such as the items of personal news with which some letters concluded, greetings to family and friends, as well as references to carriers.¹⁰

These documents, and letters in general, offer themselves to network visualization and analysis in a much more straightforward way than other forms of literature. A network is a set of relationships between objects or entities. We normally refer to the objects or entities as nodes in the network and their relationships as edges or ties. For example in an ecological network different species would be nodes and the edges might represent which animal eats which other animal; in the worldwide web, the web pages would be nodes and the hyperlinks

edges; and in a social network, such as this Protestant epistolary community, people are the nodes, and the relationships linking them are the edges. The material we have utilized includes all the letters where either the sender or recipient was residing in England, family correspondence (regardless of doctrinal position), and letters between Protestant factions.¹¹ In order to focus on the community's internal workings, we have excluded letters sent by Protestants to the authorities or to opponents. We have also had to exclude correspondence in which the sender or recipient is anonymous, with the exception of those letters where other social links are found. In the first instance we read through each of the 289 letters that fulfilled these criteria, recording the following data: who the letters are from and to, the location of both of these parties, the date of composition (where given or ascertainable), and any commendations or reported contacts. We then categorized the links that arose between the members of this community as follows: letter links (between sender and recipient); requested links (through a commendation, between sender and commendeed); implied links (through a commendation, between recipient and commendeed); reported links (where a conversation or other exchange was relayed); messenger links (where a messenger is named, making them an intermediary node between sender and recipient); spousal links; and other family links. Once we had gathered this data into a plain text flat file, we used Python code—more specifically the algorithms contained in the Python NetworkX library—to analyze the network.

What emerges from this data is a surprisingly large community, with 377 members and 795 edges, or social interactions. Many studies in quantitative sociology analyze much smaller social networks, with fewer than 100 nodes. For example, one of the classic data sets used to test network analysis algorithms is the social network of a Karate Club with 34 nodes and 78 edges.¹² The reason is that, until the advent of online social networks, sociologists were restricted to labor-intensive surveys as a means of compiling social network data. So our dataset is large enough to provide meaningful statistical results. Unlike the Karate Club network, however, which is complete and self-contained, our reconstructed Protestant network is only partial. Historic letter collections are subject not only to the vicissitudes of time, but also the bias of collectors. Foxe and Bull primarily printed letters by martyrs; and the collectors that provided these editors with correspondence were also more likely to preserve the missives of those who died for their faith. We cannot know how many more letters there were that are now lost. For example, the martyr Richard Woodman wrote letters

that have not survived; conversely, we would probably not have many of the letters of John Careless if Thomas Upcher had not gathered up letters written by the martyrs to Protestants who ultimately joined the Aarau congregation. However, it is important to remember that this is not an uncommon problem: the vast majority of network analysis deals with incomplete networks in the real world, and any statistical treatment of biases has to make assumptions about the distribution of missing links or nodes. In the following analysis we are alert to the bias of the collection and its likely effects on our findings. This bias will necessarily exaggerate the seeming prominence of martyrs in the topology of the network. The detection of infrastructural figures such as couriers and sustainers, however, is much less affected by this bias, as these individuals are identified using centrality measures such as betweenness and eigenvector centrality, which will be explained further below.

By compiling this data we were able to generate a visualization of the Protestant community as a network using OmniGraffle (Figure 1; we used the same program to generate all our figures). Such an image is very powerful: this community, which existed 450 years ago and which was only partially recorded by Foxe, is literally mapped out before our eyes. From this visualization we can immediately see who is important. The word “important” is used here, not to make a value judgment, but merely to denote figures who are structurally central to the network’s topology, which is something that can be measured with some accuracy. As in many network visualizations, the layout of the Protestant letter network in Figure 1 is force-directed, meaning that the algorithm creating the network layout models the network edges as physical springs so that any deviation from a given equilibrium length is counteracted by a force that is proportional to the displacement.¹³ As a result the most connected nodes (for example, those with the greatest number of edges or links) appear closer to the center, and those who have the least connections appear at the network’s periphery. Therefore, right at the center, with many edges radiating from them, are figures such as John Bradford, John Careless, Nicholas Ridley, and John Philpot. This is much as we would expect. They are special figures: they are martyrs who wrote a lot of letters and featured prominently in Foxe’s famous martyrology. But they are also special in another way. They are what network analysts would call hubs: nodes with an anomalously large number of edges. By comparison, many of the other nodes in the network have few, or even only one or two edges. Hubs are an extremely important component of any network. In

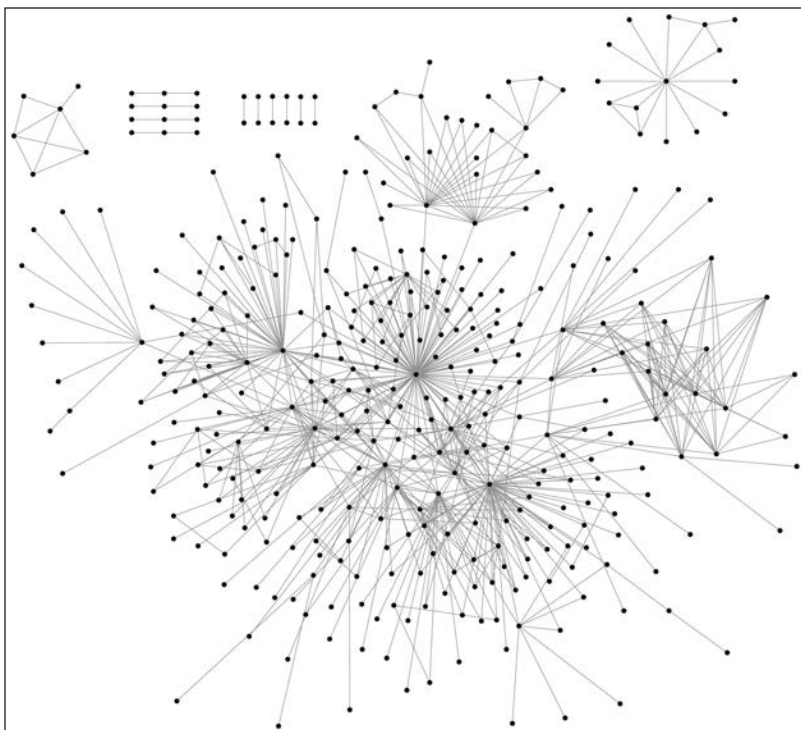


Figure 1. The entire network of social interactions.

social networks, as Barabási has observed, they are the kind of people who create trends and fashions, make important deals, and spread fads.¹⁴ If we plot the number of edges that each node in this network has on a graph (Figure 2), we can see that they follow a classic power-law distribution, which is typical of many real-world networks; there are very few nodes with many edges, and many nodes with few. This clearly demonstrates the atypical nature of the hub within a network. And it tells us that figures like Bradford, Careless, and Ridley had a significant impact on the structure of the network; without them it would look very different.

This is all quite unsurprising to historians familiar with Marian history, but it is extremely important that the method confirms what we already know. That means it works, and it means that we can put some trust in it when it draws attention to things we might not have observed before. The graph in Figure 2, however, does not distinguish

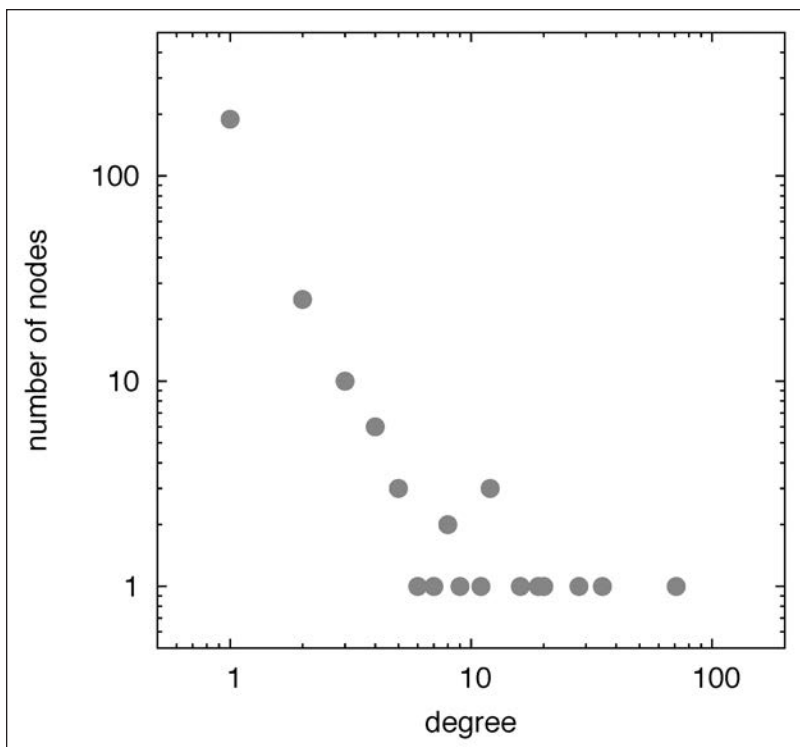


Figure 2. The degree distribution of the network of social interactions.

between letter links and what we might call social links, that is, all those links created through other kinds of social interactions and relationships described within the letters. If we distinguish these, a more nuanced picture of the different roles that characters played in the epistolary community begins to emerge, as we can see in Figure 3. Here we have plotted “letter degree” (Y-axis) against “non-letter social degree” (X-axis), in other words the number of letter connections for a given individual versus the number of his or her social connections other than those mediated by letters. A plot of these properties for the 377 nodes in this social network reveals a cluster around the bottom (that shows low letter degree, which means that few of their edges represent letter exchanges), with only a few along the diagonal line (where the number of letters sent and received equals the node’s social interactions forged via other means). On the whole

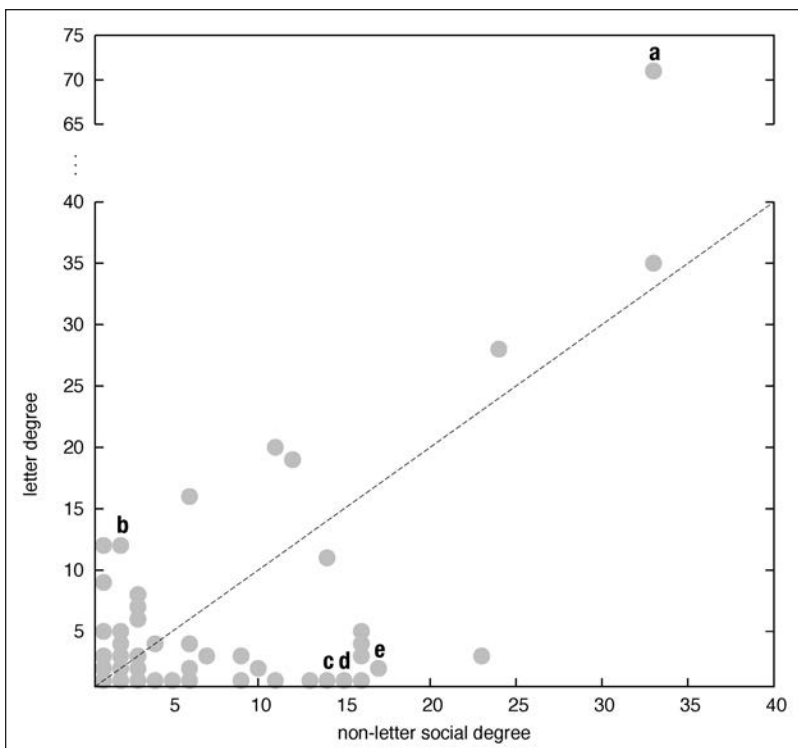


Figure 3. Letter degree versus non-letter social degree. John Bradford (a), Henry Hart (b), Bertram Calthorpe (c), John Bradford’s mother (d), and Heinrich Bullinger (e) are highlighted.

we see that those situated above the diagonal line tend to be martyrs or other significant religious leaders. The reason for this is that many of them were imprisoned, and so they undertook their ministry largely through letters because it was difficult to make and maintain relationships through other means. John Bradford, labeled (a) on Figure 3, is an outlier and provides an exaggerated version of this tendency. He wrote the most letters of all the martyrs, 119 in total, and received 19. What his position clearly shows is that his interactions with other people in the network were heavily reliant on letter interactions, but that he also had a broader circle of interactions that were independent from or additional to the links made through his correspondence. We learn about these from reported conversations, or from the inclusion of commendations, greetings or messages to be passed on verbally by

the letter's recipient. The reason for this high number of social links can be put down in part to his role as one of the chaplains in ordinary to Edward VI, during which Bradford had travelled through the country preaching reformation, in Lancashire, Cheshire, and possibly beyond. This was a man who already had a lot of social connections; and he sought to maintain and further them during his incarceration.

A contrasting example is Henry Hart, labelled (b), who is positioned very close to the Y-axis, with a letter degree of 12. This shows us that almost all his interactions within this network were via letter; barely any come through other means. Hart was a leader within a small factious Protestant group known as the Freewillers. The Freewillers were the first English Protestants to establish organised congregations that challenged the authority of the Protestant clerical leadership on the doctrine of predestination. Active from around 1550 to circa 1560, this group argued for a separation from the new Reformed Church, and can therefore be seen as the first advocates of Separatism in English history. The emphasis among some members of this community upon Separatism explains Hart's almost total lack of social links to the main body of the orthodox Protestant network through means other than letters. Why seek commendations from your opponents? Rather, Freewillers sought to achieve conversion through the circulation of treatises and by visiting those they deemed susceptible. Hart's position is a sign of the group's social isolation: he was regarded as an adversary rather than an ally, as will be discussed further below.

In direct contrast to Hart's position are the numerous nodes situated along the X-axis. Their position indicates that they take part in the social network only through means other than sending or receiving a letter: through commendations, implied links, reported conversations and relationships, or filial links, for instance. They are not in direct correspondence with the main movers in the Protestant network, such as the martyr figures we see plotted above the diagonal line. Another group, sitting just above them, has had correspondence with one, two, three, or perhaps even four different people, but they are implicated in the network mostly through other kinds of social interaction. Examples are Bertram Calthorpe (c), John Bradford's mother (d), and Heinrich Bullinger (e), situated far to the right of the graph, but very close to the X-axis. In each case we know them to be—or the letters paint them as—points of contact with the wider Protestant community in a particular location. Heinrich Bullinger, of course, was an important Protestant leader in the exile community at Zurich, and John Hooper sought to sustain contact with this vital hub within the continental

Protestant community for personal reasons, asking him to write to his wife Anne who had taken their children into exile in Frankfurt.¹⁵ In a different way, Bradford used letters to his mother as a gateway to a broader community of co-religionists in the area around Manchester, where he grew up, including, amongst many others, figures such as John Traves, Thomas Sorrocolt and his wife, Roger Shalcross and his wife, Laurence, and James Bradshaw.¹⁶

Perhaps the clearest illustration of how martyrs used letters to create and maintain links within the Protestant community beyond their prison cell is one of the two letters that Bartlett Green sent to Calthorpe of the Middle Temple. This letter, which was sent not only to Calthorpe but also to Mr. Goring, Mr. Farnham, Mr. Fletewode, Mr. Rosewel, Mr. Bell, Mr. Hussey, Mr. Boyer (probably William Bowyer), and “other my Maisters of the Temple,” on 27 Jan 1556, contains the following instructions and commendations:¹⁷

Master Fletewodd I beseche yow remember wytraunce and Cooke, too singular men amongst Common prisoners. Master Farnham, and Master Bell, with Master Hussey (as I hope) will dispatche Palmer, and Richardson withe his companions. I praye yow Master Calthorpe think on Iohn Groue an honest poore man, Traiford and Rice Apprice his accomplices. My Cosyn Thomas Witton (a scriuener in Lombardstrete) haue promised to further their deliuerie, at the leaste he can instructe yow whiche waye to worke. I doubt not but that Master Boyer wil labor for the good wife Cooper (for she is wourthie to be holpen) and Ber[n]ard the french man. There be also dyuers other well disposed men, whose deliuerance yf ye will not labor for: yett I humbly beseche yow to seeke their relefe as yow shal see cause, namely of Harry A price, Launse Lot, Hobbes, Lother, Homes, Carre, and Beckingham, a younge man of goodlie gyftes in witt, and learninge and (sauinge that he is somewhate wylde) likely to do well hereafter. There be also ij women Conyngham and Alice Alexander that may proue honest. For these and all other poore prisoners here I make this my humble sute and prayer to yow all my masters, and especiall good frendes.¹⁸

Green makes a long list of requests of each of the letters’ recipients, both individually and as a body, to do his work outside the prison. He asks them to seek the “deliuerance” of various co-religionists from prison, and failing that, to ensure their financial support. Therefore, we can see that even though Calthorpe sends no letters, through Green’s use of his contacts outside prison he is implicated in a significant web of requested and implied links, making him an important connecting figure within the social network.

What is interesting about this simple graph, then, is that it points us to a person who sent no letters within the surviving body of correspondence, and whose name is only mentioned in passing within Foxe's "Book of Martyrs" (in the printed version of the letter above).¹⁹ It gives us pause to think about the significance of figures like Calthorpe, who are virtually unknown to Reformation historians. What did they offer? To what extent was the survival of Protestantism in Marian England ensured by them? Calthorpe is just one of a large group of people who are highly connected despite sending or receiving relatively few letters. Using measures that detect the relative connectedness of each member of this dispersed Protestant community, we find that some surprising figures are highlighted as being significant; further analysis shows that they each have a vital infrastructural role within the network.

II. NETWORK INFRASTRUCTURE

A network is a collection of links, which can be combined into a myriad of possible paths. The measurement of these paths is a crucial way of establishing the ranked importance of the people in that network. "Betweenness" is one such measurement: 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. In other words, it shows us how central a particular node is to the network's organization, and how important it is in connecting other people. We took two measurements of betweenness, one of the letter network (just senders and recipients) and one of the entire social network, and ranked all the nodes accordingly. The top twenty nodes measured in terms of social betweenness (that is, the whole network) were:

1) John Bradford, 2) John Careless, 3) John Hooper, 4) John Philpot, 5) Laurence Saunders, 6) Nicholas Ridley, 7) Robert Smith, 8) William Tyms, 9) Bartlett Green, 10) Anne Smith, 11) George Marsh, 12) Calthorpe, 13) Bowyer, 14) Augustine Bernher, 15) Henry Hart, 16) Rowland Taylor, 17) Margery Cooke, 18) Thomas Hawkes, 19) Robert Glover, and 20) Thomas Whittle.

For letter betweenness the findings were similar:

1) Bradford, 2) Careless, 3) J. Hooper, 4) Philpot, 5) Ridley, 6) Green, 7) Hart, 8) James Bradshaw, 9) Marsh, 10) Tyms, 11) Saunders, 12) Taylor, 13) John Jackson, 14) Whittle, 15) Nicholas Sheterden, 16) Richard Gibson, 17) John Tudson, 18) Bernher, 19) Thomas Cranmer, and 20) Stephen Gratwick.

Some of these figures are unsurprising: the figures ranked at 1–9, 11, 16, and 18–20 in terms of their social betweenness, and 1–6, 9–12, 14–17, 19–20, in their letter betweenness, are all martyrs who wrote a number of letters, and feature prominently in Foxe’s martyrology. Several of them, such as Bradford, Careless, J. Hooper, Philpot, and Ridley are classic examples of hubs. The many letters and commendations they sent and received generate a large number of edges, which in turn helps to create short paths between any two nodes in the system. Accordingly, they make the world of this particular epistolary community very small despite a geographical spread from Zurich to Manchester. Sheterden is included in this martyr category, as he was executed for his faith and his death was recorded by Foxe; yet he is believed to have retained his belief in free will until the end. A number of other Freewillers also feature in the list, including the leaders Hart and Jackson, and those who defected from this separatist group, including R. Gibson and Gratwick. The significance of this community will be discussed further below.

But other figures within these top-twenty rankings are altogether more anonymous: they are neither martyrs nor separatists, and their names are mentioned only in passing in Foxe’s “Book of Martyrs,” if at all. These are Cooke, Calthorpe, Bowyer, Anne Smith, Bradshaw, and Bernher. Calthorpe, Bowyer, and A. Smith share similar roles in their relationship to the celebrated martyrs of the Marian reign, funnelling goods, commendations and instructions from prisoners to communities elsewhere in England. Like Calthorpe, Bowyer was one of the recipients of the letter above sent by Green to members of the Middle Temple (“I doubt not but that Master Boyer wil labor for the good wife Cooper”). Anne Smith was the wife of the martyr Robert Smith, and received a number of letters that were accompanied by financial aid provided by her husband’s fellow prisoners, Thomas Hawkes, Simpson (probably John), and his wife, Watts, John Ardeley, John Bradford, Thomas Iveson, John Launder, “father Herault,” William Andrew, and Dirick Carver.²⁰ Cooke, it seems, channelled goods and money in the opposite direction, into the prisons; but her significance is more clearly understood when she is considered alongside a group of similar women discussed below.

The other two figures who might be grouped together are Bernher and Bradshaw. Statistically Bradshaw looks insignificant: he wrote only one letter (to George Marsh) and received only one (from John Bradford). Bernher is a little more impressive: he wrote two letters and received 12, from 4 separate people, giving him the second highest

letter-in strength (that is, the number of letters received) of all the 377 nodes. But there is something more significant about these men that accounts for their betweenness: both were used as couriers by the martyrs and their co-religionists. Bernher is a particularly significant figure. This Swiss reformer, who had settled in England and became Hugh Latimer's secretary and confidante, is mentioned in numerous letters as a trusted courier, especially of letters to and from the London jails. He aided imprisoned leaders such as Bradford, Latimer, Ridley, and Careless, smuggling writing materials in, and letters and other writings out. He recorded accounts of Latimer's and Ridley's disputations and examinations, and channelled other important writings to Protestant presses on the continent. Ridley marvelled at all Bernher did, writing "Brother Austen ye for our comfort renne up and down and who beareth your charges God knoweth."²¹ It is the image of Bernher running up and down, connecting people in different places, that explains exactly why he appears so important by the measure of betweenness. He creates lots of paths that connect important people in the letter network, such as Bradford, Philpot, Careless, J. Hooper, and Tys. His connections with these figures make him very likely to be a node on a shortest path between two randomly selected nodes.

Betweenness, then, is a measure that highlights individuals within the network whose literary activities and social interactions allow connections between dispersed nodes and communities. It shows that infrastructural roles, like carrying letters, were of vital importance to the structure of the network, as well as its maintenance and furtherance. A similar, but crucially distinct, measure of importance is eigenvector centrality, which is closely related to the algorithm used by Google to assign importance to web pages in the World Wide Web, and to rank its search results by relevance. A node that has a high eigenvector score is one that is adjacent to nodes that are themselves high scorers. As Stephen Borgatti puts it, "the idea is that even if a node influences just one other node, who subsequently influences many other nodes (who themselves influence still more others), then the first node in that chain is highly influential."²² So, while betweenness measures the importance of a node in the context of flow across the network—encapsulated by the image of Bernher running up and down the country—eigenvector centrality measures how well connected a node is to hubs and other significant nodes in the network. As with betweenness, several martyrs are ranked in the top twenty nodes for their social eigenvector centrality, and Bernher and Cooke also appear again. But the measure also ranks seven people who did not appear in

the top-twenty for their betweenness rankings: Joyce Hales, William Punt, Joan Wilkinson, Anne Warcup, Robert and Lucy Harrington, and Robert Cole. Many of the same figures also show up in letter eigenvector rankings, with the addition of Catherine Hall, and Lady Elizabeth Fane.

So who are these figures? Punt, like Bernher, is a known letter carrier, who made several trips to the continent delivering J. Hooper's letters to his wife Anne. He was also close to Bradford, and he was almost certainly the "W. P." whom Bradford made co-executor of his books and to whom the martyr bequeathed two shirts.²³ The remaining figures, with the exception of Cooke, Hales, and Hall all appear on John Strype's list of sustainers, a group "who, by money, clothes, and provisions administered unto [the prisoners'] necessities."²⁴ In an article on the role of women in the maintenance of the Protestant community Freeman has also identified Cooke and Hales as sustainers.²⁵ By contrast, Catherine Hall was in receipt of the sustenance and support following her arrest and imprisonment along with her husband John and other members of a Protestant conventicle on New Year's Day 1555 from Bradford, J. Hooper, and Hales.

Such aid was rendered necessary by the private, for-profit status of sixteenth-century prisons. All prison staff, from the governors down to the turnkeys, purchased their position with the hope of recouping their initial investment, not from their salary, but rather from the prisoners in their custody.²⁶ Prisoners would effectively pay rent, which would cover their bedding, food and drink; and additional fees would buy coal and candles, furniture and furnishings, and greater freedoms, such as use of the gardens, admittance of visitors, and even permission to conduct business outside the prison walls (as long as the prisoner stayed in the presence of a keeper and returned to his or her cell at night).²⁷ The money sent by the sustainers to Protestant prisoners, then, functioned to preserve their lives and health, as well as providing opportunities and means to get letters and other writings in and out of prison. The relationships established with the female sustainers in particular also occasioned the writing of several important treatises. Bradford's "The Defence of Election" and "The Restoration of all Things" were written to comfort Joyce Hales, and his treatise on "The Hurt of Hearing Mass" was written to answer Lady Fane's questions on the subject.

Which brings us to another point: five of the top twenty most well-connected nodes in terms of their social eigenvector centrality, and six in terms of their letter eigenvector centrality, are women. This is a striking statistic for a sixteenth-century network of correspondence

between religious prisoners and their co-religionists. One important reason why these women have been largely overlooked is because they do not necessarily look that important by other measures and statistics. Only 49 people in the network have a non-zero letter betweenness rating. This means that the majority of people in the network have no shortest paths going through them. More simply put, those with a zero betweenness rating are not in crucial positions for the passage of letters across the network. Part of this majority are Cooke, Lucy Harrington, Lady Fane, and Warcup, who all rank bottom at 50/377. Yet, the measure of eigenvector centrality tells us that despite low letter betweenness they are still well connected. Why? One reason is that their acts of charity put them in direct contact with the hubs in the network, the martyrs. But this is not the only reason they were well connected.

Taking Margery Cooke as an example, we can see that these women were important nodes not only because they were friends of the martyrs, but also because of their particular social position. Cooke, who lived in Hadleigh, Suffolk, sent only one of the surviving letters in our dataset (to John Philpot), and received seven (six from Careless and one from Bradford), which is not a large amount of correspondence; but the commendations in these letters, as well as commendations to her in other letters, reveal that she not only had active connections with the Protestant community in Hadleigh, but also with co-religionists elsewhere in England. Cooke has shared edges with a total of 26 other nodes in the network, three of which are due to the communications listed above; the remaining 23 come through commendations. Of the people she shares edges with, three are martyrs (Careless, Bradford, and Philpot), two are family (husband, mother), three are carriers (Punt, Richard Proude, and William Porrege), three were co-religionists and/or sustainers who were associated with the underground London congregation (Lady Fane, John Ledley, and Robert Cole), eleven were, at some stage, Freewillers associated with Kentish conventicles, although several converted (Hart, Cole, Ledley, Roger Newman, John Barry, John Gibson, Richard Porrege, Nicholas Sheterden, William Lawrence, Humphrey Middleton, and William Kempe), another three were possibly Freewillers at some time, although doubt has been cast on this identification (William Porrege, Proude, and Thomas Upcher).²⁸ The identity and location of five other contacts—Master Heath, sisters AC and EH, and sisters Chyllerde and Chyttenden—remains unclear. Nevertheless, we can see that Cooke's significance in the network is not determined merely by her communication with the martyrs;

she was well connected in her own right. Commendations and news show that she was believed to be in contact with a wide variety of different groups—infrastructural figures like Punt and W. Porrege, heretical leaders like Hart, known sustainers like Fane, and leaders in the London congregation like Cole—who were spread across the south-east of England.

What the measure of betweenness and eigenvector centrality both bring to the fore, then, are infrastructural figures; individuals whose role may have been given minimal coverage in Foxe’s “Book of Martyrs,” or edited out all together.²⁹ This clear patterning suggests the power of algorithms to predict the roles of different nodes within the networks—an idea we decided to test. By observing attributes of martyrs, carriers, and sustainers we were able to devise a set of quantitative criteria that separated the 377 nodes into seven categories according to their network properties, thereby predicting their roles within the network as a whole. These criteria consist of thresholds for five network measures: social betweenness, social eigenvector centrality, letter degree (the number of different senders and recipients connected to a node), letter strength (the total number of letters received and sent by a node), and non-letter social degree (the number of social links created by means other than letters). By using these thresholds to label values for each of these measures as high or low we arrive at the classification outlined in detail below. When tested, we found these predictions were largely accurate.

Three levels of leaders emerged from this analysis: prolific leaders, less prolific leaders, and a category that accounts for leaders who write common letters to a large number of named individuals (such as Green, whose letter to Calthorpe, Bowyer, and others was discussed above). The most interesting and illuminating distinctions arise between the first two categories. Prolific leaders were figures who ranked highly in all of the five measures: Bradford, Careless, J. Hooper, Philpot, Saunders, Ridley, and Tyms. These are figures that feature prominently in Foxe’s “Book of Martyrs.” By contrast, less prolific leaders ranked low for letter degree and social betweenness but highly for the other three measures. These were Hart, Latimer, Ferrar, Taylor, and Cranmer. What is interesting about these two groups is that we find a general division between the younger prisoners and the older Protestant leaders. The older members, by and large, sent letters to a small group of people, most of whom were other Protestant leaders, or, occasionally, family members. The most extreme example is Ferrar, who wrote one letter each to Cranmer, Latimer, and Ridley; received

letters from J. Hooper and Laurence Saunders; and had social links (through commendations, and other reported or implied links) with Tyms, Saunders, and Bradford. These are all what we might describe as short-range links, staying within an established, close-knit community of people from similar social backgrounds, and mostly covering only short geographical distances. Latimer and Cranmer's limited personal network was possibly exacerbated by their strict imprisonment in Oxford, which made it more difficult for them to correspond, although, notably, Ridley was also imprisoned in Oxford but still functioned as a hub in the network. Hart's place in this category may be due to biases in the letter collection for, as a dissenter, his letters were probably not as desirable as the martyrs' works, but it may also signal isolation from the main, orthodox network of Protestants that will be probed further below.

By contrast, the younger martyrs like Bradford, Careless, and Philpot seem to have understood the need to maintain links with dispersed and diverse communities—making long-range links, in other words—in order for the network to survive. We might conjecture that this can be put down to the fact that, because they were younger and had attained less prominent offices within the church, they were more in contact with the faith on the ground; or they may just have had more of a natural instinct for networking in much the same way that the younger generations today make the most use of social networking sites. Certainly, as mentioned above, during his time as one of the chaplains in ordinary to Edward VI, Bradford had travelled through the country preaching reformation in Lancashire, Cheshire, and possibly beyond. In a different way, Careless may have had found it easier to connect with a diverse range of people because of his former life as a weaver in Coventry.

The remaining nodes separate into three categories of network sustainers, and a final large category of peripheral figures who do not rank highly in any of the five measures. The quantitative criteria used to identify the various levels of network sustainers generated a series of predictions that corresponds with Strype's list of sustainers, but is broader in its definition, taking in the full range of infrastructural figures that our other methods have already identified. For example, major sustainers distinguish themselves through high social eigenvector centrality, high letter strength, and relatively high non-letter social degree, but have low values for the other two measures. People that fulfil these criteria are: Warcup, Bullinger, Wilkinson, Hales, Cooke, and Lucy and Robert Harrington. As we have seen, Warcup, Wilkinson, and

the Harringtons all feature on Strype's list, and Hales and Cooke have been identified by Freeman as two of the army of female sustainers that wrote and sent goods to the Protestant martyrs. Bullinger, by contrast, is a different kind of sustainer: through the correspondence sent between him and J. Hooper, he links the imprisoned Protestant leader to co-religionists in exile in Zurich and beyond. More importantly, perhaps, Bullinger promises to write to Hooper's wife, Anne, in exile in Frankfurt, providing emotional support for the family Hooper would leave behind when he was executed.³⁰

Occupying another sustainer category by himself is Bernher, who stands apart from the other sustainers due to his high letter degree. This means that as well as connecting other people through his frequent role as carrier, his correspondence also makes him a minor hub. A third category, of minor sustainers, exhibits high social eigenvector centrality, and low values for all other measures. Individuals who fall into this category are John Bradford's mother, Ledley, Cole, W. Porrege, and Punt. Most of these nodes can also be confirmed as infrastructural figures in the network. Ledley, Cole, and Punt were all active members of the underground London congregation during Mary's reign, which played a key role in the support of prisoners due to its proximity; W. Porrege is mentioned as a carrier in several letters, and Foxe also describes him smuggling heretical literature into Kent. This leaves Bradford's mother. Although she does not have the same characteristics as the other nodes identified by the thresholds for this category, her appearance here is easily explained by the fact that, as already discussed, she acted as a gateway to a broader community of co-religionists in the area around Manchester.

By using quantitative criteria to establish categories we can see that those sharing similar profiles tended to occupy the same roles within the network. There are some slight anomalies (Hart, Bullinger, and Bradford's mother, for example), but the broad effectiveness of the method demonstrates its value for sorting larger social networks than the one we have here, or to predict roles for those individuals where scant material survives. Moreover, the categorization of nodes also allows us to identify general rules for the overall structure and function of the network. For example, by looking at how the different categories of nodes interact, we see that the most prolific leaders frequently and repeatedly wrote to network sustainers. If we look at Bradford, who sent the most letters of all the martyrs, we can see that out of 64 different people to whom he wrote, those he wrote to most often were: Hales (seven letters), Warcup (six), Lady Fane (five), Cole (four),

and Wilkinson (four). All of these recipients are network sustainers. Similarly for Careless, the only two people to whom he wrote more than three letters are Cooke (six) and Bernher (four); for Philpot the only one is Lady Fane (five); and for Ridley it is Bradford (eleven) and Bernher (five). All except Bradford are network sustainers. Therefore we see that the quickest paths across the network were also the ones most frequently traversed by letters and, by implication, carriers. Perhaps more importantly, though, the method for categorization can also alert us to patterns we might not have expected. In this case we see that several individuals who defected from the Freewillers are identified as network sustainers. Why might this be?

III. THE NETWORK UNDER ATTACK

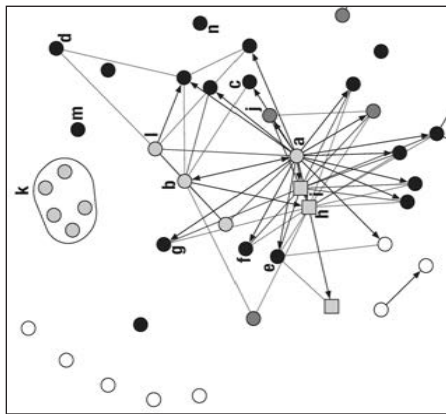
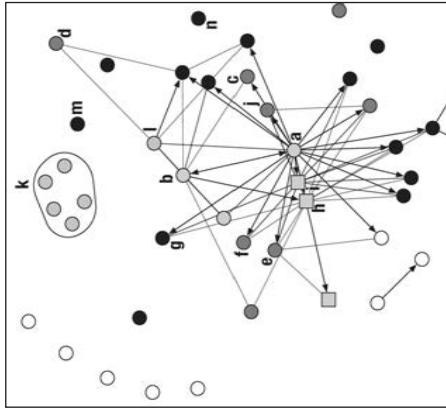
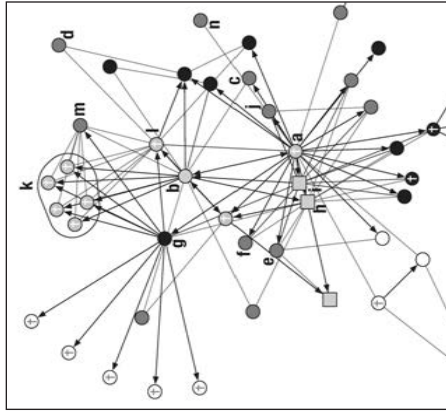
The Freewillers are a group who have appeared in a number of circumstances in this article. Henry Hart has been highlighted as a leader whose position in Figure 3, which compares the number of letter correspondents of an individual with the number of their non-letter social connections, shows him to be isolated from the orthodox majority within the network, with almost all his interactions occurring through letters rather than commendations. We have seen that, like his fellow Freewiller Jackson and two other adherents who later defected—R. Gibson and Gratwick—Hart had high betweenness. And we have discovered that R. Gibson and Gratwick were not the only significant nodes to defect: Cole and Ledey, two figures within the London congregation and key sustainers, were former Freewillers. W. Porrege, as well, may have associated with these dissenters at some time. The question is: what do these little snatches of information tell us about the Freewillers as a dissenting community?

The difficulty of considering the interactions with Freewillers is that, despite being Protestants, they were also opponents. The Marian Protestant community was defined against the English Catholic state; similarly, the Freewillers defined themselves against the orthodox Protestant community. At the same time, however, it would not be right to exclude Freewillers from this study as being simple opponents of the underground Protestant community. Perhaps most importantly, from outside, orthodox Protestants and Freewillers were perceived as one single dissident group. The doctrinal conflict merely confirmed the authorities' charge that Protestants were an inherently "factious and divisive" people.³¹ It should also be considered that boundaries between the Freewillers and those that held to predestinarian beliefs

were not stable: Freewillers sought to convert Protestants to their cause, whilst the leaders of the orthodox Protestant community launched a counter-attack, which was successful in causing a number of the dissenters to defect to predestinarian beliefs. By considering the Freewillers as hostile elements within the network, we can model how the Protestant community responded to and overcame internal attack. For, as noted above, this separatist group lasted for only ten years: by the time Elizabeth I ascended throne, the Freewillers had all but died out.

Why this group died out has been a question that has troubled scholars.³² One reason for this is that, as Freeman has pointed out, their organization should have been strong, based as it was on congregations and conventicles established in Edward VI's reign, and perhaps even earlier. In fact, he argues that "because the 'orthodox' Protestant church was weakened and outlawed in Mary's reign, the Freewillers were closer to parity with the Protestant leadership than any subsequent dissenters."³³ Nevertheless, Freeman's work and various other studies have shown how, in many ways, the demise of this group was overdetermined. The leaders lacked theological training and the credibility that it provided; they were from comparatively poor social and financial backgrounds; the movement lacked prominent martyrs; it lost a number of key figures who defected to predestinarian positions; and they failed to foster the close pastoral relationships that played such a crucial role in the maintenance of the Protestant community during persecution.³⁴ Such a summary suggests there was no one simple reason for their demise, but rather a whole collision of factors. However, their demise can be described much more simply by taking a network perspective.

One important thing to point out again here, however, is the bias of the letter collection we have available to us. The collection, which is largely focused around correspondence involving the martyrs, means that we have no surviving letters that were sent between Freewillers, so we do not know the extent to which this was a textual community, and to what extent its communities were locally constituted and maintained. What we do have, however, is a significant number of letters which document interactions between the orthodox and Freewiller communities, especially regarding the disputes between representatives from these two communities held in the King's Bench prison. In other words, we cannot uncover the internal workings of the Freewiller community, but we can chart their external interactions. The way we can trace this is by creating a partial network visualization of the



Figures 4–6. The network of freewillers (black), key orthodox Protestants (light grey with circles), network sustainers (grey with squares), and those who have defected from the Freewillers (dark grey) on 1 March 1555 (Figure 4), 14 March 1555 (Figure 5), and 20 June 1556 (Figure 6). Individuals who have died are shown marked with a cross.

Freewillers and their neighbors only (that is, any people who have a direct social or letter link with members of this community). Figures 4, 5, and 6 show the Freewillers and their neighbors at three dates (1 March 1555, 14 March 1555, and 20 June 1556), and thus chart the network evolution over time. Freewillers are shown in black, key orthodox Protestants are shown as light grey with circles, network sustainers are in light grey with squares, and those defecting from the Freewillers in dark grey (this category also includes those people who are suspected of having been Freewillers at some point). Each node is marked with a cross when they die; links through letters are in black and all other social links are in grey. What we see is that at this point of interface between the Freewillers and the orthodox community, the orthodox community consistently takes ground (including converting nodes), while the Freewiller base is challenged.

By focusing on all the interactions between Freewillers and their direct neighbors we can immediately observe the extent of the communication between two orthodox Protestant leaders, Bradford and Careless (marked as “a” and “b” in Figures 4, 5 and 6), and the Freewillers. Although Bradford and Careless were in communication with other leaders, such as Philpot and Ridley about the doctrinal threat posed by Hart and his companions, they were the ones who spent the most time fighting schism through their letters and other writings. For this reason, even in this sub-network, Bradford and Careless are the hubs. The volume of links they make, and the number of people who convert to orthodox belief following communication with these martyrs, suggests a causal link. For example, by looking at Figures 4 and 5 we can see that Bradford’s links with Roberts Skelthorpe (c), Cornelius Stevenson (d), Cole (e), and Ledley (f) predate their conversion. The selected frames from the evolving network also show March 1555 to have been a key moment in the battle between Freewillers and predestinarians, as four figures defected in the first two weeks of the month. By comparison, identified “leaders” of the Freewiller community look comparatively peripheral. This is particularly striking given the fact that the whole network focuses on Freewillers and their direct neighbours only. Moreover, the contacts that Hart (g) makes are not followed by conversion.

The orthodox side in this struggle may have had the most influential hubs, but that is only one reason for its dominance. It also appears to have had a more robust infrastructure. Several figures that have already been identified as network sustainers appear within this sub-network: Cooke (h), Hales (i), Cole (e), Ledley (f), and W. Porrege (j).

Although Cole and Ledley started out on the side of the Freewillers (as W. Porrege may have done too), it is crucial that they end up on the side of the predestinarians. As seen above, they defected at some point in March 1555, but it is only after this conversion that they gained the attributes of network sustainers. Living together with their wives and Punt in Grace Street, London, after fleeing persecution in Kent, these men are reported to have served the Protestant prisoners held in London jails, as well as relaying information and books to and from the Protestant exile community.³⁵ These were not the only significant losses. In early 1556 Gratwick (m) and R. Gibson (n) also defected from the Freewillers. As we saw earlier, both these men figured in the top twenty nodes for their letter betweenness.

Not only did the Freewillers lose key infrastructural nodes to their opponents, they also failed to make any converts from this constituency. This was not for lack of effort. We can see a number of nodes in Figure 6 that the Freewillers sought and failed to convert. Freewillers inside and outside prison tried to win souls for the cause. Prisoners condemned to death—who were usually held in Newgate until their executions—were a particular target. Hart sent a statement of his beliefs to Tyms, Christopher Lister, Robert Drake, George Ambrose, Richard Spurge, Thomas Spurge, Gratwick, Richard Nicholl, John Spenser, John Harman, and Simon Jen, which they then returned to him on 3 April 1556 with a signed refutation his belief bearing all of their names.³⁶ We can see the battle that was fought over some of these men: Cavell, Drake, Ambrose, and the Spurges (k) each share edges with nodes from both sides of the controversy in Figure 6. Yet while they share an edge with only one Freewiller, Hart (g), they share edges with three predestinarians: Careless (b); Tyms (l), who signed the letter rejecting Hart's doctrines; and Gratwick (m), who had defected from the Freewilles earlier that year. Careless's edge, in particular, represents a letter, showing that this leader did not leave his vulnerable co-religionists undefended.

Another example of this protection of key co-religionists can be traced in the communications of Bradford and Careless with Cooke and Hales. We know that both women were troubled by the doctrine of free will, which they came in contact with either through Hart's writings, or through some interaction with local conventiclers, or perhaps both. If the Freewillers had been successful in convincing these women of the veracity of their beliefs, they would have won more than converts. Whilst the battle over Tyms's and the Spurges' souls might have gained the Freewillers martyrs for their cause, the conversion of Hales or

Cooke would have been a much more tactical victory. Bradford's and Careless's dedication to pastoral care, and their particular regard for these women can be seen by the great effort these two leaders went to in order to make sure they were correctly informed on the topic of election. As already mentioned above, Bradford wrote letters to both Cooke and Hales on this topic, and he dedicated a treatise entitled "The Defence of Election" to Hales. Bradford also wrote to Hart, John Barry, Ledley, Cole, Richard Proude, Sheterden, W. Porrege, Roger Newman, William Lawrence, John Gibson, Richard Porrege, Humphrey Middleton, William Kempe, and others abiding in Kent, Essex, Sussex, and thereabout, just before his execution, warning them:

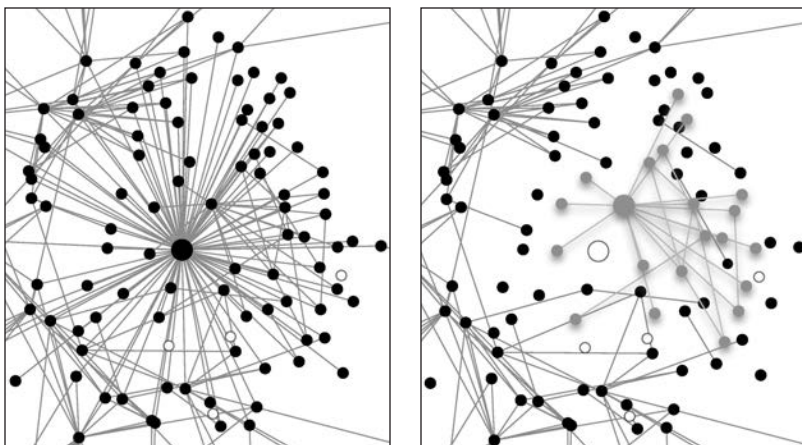
it hathe pleased god by my mynistrie to open vnto [Joyce Hales] his trothe wherein as she is settled and I trust in God confirmed so if you cannot thynke with her therein as she duth I heartelie praeie you [...] that you molest her not nor disquiet her[...]. I commend also vnto you my good sister Margerie Coke, making for her the like sute vnto you.³⁷

The letter suggests that some of the men may have previously attempted to convert Cooke and Hales to the doctrine of free will. But the letter is slightly problematic, for, at the same time as warning these men not to tempt these women into error, it places Hales in a vulnerable position. Near the beginning of the letter Bradford tells the recipients about the treatise he has written for Hales and commends it to them as profitable reading material. The fact the later commends the woman "with whom I leave this letter," Hales, suggests that this missive had been sent as an insert to another letter sent to Hales, or perhaps with the treatise itself.³⁸ Therefore, Bradford has made it necessary for Hales to make contact with at least one of the recipients of the letter in order to pass it on. In this way, he is making use of the very quality that made Hales such an attractive convert—her identity as a major network sustainer. Bradford wants to warn these men not to continue in their attempts to convert her, but at the same time she is the most straightforward means of connecting with them; or, to consider this from a network perspective, she offers the shortest path.

Bradford and Careless sent letters such as this because they cared about Hales and Cooke and their salvation. This is understandable: these women had supported them and written to them often during their imprisonments. But, as the use of Hales in the letter above shows, these two leaders clearly also recognised the infrastructural role Hales and Cooke served within the community, and the great damage that would be done to their cause if they lost them. It appears

that Bradford and Careless understood by instinct a key feature of networks that scientists have only more recently grasped: that the robustness of a network relies on figures who encourage high levels of interconnectivity. This goes for all networks: “a cell’s robustness is hidden in its intricate regulatory and metabolic network; society’s resilience is rooted in the interwoven social web; the economy’s stability is maintained by a delicate network of financial and regulatory organizations; an ecosystem’s survivability is encoded in a carefully crafted web of species interactions.”³⁹ Despite these structures, however, all networks are vulnerable to failure, whether through attack, or errors of design. Node failures can easily break a network up into isolated, non-communicating fragments. In an online system this might be caused by hackers; in a social or ecological network it could be caused by illness or death. What studies have shown is that one of the most effective ways to fragment a network into separate communities is to remove nodes or edges with the highest betweenness, a key measure of interconnectivity in the network.⁴⁰

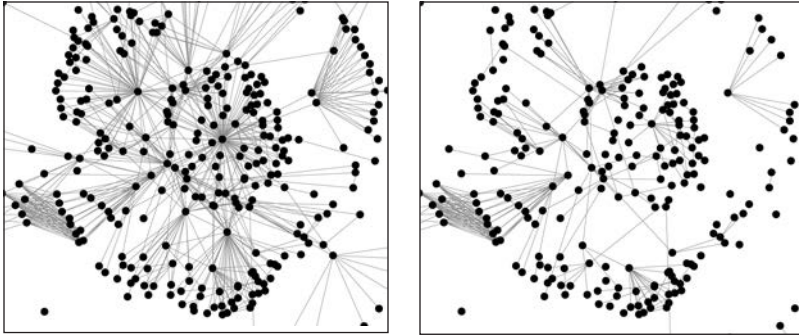
The underground Protestant community in the reign of Mary I, of course, was placed under systematic attack by the authorities. It was not strictly their intention to remove key nodes; in fact Bradford and Careless were kept alive for protracted periods, in the case of the former because the Earl of Derby was trying to secure a pardon for him, and in the case of the latter probably because the authorities wished to see the Freewiller/predestinarian disputes continue. Nevertheless, many figures with high betweenness ratings were removed through the program of burnings. From the top twenty: Bradford on 1 July 1555; J. Hooper on 9 February 1555; Philpot on 18 December 1555; Saunders on 8 February 1555; Ridley on 16 October 1555; Robert Smith on 8 August 1555; Tyms on 24 April 1556; Green on 27 January 1556; George Marsh on 24 April 1555; Taylor on 9 February 1555; Thomas Hawkes on 10 June 1555; Robert Glover on 19 September 1555; and Thomas Whittle on 14 January 1556. From this we can see that twelve of the top twenty were removed from the network within one calendar year, from February 1555 to January 1556 (the exception being Tyms). In addition, Careless died in prison on 1 July 1556. During our research, we made a video visualizing the changing shape of the network across the period covered by the letters, which shows the impact of the burnings. Unsurprisingly, the network looks radically different at the beginning of 1555 and the end of that year; and within that period the most dramatic change, unsurprisingly, follows Bradford’s execution. Figures 7 and 8 show the immediate



Figures 7 and 8. The immediate environment of John Bradford in the network immediately before (Figure 7) and after (Figure 8) his death on 1 July 1555. John Bradford is highlighted as the larger black (Figure 7) and white (Figure 8) node. The network only shows the connections of living individuals. John Bradford's death separated an entire subnetwork (shown in grey), centred around John Bradford's mother (larger grey node), from the rest of the network.

environment of Bradford in the network; he is the large black node in Figure 7 (before his death), and the large white node in Figure 8 (after his execution). The network includes only the connections of living individuals, which allows us to see that the community around Manchester to which Bradford had linked through his mother (the large grey node in Figure 8), despite internal links, becomes detached from the larger network following Bradford's execution. Of course, the incomplete nature of the data we have means that members of this community may have maintained contact with larger Protestant movement in England. But this is a perfect illustration of how what was once a large and geographically dispersed network can break into smaller communities that lack long-range links.

The connectivity decreases as more nodes are removed. If we look at the very final image of the network (Figure 10), on 28 July 1556, and compare it to the network of all connections, including those of the deceased (Figure 9), we can see the terrible toll the persecution had taken on the underground community in England. The lack of communications after this date is probably due to collection patterns: it was the martyrs' letters that were of primary interest to figures like Foxe and Bull. But it also suggests that it must have become



Figures 9 and 10. The core of the network, showing all links (Figure 9) and only those links of individuals alive at the end of the period of study, on 28 July 1558 (Figure 10).

increasingly difficult for dispersed Protestants to ascertain the health of the Protestant movement elsewhere in England. One might deduce that congregations went into survival mode, turning their attentions to the needs of local co-religionists rather than seeking to comfort and guide co-religionists elsewhere. In any case, as the reign progressed more people sought the safety of exile, including Cooke, who went to Aarau with her husband Richard; Hales, who left for Calais, notably without her husband; Robert and Lucy Harrington who found refuge in Frankfurt, and provided a home for Laurence Saunders's widow; Warcup and Wilkinson, who also fled to Frankfurt with the former's family (but without Wilkinson's husband); and Proude, who settled in Aarau.⁴¹ Some couriers also undertook their duties from a base on the continent: W. Porrege apparently had his headquarters in Calais; and Cole may have temporarily resided abroad as his is included in John Bale's first list of exiles, although Foxe records him as being back in England by Palm Sunday, 1556.⁴²

Yet, despite this systematic attack, the disappearance of fourteen of the top twenty nodes for betweenness, and the reduced interconnectivity, the network does not fragment. This is because the network retains its infrastructural backbone: we are left with a network in which Bernher, Cooke, and Punt have the highest social betweenness, meaning that they are some of the most important figures holding the network together. These figures appear to have taken on increasingly important roles in the wake of the executions. Bernher stepped in as pastor of the underground London congregation following John Rough's arrest in December 1557 until Thomas Bentham returned

from exile. Similarly, Punt, after briefly going into exile following Bradford's death, returned to London and was named as one of the "principal teachers of heretical doctrine in London" in Steven Morris's confession. According to Morris, he was one of those who did "most harm in persuading the people," being described as "a great writer of diuelishe and erronious bokes of certain mens doinges," which he would then convey to the continent to be printed and distributed.⁴³

There is less documentary evidence regarding Cooke. As Wabuda and Freeman have shown, the significance of women's roles in the Protestant community has been obscured by the way in which Foxe and Bull edited the letters involving female sustainers. In two letters written by Careless to Cooke, Bull changed all the pronouns referring to Cooke in order to suggest that she was a male co-religionist. It is clear why he went to this trouble when one considers this passage from a letter in which Careless thanks Cooke for the way in which she had comforted him in other letters (now lost), and provided him with spiritual guidance and prayer: "Blessed by the tyme that ever I knew you, for God (I parceave) hath ma[de you] an instrument in the stede of good Master Bradforde, to supple my soule [with] the oyle of Godes mercye."⁴⁴ In the past, as he reveals later in the letter, Bradford had sent him letters counseling and guiding him; but this excerpt makes it clear that Careless regards Cooke as having stepped into this role in the wake of Bradford's death. The writings printed by Foxe and Bull encourage us to think of the female sustainers as, at most, providers of money and comfort, and merely recipients of wisdom and teaching. Although Bradford and Careless instructed Cooke on the subject of election, this letter shows how Cooke had grown in faith, providing not only comfort but also prayers and guidance where she saw the need. It is not hard to imagine that she served others in similar ways, although her importance to the English Protestants is likely to have become increasingly tenuous following her exile.

What we see from the examples of Bernher and Punt especially is that network sustainers were vital to the maintenance of the Protestant network in the Marian period, preventing it from fragmenting. But their significance went beyond supporting the recognized hubs—the martyrs—in the network. In the wake of the burnings they themselves became central figures in the organization and leadership of the Protestant church in England. But it is not only their actions that prove their value; from a network perspective we know that these men were successful in holding the network together both because they were credible and well-connected figures within their local communities,

and because they had long range links which connected them with leaders elsewhere in England and on the continent. This may be a key factor as to why the Protestant Church survived the persecution of Mary's reign but the Freewillers did not. By losing sustainers, and failing to convert key infrastructural nodes in order to replace them, their movement was easy to fragment.

IV. EXTENDING THE NETWORK

These observations, taken together, aim to show not only what we can discover about the Protestant network in England at the time of Mary I's reign, but also, more generally, how the discipline of network analysis can transform the way we interact with archives. Analysis of hubs, eigenvector centrality, betweenness, and robustness show us how network analysis can provide both a picture of general structures and specific relationships. We saw that the quickest paths across the network—between the prolific leaders and the network sustainers—were also the ones most frequently traversed by letters; that Freewillers both failed to convert or retain the kinds of infrastructural nodes that made the “orthodox” Protestant church so robust. In so doing, these methods have found trends that only an expert in the field would have a sense of by reading all the letters, but would still find almost impossible to measure or quantify.

With even larger sets of data, such techniques become of paramount importance. In the age of so-called big data, with online resources rapidly transforming the material culture of literature and history into digital forms that are searchable, the methods of network science allow scholars to understand the underlying patterns within large bodies of literature. But this quantitative approach is not meant to replace traditional methods of textual analysis as many have feared. As has already been shown in other disciplines, the bird's-eye view of quantitative network analysis can work in tandem with the equally necessary and more established scholarly approaches that operate closer to the ground—or in this case, closer to the text—thus providing both a more comprehensive overview of a field of research as well as specific suggestions for further avenues of research. It offers a systematic way of highlighting significant nodes and, by implication, specific texts that may merit closer examination.

Thomas More's statement, with which this article began, is both a prefiguration of the network analyst's approach to history, and its antithesis. His metaphor for the dissemination of heretical doctrine as

a canker, corrupting a body “ferther and ferther,” shows a surprising level of intuition on two levels: not only did his fear about the ability of reformed theology to take hold in England prove accurate, he also noticed a parallel between the spread of epidemics and the dissemination of ideas, which has only recently been understood by network scientists. The image, however, also provides a classic example of scare-mongering: its exhibits the kind of rhetoric that remains popular in the pulp press even today, designed as it is to create fear and to mobilise people to support a particular position. Network analysis is poised in opposition to both intellectual intuition and scare-mongering: it can never replace them, but it does provide a way of showing why fears and hunches might be right after all.

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NOTES

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¹ Thomas More, *A letter of syr Tho. More knyght impugnyng the erronyouse wrytyng of Iohn Fryth agaynst the blessed sacrament of the aultare* (London: William Rastell, 1533), sig. A3^v.

² See Duncan Watts and Steven Strogatz, “Collective Dynamics of ‘Small-world’ Networks,” *Nature* 393 (1998): 440–42; Albert-László Barabási and Reka Albert “Emergence of Scaling in Random Networks,” *Science* 286 (1999): 509–12; Albert and Barabási, “Statistical Mechanics of Complex Networks,” *Rev Mod Phys* 74 (2002): 47–97; and Mark E. J. Newman, *Networks: An Introduction* (Oxford: Oxford Univ. Press, 2010). For a general overview, see Barabási, *Linked: The New Science of Networks* (Cambridge, MA: Perseus, 2002).

³ Gary Schneider, *The Culture of Epistolarity: Vernacular Letters and Letter Writing in Early Modern England, 1500–1700* (Newark: Univ. of Delaware Press, 2005), 27.

⁴ Schneider, 27. See also Paul D. McLean, *The Art of the Network: Strategic Interaction and Patronage in Renaissance Florence* (Durham: Duke Univ. Press, 2007).

⁵ Alan Stewart and Heather Wolfe, *Letterwriting in Renaissance England* (Washington, DC: Folger Shakespeare Library, 2004), 121.

⁶ See Franco Moretti, *Distant Reading* (London: Verso, 2013) and Matthew L. Jockers, *Macroanalysis: Digital Methods and Literary History* (Urbana: Univ. of Illinois Press, 2013).

⁷ Jockers, *Macroanalysis*, 23; Martin Mueller, <http://scalablereading.northwestern.edu/>.

⁸ Thomas S. Freeman, “‘The Good Ministrye of Godlye and Vertuose Women’: The Elizabethan Martyrologists and the Female Supporters of the Marian Martyrs,” *The Journal of British Studies* 39 (2000): 8.

⁹ The letters used in this study are found in John Foxe, ed., *The Unabridged Acts and Monuments Online* (HRI Online Publications, Sheffield, 2011), <http://www.johnfoxe.org> (hereafter TAMO); [Henry Bull], ed., *Certain most godly, fruitful, and comfortable letters of such true saintes and holy martyrs of God*, (London: John Day, 1564),

451–54 (hereafter *LM*); Nicholas Ridley, *A pituous lamentation of the miserable estate of the churche of Christ in Englande* (London: William Powell, 1566); *Original Letters Relative to the English Reformation: Written During the Reigns of King Henry VIII, King Edward VI, and Queen Mary: Chiefly from the Archives of Zurich*, 2 vol., ed. Hastings Robinson (Cambridge: Cambridge Univ. Press, 1846–47); British Library (hereafter *BL*) Additional MS 19400, Harley MSS 416 and 425, and Lansdowne MS 389; and Emmanuel College Library, University of Cambridge (hereafter *ECL*), MSS 260–262. Those that appear in the manuscripts only remained unprinted for various reasons: some were simply not interesting enough; others were written by figures who do not feature prominently in Foxe’s martyrology; and some were too controversial for publication, touching on doctrinal schism and debate within the Protestant community.

¹⁰ On the editorial practices of Foxe and Bull, see Susan Wabuda, “Henry Bull, Miles Coverdale, and the Making of John Foxe’s *Book of Martyrs*,” in *Martyrs and Martyrologies: Papers read at the 1992 Summer Meeting and the 1993 Winter Meeting of the Ecclesiastical History Society*, ed. Diana Wood, *Studies in Church History* 30 (Oxford: Blackwell, 1993), 245–58.

¹¹ We have therefore excluded a further 85 letters written to or from English Protestant exiles where both parties reside on the continent.

¹² Wayne W. Zachary, “An Information Flow Model for Conflict and Fission in Small Groups,” *Journal of Anthropological Research* 33 (1977): 452–73.

¹³ T. Kamada and S. Kawai, “An algorithm for drawing general undirected graphs,” *Information Processing Letters* 31 (1989): 7–15.

¹⁴ See Barabási, *Linked*, 56.

¹⁵ See John Hooper’s letters to Heinrich Bullinger in Robinson, 1:100–105 and Bullinger to Hooper, 10 October 1554, *ECL* MS 260, fol. 28^r. Whenever a particular letter was printed in more than one of John Foxe’s and Henry Bull’s publications, reference will be made only to the earliest work in which it appears. However, if a holograph or early manuscript version of this work survives, reference will be made to that manuscript alone.

¹⁶ See for example, *LM*, 451–54, and *ECL* MS 260, fol. 124^r.

¹⁷ Although the biographical entry on Robert Bowyer by R.J. W Swales in S. T. Bindoff, ed., *The History of Parliament: The House of Commons, 1509–1558*, 3 vol. (London: Secker & Warburg for the History of Parliament Trust, 1982), 475 identifies him as the ally of the incarcerated evangelicals, conversations with Scott Lucas lead us to suggest William Bowyer as a more likely candidate. Robert Bowyer seems too focused on Chichester to be involved with the evangelicals in London. And, as MP for Chichester in the 1555 parliament, it seems difficult to believe he would have put his career at risk by serving Bradford, Green, and others at this time.

¹⁸ *ECL* MS 260, fol. 64^r.

¹⁹ Foxe, 1534–35.

²⁰ Foxe, 1335–36.

²¹ *ECL* MS 260, fol. 270^r.

²² Stephen P. Borgatti, “Centrality and Network Flow,” *Social Networks* 27 (2005): 61.

²³ Thomas S. Freeman, “Punt, William (fl. 1548–1563),” *Oxford Dictionary of National Biography* (New York: Oxford Univ. Press, 2004).

²⁴ John Strype, *Ecclesiastical Memorials: Relating Chiefly to Religion, and Its Reformation Under the Reigns of King Henry VIII, King Edward VI, and Queen Mary the First*, 3 vol. (Oxford: Clarendon Press, 1822), 3: 223–24.

²⁵ See Freeman, “The Good Ministrye of Godlye and Vertuose Women,” 13,

15–17, 24.

²⁶ Freeman, “Introduction: The Rise of Prison Literature,” *Huntington Library Quarterly* 72 (2009): 141.

²⁷ On prison conditions, see Ruth Ahnert, *The Rise of Prison Literature in the Sixteenth Century* (Cambridge: Cambridge Univ. Press, 2013), 11–22.

²⁸ On William Porrege and Richard Proude, see Michael T. Pearse, *Between Known Men and Visible Saints: A Study in Sixteenth-Century English Dissent* (Madison: Fairleigh Dickinson Univ. Press, 1994), 48.

²⁹ On the editing of the letters, see Wabuda, 245–58.

³⁰ ECL MS 260, fol 28^r–29^v. See Anne Hooper’s letters to Bullinger, in Robinson, 301–4.

³¹ Freeman, “Dissenters from a Dissenting Church: The Challenge of the Freewillers 1550–1558,” in *The Beginnings of English Protestantism*, ed. Peter Marshall and Alec Ryrie (Cambridge: Cambridge Univ. Press, 2002), 134.

³² See Patrick Collinson, “The Persecution in Kent,” in *The Church Of Mary Tudor*, ed. Eamon Duffy and D. M. Loades (Aldershot: Ashgate, 2006), 332 and Joseph W. Martin, *Religious Radicals in Tudor England* (London: Hambledon, 1989), neither of whom arrive at any clear conclusions.

³³ Freeman, “Dissenters from a Dissenting Church,” 155.

³⁴ See Freeman, “Dissenters from a Dissenting Church,” 129–56; Martin, 61–63; and Andrew D. Penny, *Freewill or Predestination: The Battle over Saving Grace in Mid-Tudor England* (Woodbridge: Boydell and Brewer, 1990), 103–24.

³⁵ Foxe, 1781. See also Penny, 110–12 and Christina Hallowell Garrett, *The Marian Exiles: A Study in the Origins of Elizabethan Puritanism* (Cambridge: Cambridge Univ. Press, 1938), 121–22, 217.

³⁶ ECL MS 260, fol. 87^{r-v}.

³⁷ BL MS Additional 19400, fol. 33^v–34^r.

³⁸ BL MS Additional 19400, fol. 34^r.

³⁹ Barabási, *Linked*, 111.

⁴⁰ See M. Girvan and M. E. J. Newman, “Community Structure in Social and Biological Networks,” *PNAS* 99 (2002): 7821–26.

⁴¹ Lucy died shortly afterwards. By 18 June 1556 Robert Harrington had married Saunders’s widow. See Garrett, 127, 177–78, 262.

⁴² See Garrett, 258, 122 and Foxe, 1686.

⁴³ Foxe, 1686.

⁴⁴ ECL MS 260, fol. 236^r. Compare *LM*, 631–32.