THE SPACE BETWEEN:
THE GEOGRAPHY OF SOCIAL NETWORKS IN THE TIBER VALLEY

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In a *Far Side* cartoon by Gary Larson, a man with a crumpled map wants to get from point B to point A. The farmer responds, 'Beats me, sonny. Most people want to go the other way'. The joke underscores the fact that most people have a mental diagram of how places interconnect. That mental diagram is laid out as a list and it depends on the sequence of way-points along the way, a series of connections from place to place. It is more like the London Tube map than the OS or IGM maps.

In the Roman world, space was understood as an itinerary, as a sequence of what comes next[1]. In the Tiber Valley Project[2], we use a GIS to understand the spatial relationships between sites and places, with a very Euclidian understanding of space as a plane viewed from on high. How we represent space, and how the Romans understood space, are completely at odds with one another, and so we miss important elements of the experience of living in the Tiber Valley. When viewed from on high, it is too easy to put too much emphasis on 'South-Etruria', 'Sabina', 'left bank', 'right bank' and the 'Tiber as a Barrier', as mental categories, almost in isolation from one another. Recent work by Horden and Purcell puts the emphasis on understanding the ancient Mediterranean as a series of interconnected micro-regions[3]. They argue that we must understand the connections to understand ancient life. Yet, we use the GIS simply to represent locations, rather than to understand what might be called a 'geography of relations'. We neglect that places were understood in the past to have particular relationships with other places, and the way we use GIS reinforces this neglect[4].

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[1] BRODERSEN 2001.

[2] PATTERSON-MILLETT 1998; PATTERSON 2004.

[3] HORDEN-PURCELL 2000.

[4] Cf. BATTY 2003, pp. 2-3 on the difference between 'Geographic Information Systems' and 'Geographic Information Science'.

What happens if, informed by a network perspective, we look at the geography of the Tiber Valley from a point of view that puts the emphasis on those interconnections? The 'science of networks' has developed rapidly over the last few years[5], and it is expressly concerned with understanding the processes that occur on the network structures we find. That is, if we have put dots on the map, the science of networks might be able to tell us something of what happened in the space between those dots and what those dots represent. Batty makes the important point that what might appear to be random in Euclidean space (our dots on the map), can in fact be rather ordered in terms of networks[6]. This paper concentrates first on the problem of representing these connections, and then turns to possible avenues to explore their meaning. It aims to demonstrate the potential power of a network science point of view for understanding the Roman world.

Representing space

In this volume, there are many maps of the middle Tiber Valley. North is always at the top of the map. There is no real reason why we do this, other than the dictates of convention. Since that is how we learn to read maps, that is why we do it. But it does have an effect on how we interpret the information displayed on the map. Rome is always at the bottom of these maps. Even if we did not know a single thing about the City of Rome, there is an implicit assumption, by displaying the map in this way, that everything and everyone must make its way to Rome.

There is empirical evidence to suggest that how we display information on a map affects how we interpret it[7]. At conferences or in the lecture hall, even the size of the screen has an effect on how we interpret the interrelatedness of the information displayed, especially when we are displaying point-data. Researchers have discovered that, when viewing point-data displayed on a screen (what the viewers implicitly recognize as a map), people are more inclined to associate points together in the vertical dimension, rather than in the horizontal.[8] That is, up-down relationships are more likely to be seen in the patterning, rather than left-right. Viewers tend to regard points in the up-down dimension as being more alike, more similar, even when the distance between them is exactly the same as for the horizontal points.

Is the Tiber a barrier or a bridge? When we display the information in our GIS as convention would dictate, we naturally focus on north-south relationships, rather than east-west. We should rethink that. Set your GIS to display maps with west at the top, and see what else becomes apparent. Fig. 1 represents the distribution of stamped bricks (from the British School at Rome collection) in South Etruria. There is seemingly no pattern to this distribution, at least by eye. But when the same information is displayed as in fig. 2, with a 90° rotation, suddenly east-west and trans-Tiber connections jump to the fore (compare with fig. 6 below).

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[5] BARABASI 2002; WATTS 2003 for recent syntheses of the topic.

[6] BATTY 2003, p. 5.

[7] MONTELLO *et al.* 2003, pp. 316-331.

[8] MONTELLO *et al.* 2003, p. 317.

If how we display and represent space affects how we interpret the importance of relationships between places, should we expect the Roman conception of space to have had any different effect? We can approach this problem of understanding the connections between places from another angle, this time using our best guide to the Roman understanding of how places are connected: the Antonine Itineraries. In the Itineraries, the sequence of towns to visit to get from one part of the empire to any other part is listed. Instead of looking at these itineraries plotted on a map, we can follow the lead of Henry Beck, the inventor of the Tube Map, and represent the Itineraries as a network diagram, where the points are the towns, connected to the next town in the itinerary. This network diagram is a *social* network diagram, because it indicates something of the social, commercial, and cultural interactions between individual towns (for why else would one want to get from town A to town B?).

Geography and social network analysis

Some urban geographers now argue for an understanding of cities and settlement structures in terms of social relationships and their intensity where different social networks intersect[9]. Social life works across various networks, and cities are the foci of multiple overlapping social networks (think of the Third-World immigrants in modern Rome who peddle trinkets to North American tourists. Here in one city are two worlds that overlap, occasionally touch, but are entirely foreign to one another). Networks extend beyond the city, linking different cities together in different ways, but they also incorporate every point in between along the continuum of settlement types from humble rural farmsteads upwards. In this view, cities themselves are nodes of social relations in time and space. At any given time a city will be a node in any number of different networks of power and influence[10].

Networks do not exist independently of the people within them, and it is not enough that mere interconnections should exist. Individuals matter. Individuals must *make* something of these interconnections, for the networks to work[11]. This idea can be seen to underlie Laurence's recent discussion of the transformation of Britain into a Roman province[12]. He explicitly considers the Itineraries as evidence for the purposeful reconfiguration of existing networks, over which people, goods, and capital flowed, into a distinctly *Roman* pattern.

An example from Italy concerns the creation of *fora* (market-centres) and the process of establishing control in newly centuriated land, instances where individual élite intervene in the landscape. This process represents the conscious decision to warp and reconfigure local network patterns[13]. This process is visible at Forum Novum, a settlement established in the 2nd century BC, upstream from Rome along the Aia tributary of the Tiber, in the Sabina region. A town centre was built, as well as a market for the surrounding farms. There was much ostentatious display and the typical self-aggrandizement of the local elite who paid for the

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[9] MASSEY *et al.* 1999, p. vii.

[10] MASSEY *et al.* 1999, pp. 42-49, 100-136.

[11] MASSEY *et al.* 1999, pp. 161-163.

[12] LAURENCE 2001a.

[13] Cf. LAURENCE 2001b, p. 596, 598 on the space-economy of Roman Italy.

development, including an aqueduct and an amphitheatre for games[14]. Yet, it never grew into a town as such, and there was little in the way of housing. Even today its modern successor, Vescovio, is not much more than a church and a restaurant. After the initial capitalization on the intersecting trade and farming networks in the river valley where Forum Novum is situated brought the settlement into being, those networks were evidently not sufficient to transform it from a minor centre. This is because of its end-point positioning in relationship to other settlements in the networks of trade and communications in the Tiber Valley, more on which below.

A network approach to cities and settlements can be more than metaphorical. Social network analysis[15], which normally considers the 'vertices' or 'nodes' in a network to be individual persons, can be adapted for our purposes to look for connections within and across cities and space. This is why we reconsidered the Itineraries as a type of social network. Then we can ask, what does position *here* vis-à-vis other 'nodes' imply for the dynamics of interaction and the overall global structure? When we consider the connections between towns today from that perspective, we find occasional long distance links. These are the motorways and so on which allow travel from one city to another without stopping in the little towns in between. These long distance links are important, because they let information travel across the network in a much quicker route than would otherwise be possible. They turn the network into what is known in network science as a 'small-world'[16]. A small world is simply one in which, locally, most 'nodes' (be they people or cities) are tightly linked to neighbouring nodes, but a few long-distance connections have the global effect of shortening the average number of steps it takes to get from one node to any other node chosen at random, as in fig. 3[17]. That is to say, global characteristics of the network emerge from local interactions. When the lights went out in North America, London, and Italy in the summer of 2003, this was because the electricity grid has similar long distance connections that allowed errors to travel quickly and accumulate. In an economic network, the same 'small-world' principal allows capital to accumulate and be used effectively. In a social network, it allows certain people to become indispensable because they effectively can control where the information goes. They can control who knows what.

The Itineraries do not have any of these long-distance connections (fig. 4). The Roman world was not 'small' in the sense described above. There are some sea-connections in the Itineraries, but not enough to actually affect the way information travels through such a network. This means that, from a network analysis point of view, the interconnections between towns in the Empire are exceedingly fragile. Only a few 'links' would have to be broken, for the whole network to appear fragmented. Throughout human history, the majority of people never travelled much further than a handful of miles from their place of birth. Geographic knowledge of distance places therefore had to be provided through some other agency. On

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[14] GAFFNEY *et al.* 2001.

[15] For the basics of which, see *Wasserman-Faust* 1994.

[16] The most accessible discussion of the characteristics of a 'small-world' is WATTS 2003, pp. 69-100. Cf. also WATTS-STROGATZ 1998.

[17] WATTS 1999.

this evidence, to the Roman who wanted to travel some distance using these Itineraries, it would not take much bad news to persuade him that a particular route was blocked.

Yet appearances can be deceiving

When we actually examine the road network (fig. 5, a detail of the Roman roads around Rome), it is clear that there are many alternative routes, many different ways to get from point A to point B. This discrepancy is the crux of the matter. The global picture of how places interact available to a Roman in the form of the itineraries provides only for a limited number of ways to get from A to B, while the local picture, known to the people who live in an area, suggest multiple pathways.

Batty argues that in transportation systems, the adding of new layers to existing systems – such as canals to road networks, rail to canal networks – has the effect of creating small-world conditions[18]. In this sense, the *cursus publicus* as a rapid specialized communications system for the Emperor[19], overlaid on the existing transport system, may have created small-world conditions for the Emperor's intelligence network, with all the attendant implications for wealth and knowledge condensation[20].

Local routes and pathways

To understand local multiple pathways, and their implications for how geography was understood, the gravity settlement model developed by Rihll and Wilson[21] was used to study the interconnections between sites using stamped brick, identified during the South Etruria Survey, in the Tiber Valley. Rihll and Wilson's process works on modelling the amount of interaction between places, based on the assumption that places closer together will be more likely to interact, than places further apart. This mathematical model is not built on any other geographic information, other than the relative positioning of each site, based on its x and y coordinates. While a multitude of sites used brick, comparatively few used stamped bricks. Not every brick was stamped, of course, but the presence of a stamped brick probably indicates a larger shipment of brick. Patterns of supply can reflect the social ties of the builders, so the distribution of different stamp types can be used as an indicator of the degree to which the owners/builders of a site were engaged in the games of competitive display with each other, both in the countryside and the Metropolis[22].

What was interesting about this model applied to the Tiber Valley was the way it suggested interactions changed over time (fig. 6, the output from this model). To the naked eye, the distribution of sites using stamped brick does not appear appreciably different from one period to the next. Yet, to the model, subtle differences in positioning create different network patterns of interaction. At some periods, strong trans-Tiber connections are

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[18] BATTY 2003, pp. 18-20.

[19] Cf. KOLB 2001.

[20] BOUCHAUD-MÉZARD 2000, p. 536, and BUCHANAN 2002, pp. 195-196.

[21] RIHLL-WILSON 1991.

[22] GRAHAM 2002, pp. 100-7; GRAHAM forthcoming on using the Tiber as infrastructure; cf. DE LAINE 2002.

suggested amongst sites using stamped brick; other times, more north-and-south connections; sometimes certain main roads are implied, such as the via Cassia; other times, the use of the Tiber is implied as the route for these interactions. It is interesting to note how the east-west connections suggested by this model recall the same connections apparent to the eye when we turned the map in fig. 1 ninety degrees. These are as much social interactions as geographical interactions, and so suggest a much more complicated geography than one in which every product uniformly makes its way to the bottom of our map, to Rome.

These interactions also are implied in the archaeometry of stamped bricks. Seventy-five stamped bricks from the Tiber valley were tested using X-ray fluorescence[23]. The results were then correlated with the information on the stamps. Contrary to what we would expect it seems that not all bricks carrying the same stamp type were made from the same clays. There are also cases where multiple land-owners exploited the same clay sources. Some of the tested bricks were transported up the valley from where they were made; others were transported down stream; still others from one side of the valley to the other. This seemingly goes against our functionalist, cost-of-transport view of the economy, but it does point to a somewhat neglected side of the consumer city model: the social relationships that mediated trade[24].

The local and the global

Assume for a moment that all trade flows downstream, and like the Roman informed by the Antonine Itinerary we recognize only one route from point A to point B. It is here, in the discrepancy between local and global knowledge of geography, that an individual or community can make money and impact the economy. In trade, it is not the cost that matters so much as the profit that can be made. So for the well-connected individual (as in fig. 7) it should be easy to work out the discrepancy between the local and the global – between what she knows, and what her buyers know. It is 'she' because the single most important individual in the social network of the brick industry, the individual who sat in the very centre, was Domitia Lucilla, mother of Marcus Aurelius[25]. Over 200 people can be connected to her in only a few steps, making the industry a small-world, and putting her in a position to control the flow of information in the trade. She would have known, as a function of her position in the network, about clay sources and building contracts, about the amount of profit that could be made for a given distance of trade, whether upstream, downstream, overland, or overseas. To be able to call on clients, to be able to use the resources of skilled slaves, to have the right connections, allowed Domitia Lucilla and other well-connected individuals to get the material to where it was wanted with a minimum of fuss.

However, because of the way geographic knowledge was formulated in the Roman world, the perception of cost-of-transport could well have been out of kilter with the reality. The person buying would not necessarily have known the routes, the difficulties, except in the broadest possible terms. That meant that the buyer would find a certain cost level to be acceptable, even when that cost was in reality much higher than circumstances should have actually dictated. Today it would be similar to the way that, if we are not plumbers, we are at

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[23] GRAHAM 2002, pp. 52-73.

[24] WALLACE HADRILL 1991

[25] Cf. GRAHAM forthcoming on controlling the brick industry.

the mercy of the "cow-boy" who tells us the work is going to take longer and cost more than in truth it does. Most emperors were not, almost by definition, stupid men. Why do they invest so much in the brick trade? It may be that a significant factor is the discrepancy between the local and the global which makes the otherwise humble building trade economically valuable (remembering that brick making was an adjunct to agriculture), and allows it to function in the way that is visible archaeometrically. This is in line with what people such as Janet DeLaine have suggested concerning ideologies of construction, and the use of so-called 'exotic' materials[26]. 'Exotic' was in the eye of the beholder, and could even apply to something as humble as brick, if it seemed that it was difficult to obtain. That difficulty depended on how one perceived space, and the interconnections between places.

Conclusion

In the Tiber Valley, the relationships between places change over time, and they are not in the patterns we expect. As Batty argued[27], we need to move from representing locations, to representing relationships. If merely we study the 'dots on the map', we miss important facets of the way the social and economic geography of the Roman world worked. 'Dots on the map' represents a local understanding of space. To get to the global, as preserved for us in works such as the Antonine Itineraries, we need to explore the space between the two levels. Network science offers us a formal methodology for exploring the space between the local and the global. Networks are not static, nor are they deterministic. They evolve, for they change in response to the decisions people make, but they also influence those decisions. They can even make brick exotic.

Abstract

In displaying archaeological information as points on a map, we lose elements of the social and economic geography of the region we are studying. This paper suggests a methodology for exploring the space between our 'dots-on-the-map', based on the rapidly developing 'science of networks'. It takes as a case study the distribution of sites using stamped brick in the Tiber Valley. It suggests that contradictions between local and global understandings of spatial relationships were exploitable economic opportunities.

Visualizzando i dati archeologici come punti su una mappa, perdiamo elementi della geografia socio-economica dell'area che stiamo studiando. Questo contributo suggerisce una metodologia per esplorare lo spazio compreso tra i "puntini", basata sui costanti sviluppi della "scienza delle relazioni". Come esempio, si è scelto la distribuzione dei bolli laterizi nella valle del Tevere. Tale esempio suggerisce che le contraddizioni tra le percezioni locali e globali delle relazioni spaziali potevano essere sfruttate a livello economico.

[26] DE LAINE 2002

[27] BATTY 2003

Bibliography

BARABÀSI 2002: A.L. BARABÀSI, *Linked: The New Science of Networks*, Cambridge 2002.

BATTY 2003: M. BATTY, *Network Geography: Relations, Interactions, Scaling and Spatial Processes in GIS* [Centre for Advanced Spatial Analysis Working Paper #63, at www.casa.ucl.ac.uk/working_papers/paper63.pdf]. To be published in D. UNWIN (ed.), *Re-Presenting GIS*, Chichester 2003.

BORGATTI *et al.* 1996: S.P. BORGATTI - M.G. EVERETT - L.C. FREEMAN, *UCINET IV Version 1.64* [Natick, MA, Analytic Technologies URL: http:www.analytic.com], 1996.

BORGATTI 2002: S.P. BORGATTI, *Keyplayer v.1.1* [Natick, MA, Analytic Technologies URL: http:www.analytic.com.] 2002.

BOUCHAUD 2000: J.P. BOUCHAUD - M. Mézard, *Wealth Condensation in a Simple Model of Economy*, in *Physica* CCLXXXII, 2000, p. 536.

BRODERSEN 2001: K. BRODERSEN, *The Presentation of Geographical Knowledge for Travel and Transport in the Roman World: Itineraria non tantum adnotata sed etiam picta*, in C. ADAMS and R. LAURENCE (eds), *Travel and Geography in the Roman Empire*, London 2001, p. ff.

BUCHANAN 2002: M. BUCHANAN, *Nexus: Small Worlds and the Groundbreaking Science of Networks*, New York 2002.

CUNTZ 1929: O. CUNTZ, *Itineraria Romana. Vol.1, Itineraria Antonini Augusti et Burdigalense* Stuttgart 1990[2].

DE LAINE 2002a: J. DE LAINE, *The Temple of Hadrian at Cyzicus and Roman Attitudes to Exceptional Construction*, in PBSR LXX, 2002, p. 205 ff.

DE LAINE 2002b: J. DE LAINE, *Building Activity in Ostia in the Second Century AD*, in C. BRUUN - A. GALLINA ZEVI (eds.), *Ostia e Protus nelle loro relazioni con Roma*, in AIRF XXVII, 2002, p. 41 ff.

GAFFNEY *et al.* 2001: V. GAFFNEY - H. PATTERSON - P. ROBERTS, *Forum Novum-Vescovio: Studying Urbanism in the Tiber Valley*, in JRA XIV, 2001, p. 59 ff.

GRAHAM 2002: S. GRAHAM, *'Ex Figlinis': The Complex Dynamics of the Roman Brick Industry in the Tiber Valley during the 1st to 3rd Centuries AD*, PhD thesis, School of Human and Environmental Sciences, University of Reading 2002.

GRAHAM (forthcoming): S. GRAHAM, *Who's in Charge? Studying Social Networks in the Roman Brick Industry in Central Italy*, in C. MATTUSCH - A. DONOHUE (eds.), *Acta of the XVIth International Congress of Classical Archaeology* (forthcoming).

GRAHAM (forthcoming): S. GRAHAM, *Of Lumberjacks and Brick Stamps: Working with the Tiber as Infrastructure*, in A. MACMAHON - J. PRICE, *Roman Urban Living* (forthcoming).

HELEN 1975: T. HELEN, *Organization of Roman Brick Production in the First and Second Centuries AD. An Interpretation of Roman Brick Stamps*, Helsinki 1975.

HORDEN-PURCELL 2000: P. HORDEN - N. PURCELL, *The Corrupting Sea: A Study of Mediterranean History*, Oxford 2000.

KOLB 2001: A. KOLB, *Transport and Communication in the Roman State, The Cursus Publicus*, in C. ADAMS - R. LAURENCE (eds.), *Travel and Geography in the Roman Empire*, London 2001, p. ff.

LAURENCE 2001a: R. LAURENCE, *The Creation of Geography: An Interpretation of Roman Britain*, in C. ADAMS - R. LAURENCE (eds.), *Travel and Geography in the Roman Empire*, London 2001.

LAURENCE 2001b: R. LAURENCE, *Roman Italy's Urban Revolution*, in E. LO CASCIO - A.S. MARINO (eds.), *Modalità insediative e strutture agrarie nell'Italia meridionale in età romana*, Bari 2001, p. ff.

MASSEY *et al.* 1999: D. MASSEY - J. ALLEN - S. PILE (eds.), *City Worlds: Understanding Cities 1*, London 1999.

MONTELLO *et al.* 2003: D. MONTELLO - S.I. FABRIKANT - M. RUOCCO - R. MIDDLETON, *Testing the First Law of Cognitive Geography on Point-Display Spatializations*, in W. KUHN - M.F. WORBOYS - S. TIMPF (eds.), *COSIT 2003, LNCS 2825*, 2003.

PATTERSON-MILLETT 1988: H. PATTERSON - M. MILLETT, *The Tiber Valley Project*, in PBSR LXVI, 1988, p. 1 ff.

PATTERSON 2004: H. PATTERSON, *Bridging the Tiber: Approaches to Regional Archaeology in the Middle Tiber Valley*, London 2004.

RIHLL-WILSON 1991: T.E. RIHLL - A.G. WILSON, *Modelling settlement structures in ancient Greece : new approaches to the polis*, in J. RICH - A. WALLACE HADRILL (eds.), *City and country in the ancient world*, London 1991, p. ff.

SETÄLÄ 1977: P. SETÄLÄ, *Private Domini in Roman Brick Stamps of the Empire: A Historical and Prosopographical Study of Landowners in the District of Rome*, Helsinki 1977.

STEINBY 1974: E.M. STEINBY, *La cronologia delle "figlinae" doliari urbane dalla fine dell'età repubblicana fino all'inizio dell III secolo*, in BullCom LXXXIV, 1974, p. 7 ff.

WALLACE HADRILL 1991: A. WALLACE HADRILL, *Elites and trade in the Roman town*, in J. RICH - A. WALLACE HADRILL (eds.), *City and country in the ancient world*, London 1991, p. ff.

WASSERMAN-FAUST 1994: S. WASSERMAN - K. FAUST, *Social Network Analysis: Methods and Applications*, Cambridge 1994.

WATTS 1999: D.J. WATTS, *Kevin Bacon, the Small-World, and Why It All Matters*, in Santa Fe Institute Bulletin [at http: //www.santafe.edu/sfi/publications/Bulletins/bulletinFall99/workInProgress/smallWorld.html], 1999.

WATTS 2003: D.J. WATTS, *Six Degrees: The Science of a Connected Age*, London 2003.

WATTS-STROGATZ 1998: D.J. WATTS - S.H. STROGATZ, *Collective dynamics of 'small-world' networks*, in *Nature* CCCXCIII, 1998, p. 440 ff.