Part I Maps and Technology

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When History meets Geography: The Visualising Urban Geographies Project[1]

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Abstract The chapter proceeds from an account of the cautious embrace of historical mapping in Britain to explain why a new emphasis on open source mapping tools provides an attractive and productive way forward for historians. More specifically, the argument is that such tools facilitate analysis of historical sources and that these can be understood and applied with a very modest investment of time while yielding new perspectives on a wide range historical data. Furthermore, since there is a historical dimension to most humanities and social science disciplines, the tools development by the Visualising Urban Geographies (VUG) project at Edinburgh University offer productivity gains for researchers in other disciplines too.

Structural dimension to historical mapping in Britain

Historians are accustomed in their post-modern world to the 'linguistic turn' and the 'cultural turn.' As a result, the edges of their territory, and perhaps even some of their core areas, have been invaded by related humanities and social science disciplines. These friendly 'aliens', with their linguistic and cultural contributions, have re-shaped historians' intellectual space. Yet, space itself, and spatial relationships particularly, seem to present a road-block to the time-travelling historian.

Why should history and geography, time and space, be in a state of tension? Arguably it might begin at school: in Britain, the national curriculum forces school pupils to choose aged 14 between geography and history as timetabling rarely, if ever, permits both. At university, geography has been colonised by geo-

[1] The 'Visualising Urban Geographies' project was funded by the Arts and Humanities Research Council, UK, under the Knowledge Transfer Fellowship Scheme, Grant AH/G017077/1. See also R. Rodger, C. Fleetand S. Nicol, 'Visualising urban geographies' in *e-Perimetron: An International Web Journal on Sciences, and Technologies* 5:3, 2010, 118-31.

sciences, and humanities remains home to history. Students rarely, if ever, study both subjects and the funding algorithms for universities have favoured physical geography so that even within geography itself historical geography has been in decline in recent decades. Furthermore until about 2000 the humanities research council funding mechanisms in the British university sector favoured the 'lone scholar' rather than the research teams that featured prominently around senior professorial leadership in Germany, North America, and to some extent through the French Centre National de Recherche Scientifique (CNRS).[2] Coupled with these structural factors was the emergence in the 1960s of main-frame computer-based mapping technologies embedded in science disciplines, and the less capital intensive emergence in 1986 of DOS-based desktop versions and, in the 1990s, a Windows platform using a MapInfo package.[3] This technological dimension reinforced the 'lone scholar' emphasis – first because the heavy capital investment was not available to the humanities, and subsequently because 'distributed computing' with its desktop machines gave humanities a degree of autonomy.

Despite these developments one formidable barrier confronted the history user in addition to the not inconsiderable cost of software: the steep-learning curve of GIS was intimidatory and a powerful disincentive to the occasional user. For the social scientist using contemporary boundaries to elicit voting patterns or social inequalities, or the archaeologist or geographer with technical support, the learning curve could be flattened, or even eliminated.[4] This was not so for most historians as 'lone scholars.' As the editor of what was described as 'the first collection of case studies applying geographic information systems (GIS) to the study of history' proclaimed in 2002: 'For many scholars working in disciplines other than geography, GIS is a new and daunting tool.'[5] Nonetheless, undaunted presumably, the number of historical GIS topics had so increased that just six years later, in 2008, the same editor commented: 'The number of historians using GIS … is growing so rapidly that many of us in the field expect to see an exponential rise in GIS-based historical studies over the next decade.'[6]

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[2] An exception was Humphrey Southall's large scale 'Vision of Britain' project. See http://www.visionofbritain.org.uk/footer/about.jsp

[3] See for example, T. Foresman, *The History of GIS (Geographic Information Systems): Perspectives from the Pioneers* (Harlow 1997).

[4] I. Gregory, *A Place in History: A Guide to Using GIS in Historical Research* (Oxford 2002), online at hds.essex.ac.uk/g2gp/gis/index.asp where a number links provide historical case studies that can be viewed.

[5] A. K. Knowles, ed., *Past Time, Past Place: GIS for History* (ESRI, Redlands 2002), xi.

[6] A. K. Knowles, ed., *Placing History: How Maps Spatial Data and GIS are Changing historical Scholarship* (ESRI Press, Redlands 2008), 2.

Maps in minutes

Historical mapping has so far relied almost exclusively on GIS. In turn this has required digitised and geo-referenced maps, databases designed to retrieve information on selected parameters. 'Polygons (representing the exact shape and location of administrative units) and attributes associated with those polygons'[7] were what underpinned historical GIS and presented a barrier to the general user. The Visualising Urban Geographies (VUG) approach (see http://geo.nls.uk/urbhist/) developed at Edinburgh University reasoned as follows: if an accessible tool was available to map historical data it would transform the research and teaching potential of many individuals who are currently deterred by the steep investment required to use GIS. So to liberate the spatially challenged from these 'daunting' GIS tasks – whether students, lecturers, or the general public – the VUG project developed mapping tools that could be used in conjunction with some of the 20,000 digitised historical maps held by the National Library of Scotland covering the period 1560 to 1928.[8] Maps created in this way and superimposed on a historical map chosen by the user would be developed in a matter of minutes. Technically, the 'mash-up' of open source web-based application programming interfaces (APIs) operated in the background and, rather like programs used every day, historians only needed to be familiar with simple cut and paste routines.

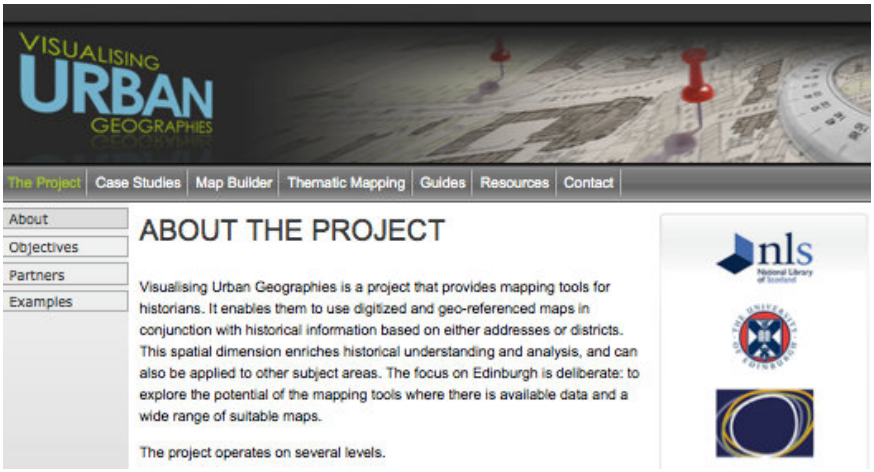

Fig. 1. Visualising Urban Geographies homepage.

Historians deal with data in two main forms: firstly, and most often, they rely on addresses since tax, employment, births, marriage and death, financial transac-

[7] I. N. Gregory and H. R. Southall, 'Mapping British population history', in A. K. Knowles, ed., *Past Time Past Place*, 120.

[8] Not all of these maps are geo-referenced.

tions such as mortgages and credit rating, and many other everyday practices are linked to place of residence. In past times, however, lists of commercial debtors, types of employment, and locations of places of worship, have been stock in trade for historical analysis, but inspection of lists is laborious and the spatial dimension is difficult to identify unless the historian is very familiar with the terrain. The second main form of historical data is compiled in districts – polygons formed by church, state, municipal, political, ethnic, and other bounded regions to record the frequency of disease, deaths, electoral characteristics, migration and the character of an area or neighbourhood. Both types rely heavily on spatial elements, but are difficult to manipulate where the data set is voluminous.

So since much of the address-based data is collected from archival records, spreadsheets form a core element of VUG tools. Cutting and pasting addresses, together with columns for other data (notes, pictures, archival source references) into a Yahoo geo-coder results in the generation of further fields for latitude and longitude. These locations can then be viewed in Google maps, or saved as a kml file to generate plots in Google Earth, or used in conjunction with geo-referenced historical maps of the period.[9]

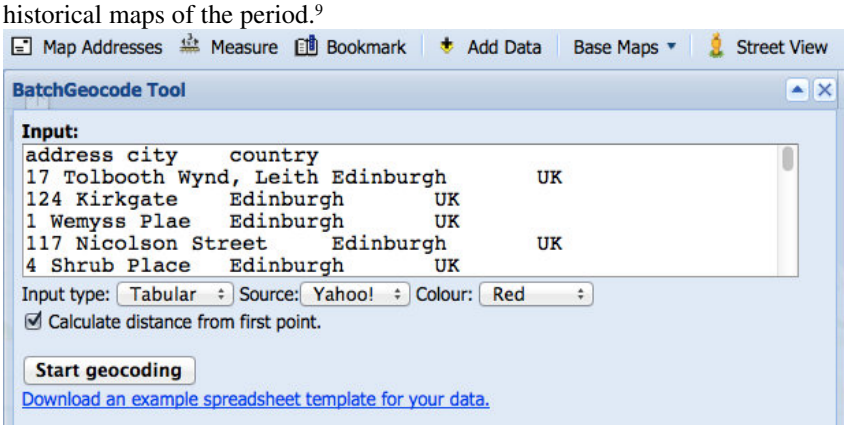

Fig. 2. Batch Geo-coding Addresses near here; see also mp4 geocoding

More specifically, Figure 3 shows the distribution of Edinburgh solicitors in 1861 and 1911, and this shows a drift of solicitors towards the main city centre streets during this time. This raises questions about the nature of legal firms, the complexity of the law over time, and a range of related research questions that would be difficult to identify otherwise. For the historian an inspection of addresses in trade directories would not itself reveal such a pattern so the mapping

[9] Batch geo-coding is not without difficulties. Like most datasets standardisation using street, city and country column headings to ensure that Edinburgh is considered to be in Scotland, not the USA. Where streets have been obliterated, it is possible to develop 'reverse geo-coding' – where the location in the city, if not the historic street, can be identified, so that a latitude and longitude or a post-code can be assigned. This is a laborious process where there are many such locations.

exercise, achieved in about twenty minutes from start to finish improves research productivity considerable

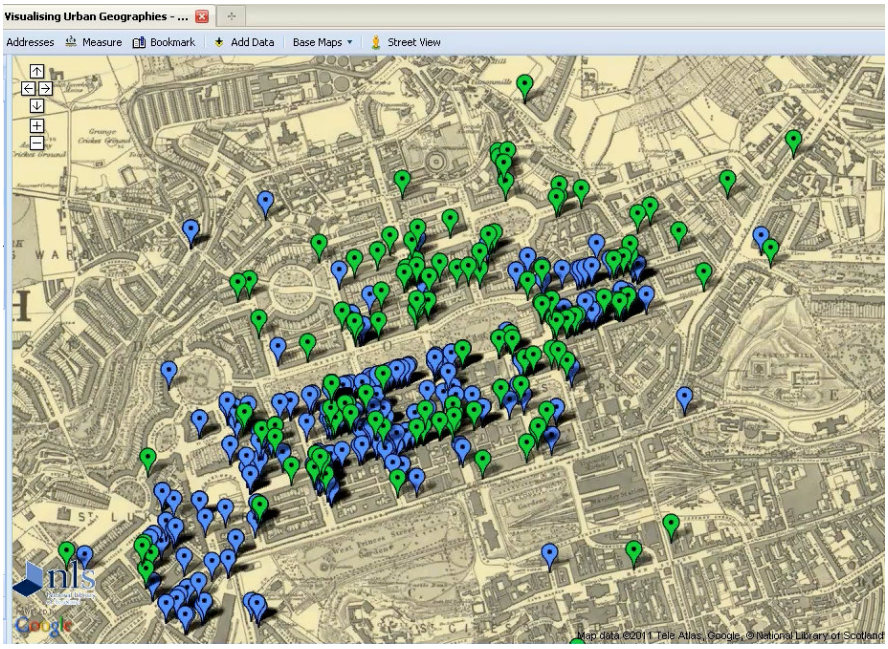

Fig. 3. Edinburgh Solicitors 1861 (green) and 1911 (blue)

The geo-coding routine also allows users to calculate the distances of each observation from a selected point, and this provides a measure of dispersion in the data to be established. For example, are retailers such as tobacconists more concentrated than opticians? We may speak of a 'jewellery quarter' in Birmingham but are other activities just as concentrated – just less obvious? Measures of this kind enable the historian to develop hypotheses about the spatial distribution of social, economic, political and cultural activities that relate directly to archival sources. Users have found these tools helpful in understanding the concentrations of Liverpool moneylenders in the inter-war period and of Dundee prostitutes during the same period. In a more extended study, membership records of several clubs and societies in Leicester since 1950 have been analysed to test the hypothesis that suburbanisation in Britain diminished the coherence of civil society.[10] Another study considered the introduction of gas lighting to Edinburgh in the 1820s, posing the question: was this more prevalent in affluent areas where it was affordable or in poor areas of the city where policing and urban management were the priority? It is worth stressing again that the use of a historical base map with its

[10] See for example, L. Balderstone, 'Semi-detached Leicester: social and cultural connections in suburban Leicester', in R. Rodger and R. Madgin, eds., *Leicester: A Modern History* (Lancaster, forthcoming).

physical features and buildings of the period provides a more appropriate context for the data than a present day Google map.

The VUG project brings other analytical tools to the assistance of the historian. Precise metric measures of distance, area, altitude and gradient are features that add considerably to the interpretation of contemporary topography and scale.

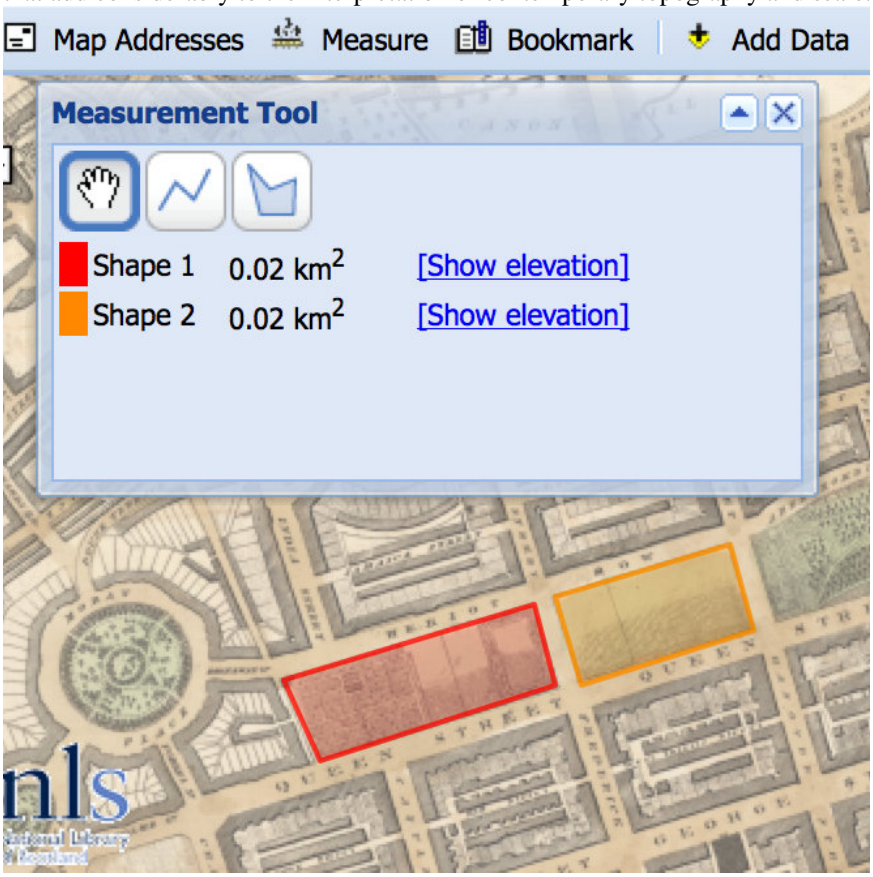

Fig. 4. Distance and area measuring tools – see also mp4.

It is particularly easy, when using two-dimensional maps, to overlook the combined significance of distance and gradient in earlier periods, and the sheer manual effort involved in many occupations and daily activities. Lifting and carrying over considerable distances and heights fundamentally influenced human actions and interactions in ways that our contemporary preoccupation with private cars and public transport systems largely discount. Importantly, too, a focus on the 'walking city' provides a nuanced understanding of how individuals went about their business, the routes they used to avoid scrutiny or congestion, and served the users' purposes. No wonder, then, that in the West Bow leading out of the Grassmarket to the Lawnmarket near Edinburgh Castle, a distance of 160 metres was

associated with a 12 metre incline (a 14% gradient) for carts and carters and presented such serious conditions underfoot in winter especially that an improved route was funded by the City Council to reduce the risk of accidents and the spillage of goods on to the cobbled streets.

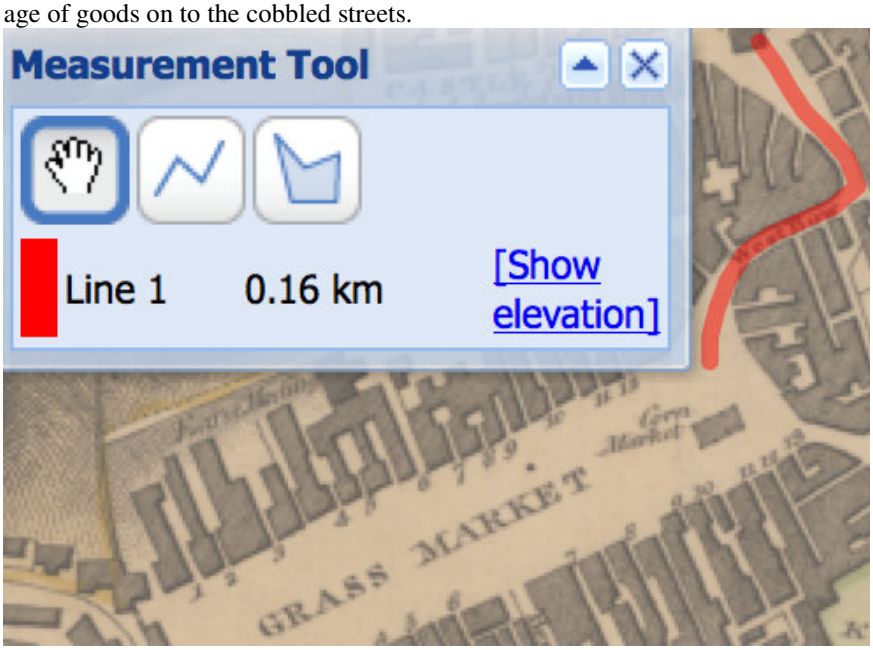

Fig. 5. Distance and gradient in the West Bow, Edinburgh before 1830.

In another case the decision to build housing on a hillside had much to do with the gradient since the costs increased disproportionately with steeper inclines and this defined profitability. The VUG mapping tools, particularly those associated with gradients, improve an understanding of such business decisions and do so on geo-referenced historical maps that provide precise topographical details.

Map Layers

The VUG tools provide a powerful analytical tool for historians. However, the productivity of the tools is enhanced by deploying them in conjunction with historical maps of a time period appropriate to the data. In most European towns and cities map-making in the nineteenth century was itself a flourishing business. Municipal authorities, large and small, sought to understand and manage their jurisdictional areas. These maps, commissioned by the city and the state, are increasingly available in digitised and geo-referenced form, and so historians can deploy their data in conjunction with maps that correspond closely to the era to which

they relate.[11] In the VUG project 25 geo-referenced maps covering the period 1765 to 1940 have been made freely available as downloadable JPEG images, KML SuperOverlays, Tile Map Services and Web Map Services.[12] These include the most detailed and accurate maps of the city based on a direct survey by William Edgar (1765), John Ainslie (1804), Robert and James Kirkwood (1817, 1821), John Wood (1831), James Kay (1836), Bartholomew's (1865, 1882, 1891, 1893-94, 1902, 1907, 1912, 1917-18, 1919, 1932-33, 1939-40), W. & A.K. Johnston (1905-06, 1910-11), and two Ordnance Survey series maps (1853-53, 1877).[13]

The VUG project is organised around the concept of a Map Builder. This is a customised open source mashup framework for working with maps and data. That is to say: the user's data forms the basis of a layer superimposed upon a historical map chosen by the researcher to match as closely as possible the date of the data. Examples were presented in Figures 2-5 when customised VUG Map Builder tools were used to plot addresses, and to identify distance, gradient, area and altitude in relation to a map of the period.

How, though, are the geo-referenced maps uploaded in the first place so that they can appear as choices in the menu bar, as shown in Figure 6 Map Builder provides the basis for this; it requires a Google account which means that this is where users' data is stored – not on the VUG server! First time users see an instruction to 'Add Map' from the VUG Map Builder menu; this leads to a screen with an empty spreadsheet that requires a map to be named and an address to be provided, and finally leads to an instruction 'Publish as a web page' for the named map. Such published links are, of course, portable as with any web link.[14] This sequence enables users to add further maps to correspond with their historical data. The result is that geo-referenced historical maps are customised so as to give a suite of options that correspond closely to the researcher's historical data set. The National Library of Scotland has been at the forefront of such digitising and geo-referencing initiatives, and accordingly there are many existing options to 'Add Maps' to a personalised list.

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[11] If not already undertaken by an archive or other repository, the VUG project website provides a drop-down 'Guides' menu with step-by-step help on how to geo-reference maps. See http://geo.nls.uk/urbhist/guides_georeferencing.html This can be done using ArcGIS, QuantumGIS, and Georeferencer methods for cropping, choosing co-ordinates, adding control points and transformations. For further methodological considerations see C. Ballett, 'Georeference in the analysis of the geometric content of early maps', in *e–Perimetron*, 1:1, 2006, 32-42; C. Boutoura and E. Livieratos, 'Some fundamentals for the study of the geometry of early maps by comparative methods' in *e–Perimetron*, 1:1, 2006, 60-70.

[12] These maps and WMS layers are all based on the British National Grid, OSGB 1936 (EPSG:27700) coordinate system.

[13] http://geo.nls.uk/urbhist/resources_maps.html

[14] This sequence of steps is provided in detail and with several screen shots as part of the information on customising Map Builder and on how to publish maps as web pages See http://urbhist.nls.uk/mapbuilder/

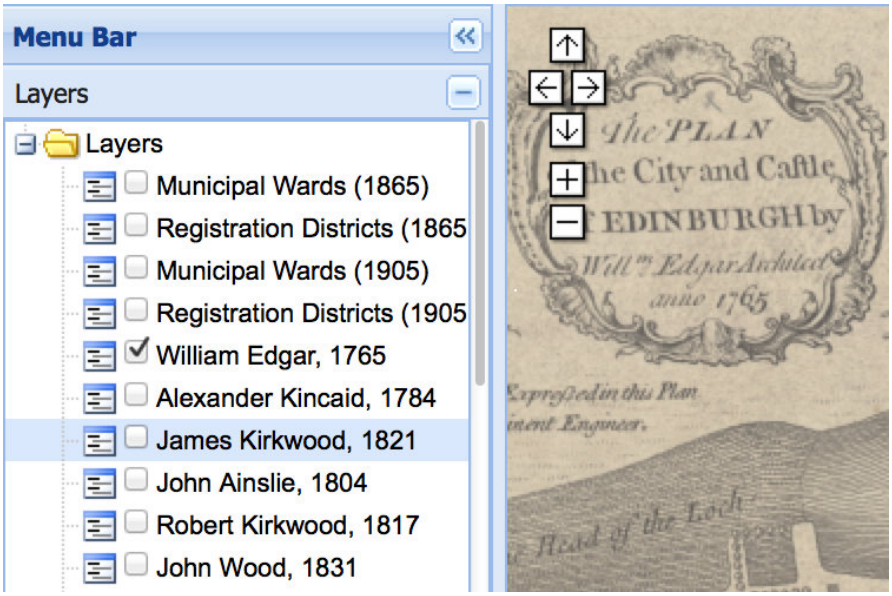

Fig. 6. Map Layers

However, not all maps produced by archives or data libraries are available in an immediately usable electronic form. Physical copies need to be scanned and georeferenced. Where datasets generated by researchers from archival sources are to be analysed and presented on a thematic basis – debts, prison sentences, migrants, occupations, vacant properties – it is essential to capture local boundaries, administrative districts, and jurisdictional areas that will reveal the underlying demographic, socio-economic, cultural, religious and political relationships and their spatial characteristics.[15] Where boundaries are subject to change over the long historical sweep, as is often the case, it is necessary to record these changes by tracing them on a map and then saving the boundary lines as a separate vectorised overlay. Such newly created maps can then be uploaded using the 'Add Map' option and will appear in the VUG Map Builder sidebar as options. With administrative areas available then spatial analysis can be undertaken using 'choropleths' – shaded polygons that capture the graduated nature of the characteristics.

In Edinburgh a number of such administrative boundary polygons have been captured by the VUG project and made available as shape files and kml files. These templates include the changing registration districts, wards and municipal boundaries for Edinburgh from 1865 to 1912, and the various extensions of the city limits from 1685 to 1885. In addition, an exemplar of other types of bounda-

[15] In the 21st century the Office of National Statistics and the Scottish Government use respectively over 31,000 and over 6500 geographical units to map various social characteristics and overall indicators of multiple deprivation. See http://www.scotland.gov.uk/Resource/0041/00410727.pdf

ries, Kirkwood's detailed cadastral map of landownership in Edinburgh in 1817 has been captured in a database that also contains landowners' names. The area of each plot is also generated as a by-product of geo-referencing. Similarly, a range of socio-economic data has been recorded and made available, and each item of data provides background content to the dynamic thematic maps in the Map Builder application. (See Figure 7). Population details from the censuses from 1861 to 1921 have been recorded, including numbers of males and females; inhabited houses by registration district for each census and house rental values by sanitary districts have also been recorded for 1874 (see Figure 8). In addition, details of the occupants and their addresses in the selected Edinburgh housing settlements in 1891 have been made available. Overall, 25 maps were geo-referenced, 23 administrative boundaries were vectorised, and 16 socio-economic datasets provided as part of the VUG project. In each case the intention is to demonstrate how boundary based maps, used in conjunction with historical data derived from archival sources, enriches historical understanding and interpretation.

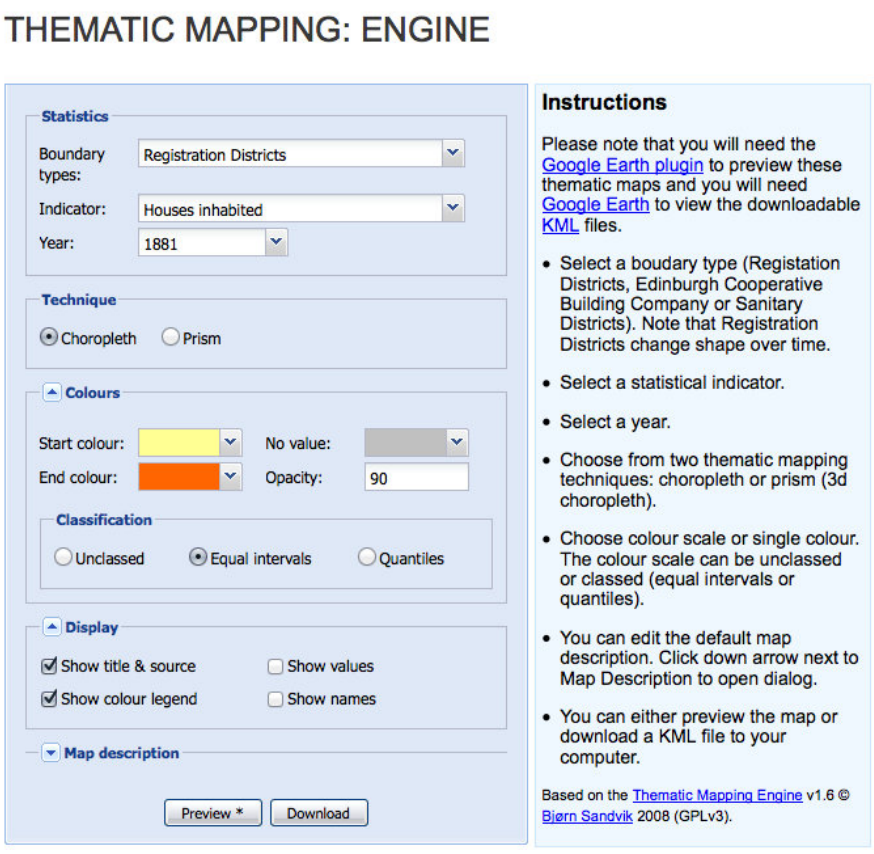

Fig. 7. Map Builder and the Thematic Engine

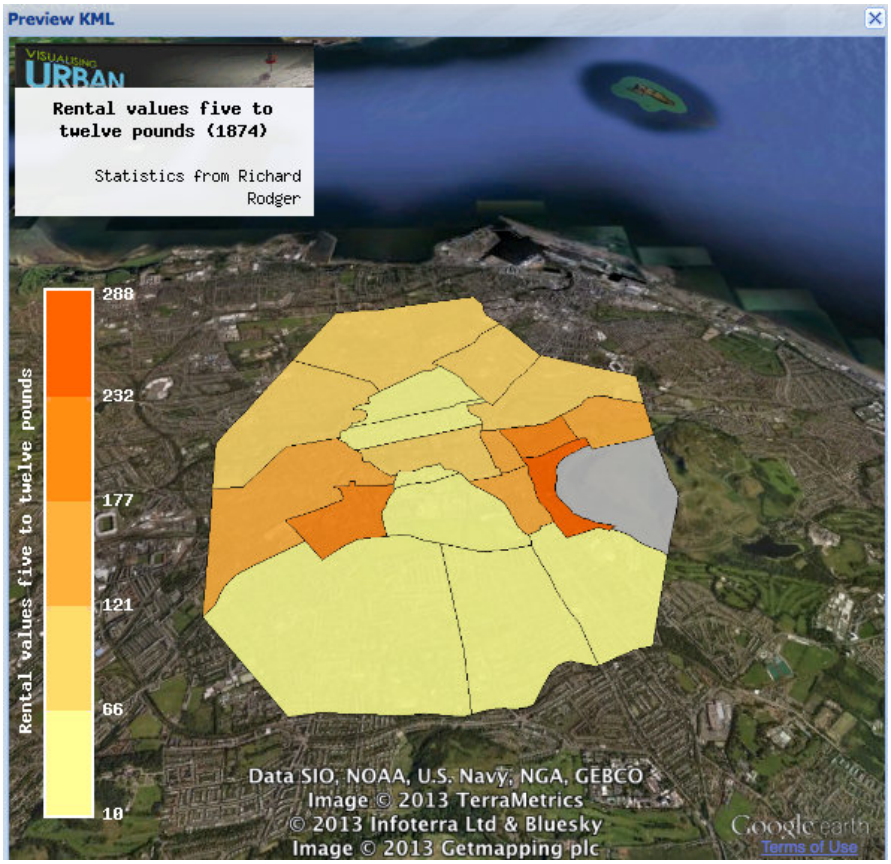

Fig. 8. Distribution of house rentals (£5-12) by Edinburgh districts, 1874.

Dissemination strategies

The programme of disseminating project results differed in its intensity and extent from that originally planned. Whereas an important element in the original plan was to take the project to a number of archives and libraries, it transpired that a number of public events were hosted by other organisations so it was possible to make contact directly with large numbers of delegates and members of the public. This was the case, for example, at roadshows within Scotland (Perth, Inverness, Dunfermline), through public events hosted in Edinburgh, and webcasts and academic conferences.[16] An active follow-up programme of leafleting reached the

[16] See for example, VUG Workshop (6 Dec 2010) http://geo.nls.uk/urbhist/workshop.html; VUG Launch (24 Feb 2011) http://geo.nls.uk/urbhist/launch.html

memberships of organisations and schools, and regular features in *Cairt*, the Newsletter of the Scottish Maps Forum, engaged with the geographical and cartographic interests of the public. Dissemination to the scholarly community involved presentations to national and international meetings largely as planned. An early decision to present a paper at an International Digital Cartographic conference in Vienna enabled the technical officer to make and, subsequently, develop important personal contacts.

The lists of contacts and dissemination activities far exceeded those anticipated. Expertise acquired in developing the Map Buildertool and the developing NLS list of georeferenced maps proved popular and widely appreciated, and technical dialogues arising out of the VUG project developed within and between a variety of organisations and projects, including Information Services personnel at Edinburgh University, EDINA, and several digitisation projects in European Union countries. Disciplines outside the humanities also showed an interest in using the mapping tools, specifically in medicine, psychiatry and criminology. A contribution to the Digital History seminar at the Institute of Historical Research provided an opportunity by means of a webcast to disseminate the VUG outputs through Twitter, and other social networks reflected this wider reach. Google Analytic data shows over 70,000 pageviews and almost 50,000 unique page views in a three-year period between March 2010 and March 2013. The Guides and Help Notes appeared to be particularly appreciated.

Student participation - and road testing the various mapping tools - was originally planned as a minor part of the VUG project but the concept and utility of mapping historical data soon caught on with Edinburgh University undergraduates following a 'History in Practice' seminar with 20 students. Various requests for assistance with student projects at all levels of the curriculum, including several PhD candidates, then developed from different universities.

An unexpected project outcome resulted from a meeting with an undergraduate from Edinburgh College of Art. In the final degree show at the Edinburgh College of Art, and arising out of a presentation by the VUG team, a student has used historical maps of central Edinburgh to trace shapes on glass, and backlight these to provide illuminated shapes and profiles of courts, wynds and closes. Another creative element involved tracing relatives' migrations over the last century and using the patterns developed as the basis of designs for pen and ink drawings. This creative work is ongoing.

Postscript

Arising out of the energy generated by, and public interest in, the VUG project,

a group of 30 contributors and 5 partners[17] has successfully proposed a three-year funded project to the UK Arts and Humanities Research Council.[18] 'Mapping Edinburgh's Social History (MESH): A Capital Digital Resource' will develop further the tools associated with the VUG project and disseminate these by means of a digital atlas that will provide important guidelines and protocols for similar publications and websites for other towns and cities. Together with digital data and maps the intention is to extend and enrich the public's local historical interests and participation. A fully developed scholarly agenda also forms part of the MESH project.

In our modern world, post-codes define the activities of mail order firms and fleets of commercial delivery vans, and sat-nav equipment enables travellers to hurtle through the countryside oblivious as to how places relate to one another. Historians, and humanities researchers generally, are increasingly able to refine a spatial 'turn' or perspective using data which has sometimes remained obscure. Digital mapping now renders this amenable to systematic analysis.

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[17] The partners are the National Library of Scotland, World Heritage Centre, Edinburgh City Council, Royal Commission on Ancient and Historical Monuments in Scotland, and a private firm of conservation architects.

[18] AHRC AH/K002457/1.

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Websites

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http://geo.nls.uk/urbhist/workshop.html (VUG Workshop (6 Dec 2010))

http://urbhist.nls.uk/mapbuilder/ (Map Builder and on how to publish maps as web pages)

http://www.visionofbritain.org.uk/footer/about.jsp (Vision of Britain)

http://www.scotland.gov.uk/Resource/0041/00410727.pdf (Summary of key findings from the Scottish Index of Multiple Deprivation (SIMD 2012) published on 18 December 2012)