and others. Ordnance Survey Northern Ireland, the national mapping agency, has agreed to allow CDDA to use their modern townland boundary coverage free of charge for educational purposes. CDDA has the straight-forward task of time-enabling these 1970s boundaries. Other key alliances have been formed with local museums, the School of Geography at Queen's University, and the Northern Ireland Statistical Research Agency, each providing unique expertise or sets of data for the Irish GIS.

Finally, the Irish project is learning from the experiences of the pioneers of national historical GIS development. Unlike the Great Britain Historical GIS, the Centre is not digitizing multiple administrative boundaries—it is starting with the most recent, accurate, detailed boundaries and working back in time. This avoids the problem of inaccurately overlaying coterminous boundaries that appear not to match as they have been digitized from different, imperfect sources. Because of the nature of Ireland's administrative geography, different coverages for different administrative units will not be created, as all units will be built from the townlands. CDDA is not re-digitizing existing electronic data, namely the boundary data coming from the Ordnance Survey and recent socioeconomic data from the Northern Ireland Statistical Research Agency, considerably reducing costs as a result. Furthermore, in collaboration with the Electronic Cultural Atlas Initiative (see separate report) and the School of Archaeology at the University of Sydney, we are adapting TimeMap, a free, easy-to-use geospatial browser that enables researchers to use the data without having to learn GIS software.

To date, the Centre has the bulk of the attribute data in digital format and the modern boundary data available. Scholarly research so far has identified the need to begin mapping Ireland's past and the potential of spatial analytical techniques (see Ell and Gregory, this volume). The geospatial browser is well developed. Over the next few months, work to time-enable the townland coverage will begin together with the computerization of the locational attribute data. Each stage in this process is linked to a range of substantive research outputs. CDDA is creating a major research resource and will also be at the forefront of scholarship using the resource.

CDDA Resources Online

- CDDA online: http://www.qub.ac.uk/cdda

—Paul S. Ell
Centre for Data Digitisation and Analysis, Queen's University, Belfast

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The Belgium Historical GIS

Since 1990, a historical database of Belgian municipalities has been under construction at the Department of Modern History at Ghent Uni-

versity. Historical demographic and economic statistics at the level of municipalities for the period 1800-1961 have been systematically collected. Hundreds of historical maps have been digitized, representing the territorial structure of Belgium for the period 1800-2000. Recently, a sophisticated historical geographical information system and a website have been developed to make these maps and data accessible to the public.

The main goal of the project is to build a historical GIS that links the historical data to territorial units and enables users to map and analyze the data through time. To handle the evolution of hierarchical territorial units (such as municipalities, cantons, and arrondissemental districts) within a historical geographical database, four dimensions have to be integrated: geographical (longitude/latitude) coordinates, descriptive attribute data (such as population figures or place-names), hierarchic relations between different territorial units (which municipality is part of which district), and time. These components are subject to continuous change—boundaries, hierarchical relations, and attribute data evolve simultaneously and independently from each other. It is clear that this complex situation cannot be described within a simple table-linked-to-map -system. To reconstruct territorial evolutions within an HGIS, advanced methods such as the method of least common geometry have been applied.

The Belgium HGIS is based on three modules:

Module 1: A map of least common geometry, containing all historical boundaries of Belgian municipalities for each census year between 1800 and 1963 and for the present-day situation as of 2003. The map is stored in one single map layer, as an ArcView shapefile, in Belgian Lambert 72 map projection. This is a flexible storage system for geometric data, which contains all polygons representing every historical municipality down to the smallest units. Each polygon has been time-stamped. By linking historical data to this map the boundaries of municipalities, valid only for a particular moment in time, can be extracted from this map.

In comparison to systems based on simple tables linked to different historical maps (snapshots in time), the most important advantages of the method of least common geometry are:

• The geometry of the map can be easily updated, and each boundary exists only in one map and not in hundreds of different historical maps; and

• Evolutions of attribute data (for example, population densities) of territorial units can be interpolated through time, even if the names, shapes, and areas of territorial units have been changed.

Module 2: A spatio-temporal relational database-management system, powered by Microsoft Access XP, containing all information of the evolution of the historical territorial units, their composition and the historical attribute data, linked to the territorial units and to the map of least common geometry. Thanks to the hierarchical structure of Belgian adminis-

trative units, the map of the municipality boundaries also can be used to reconstruct territorial units at a higher level, such as departments and districts, since districts are assembled of different municipalities and departments consist of different districts.

The database contains the following information:

- The name of each Belgian municipality since 1800.
- A linktable for the composition of each department between 1800 and 1963: districts in each department.
- A linktable for the composition of Belgian districts between 1800 and 1963: municipalities per district.
- A linktable for the composition of the Belgian cantons (juridical and electoral) between 1800 and 1965: municipalities per canton.
- Dates marking the creation and abolition of each department, district, electoral canton, and juridical canton since 1800.
- The number of inhabitants for each census year between 1800 and 2001.
- Data on land use in 1834 per municipality: area per land use category.
- Selected municipal data on agriculture (province of Antwerp, 1846), industry and employment (province of Eastern Flanders, 1846, 1880, 1896, 1910).

Module 3: Since September 2003 a website has been created, making all data accessible via the Internet. The maps on this website are snapshots in time: each map is valid for a certain moment in time (December 31 of each census year). Data linked to these maps can be visualized and analyzed interactively. The system is free and open to the public. The map browser of our website is powered by "CommonGIS," which is a shareware program, developed and provided by the German Fraunhofer Institute. Users of our website do not need to install additional software on their local PCs; CommonGIS will be started on our server whenever the user sends a request to consult a particular map.

From 2005 onwards, the information system of the Belgium HGIS will be used and developed further to compile a Historical Atlas of Belgium, 1800-2000. This atlas will be based on a large collection of statistical municipal datasets and will visualize the country's main demographic and economic transitions in a large set of interactive maps. The digital atlas will also be available in print including texts analyzing the main historical trends.

The HGIS is explained in greater length in M. De Moor and T. Wiedemann, "The Historical Geographical Information System of Belgium," *History and Computing* 3:1 (2001): 69-96. The system provided the empirical basis for S. Vrielinck's three-volume study, *De territoriale indeling van België 1795-1963* [The territorial division of Belgium] (Universitaire Pers Leuven, 2000).

Belgium HGIS Resources Online

• Belgium HGIS online: http://www.flwi.ugent.be/hisgis/

—*Eric Vanhaute*
Ghent University

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Towards a Historical Geographic Information System for the Netherlands (HGIN)

As this issue goes to press, the History Department of the Netherlands Institute for Scientific Information Services (NIWI) in Amsterdam is in the process of digitizing all Dutch historical censuses (1795-1971). Within a few years, they will be accessible for statistical research. In order to add a geographical component to these census statistics, the NIWI recently has started a complementary project called Historical Geographic Information System for the Netherlands (HGIN).

The HGIN project is not the first of its kind in the Netherlands. Two pioneer projects, "Kartofoot" and "NLKAART," will be integrated into the HGIN project. The Kartofoot project, which started in the 1960s, was the first historical mapping system for the Netherlands. From a map of the 1856 municipal division of the Netherlands, E.W. Hofstee constructed the "Kartofoot," a giant jigsaw puzzle of over 1,000 pieces, in which every piece represented a different municipality. With ten differently shaded copies for every municipality, he was able to construct choropleth maps for all kinds of variables. As soon as an assistant finished the puzzle according to Hofstee's instructions, a photograph was made which was ready for publication (see Figure 1).

The main problem with Hofstee's map was that it only represented the municipal division of the Netherlands in 1856. However, every year, municipalities merged or boundaries changed. As a consequence, the total number of municipalities in the Netherlands fell from more than 1,200 in 1830 to about 600 in 1990. In order to draw a correct municipal map of the Netherlands for every moment in time between 1830 and 1990, 280 different maps are needed instead of the one Hofstee created. Hofstee more or less solved the problem by recalculating or interpolating the original statistics. In so doing, he managed to use his 1856 map for data from the start of the nineteenth until the beginning of the twentieth century.

The second pioneer project, NLKAART, was initiated by Onno Boonstra. This project, which started in the mid 1980s, aimed to solve Hofstee's problem using computer technology. Boonstra's system consisted of just two tables in a relational database. The first table identified the municipality and the time period in which each municipality existed in a specific form, the second table contained the coordinates of that specific