MAP: MONTRÉAL L'AVENIR DU PASSÉ SHARING GEODATABASES YESTERDAY, TODAY AND TOMORROW

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An interdisciplinary team of scholars has developed historical geodatabases for Montreal, with applications in architecture, demography and public health, as well as urban conservation. Using high-quality cartographic sources of the nineteenth century, data from taxrolls and directories are geocoded to cadastral lots. Key partners include the City of Montreal. Beta-test release is planned for October 2003.

Une équipe interdisciplinaire travaille à la confection d'un ensemble de géobases qui ouvriront de nouvelles perspectives sur l'histoire de Montréal. En utilisant des sources cartographiques du XIX^e siècle, d'une précision exceptionnelle pour les années 1825, 1846 et 1880, nous avons lié au lot cadastral les données complémentaires de plusieurs répertoires, rôles d'évaluation et recensements. La Ville de Montréal figure parmi les partenaires clés, et une première version intégrée sera à la disposition des chercheurs dès le mois d'octobre 2003.

Introduction

An interdisciplinary team of scholars has developed electronic geodatabases for nineteenth-century Montreal, with potential applications to the history of architecture, historical demography, geography, and public health. Household data from taxrolls, censuses, and directories are geocoded to their addresses or cadastral lots, mapped from high-quality cartographic sources of the nineteenth century. Overall objectives of the project are to extend techniques of geomatics into Canadian historical scholarship, and to expand the geomatics framework for recording and investigating urban heritage: the buildings, the documents, the stories, the "who and where" of what was once the future and is now the past. The electronic maps, designed to be shared with the larger research community, are integrated into a single framework. The foundation for their integration is the city planning database furnished by the City of Montreal (year 2000), and all the older sources are 'warped' to match. To take advantage of historic maps of exceptional quality, five dates were privileged: 1825, 1846, 1880, 1949, and 2000. The original cartography portrayed individual buildings, and the derived geodatabases are bundled with rich nominal sources of information about households, individuals and entreprises.

In addition to the City of Montreal, a dozen other institutional partners provided access to sources, scanning, and technical support. GEOIDE, one of the country's Network Centres of Excellence, provided assistance ($118,000 grant) in line with NCE concern for Canada's scarcity of specialists who combine a grasp of geomatics with library sciences and/or the humanities. Collaboration with archivists and museum curators acknowledges the potential of geomatics in a 'new pedagogy' of Canadian history, and involvement of graduate students with diverse thesis research objectives has given versatility to the system. In addition to directory and census data which are built in, design encourages further add-ons such as cemetery records or building permits, photographs and architectural drawings.

With this tool, one can bore 175 years into the past, to discover the politics of zoning or urban renewal, expansion of an industry, or one's own family network of a century ago. What remains today of the city of 1880? What diseases were associated with high-density occupancy? The 1880 map revealed houses rebuilt after the great fires of 1852 on foundations dating from the 1820s, as well as a thousand cartways (*portes-cochères*) vital to a town dependent on horsepower. The work involved in creation of the tool also raised new questions about past conceptions of city planning and present-day policies for urban conservation.

In this paper, we review first the design of the MAP system. In the second section we delve into methods: experiments in georeferencing and cre-

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ation of a prototype. In the third, for each bundle of databases associated with a particular marker-date, we try to convey some of the potential applications which are stirring excitement among researchers on the team. We point to problems yet to be resolved, to the opportunities for teaching, and finally, to some problems which challenge all of us in the field of geomatics.

Since this is the first project NCE-GEOIDE has funded in the humanities, we invite our colleagues in industry, government and university geomatics to consider, in relation to their own interests, the *problématiques* which drive research into the urban past: the wellsprings of urban identity, the city's power of attraction, its mechanisms for redistribution of wealth, the evidence of social mobility, the massive inequality in control of property, the innovative capacities of urban entreprise, the interactions of distinct communities of language, religion and culture, and their ability to project a collective memory and protect a shared heritage.

1. Design of the Project

The challenge was to create a research instrument with the precision and versatility to meet the needs of a great variety of people interested in the city's history and heritage. In the 1990s Canadian archivists and museum curators moved rapidly into scanning and digitizing maps to ensure preservation of rare documents and at the same time offer wider access to researchers, genealogists, and the public. Initial efforts took little account of scale and compatibility of platforms, each person or institution obliged to re-invent a wheel. A dozen researchers came together in April 2000 with a sense of urgency about the need for a 'shareware' system of geographic referencing for managing historical data on Montreal. What we have undertaken could be carried out in any community (perhaps more sensibly in a small one!) but teamwork is essential; nobody can afford to do it alone, and none of us alone has all the requisite skills.

While each of the half-dozen multi-layered, multi-scale base maps could be considered a subproject, their integration was the central issue, to be achieved by bringing all of the historic maps to a common geographic reference, the present-day municipal *Système d'information urbaine à référence spatiale* [*Ville de Montréal SIURS* 2000]. With the City's contribution as foundation for the common venture, the primary task was to develop methods which would respect the original sources, exploit them to greatest advantage, and ensure reliability of linkages among them.

What degree of precision could be obtained? House-by-house referencing would accommodate an approach known as *micro-history* in which the researcher matches and tracks small samples—households, couples, firms or individuals—through nominal sources like census or vital register. In all of North America, Montreal is the city richest in such historical sources, which can be effectively handled as relational databases and keyed to the electronic geodatabases which municipalities routinely use to footprint buildings and value property. This implies a higher level of precision than some of the early and ambitious projects which are now bearing fruit, such as the Great Britain Historical GIS or the Electronic Cultural Atlas Initiative for counties of China [see *Knowles* 2002; *Beveridge* 2002, and Web sites referenced].

To create an open-ended system—a system that would grow—we involved scholars with diverse interests, familiar with a wide range of sources from their training in history, geography, architecture, planning, and epidemiology. Because the techniques of geomatics are new to historians, the project required outreach and implied consistent preferences for means that would be inexpensive, dependable, user-friendly, and enabling. Penetration of geomatics into the teaching of history and the practice of historical research is central to our objectives, and ten theses (one defended, two submitted, the others in progress) have already generated or harnessed some components. The graduate students, through their ingenuity and interactions, forged new links and added appendages to a virtual Tinkertoy.

2. Experiments: Problem-Solving

By the time the two-year budget was exhausted, the logic and determination of researchers had been vindicated: it works! Leaping over some false starts and dead-end paths, we comment briefly here on preparatory assemblage of tools, imagery and pilot projects, give a little more attention to the central problem of rectification of images of various dates, and then comment on problems which arose from trade-offs among several objectives: accuracy, fidelity to the sources, and economy of means. In response to these problems, we experimented with autovectorization, error control, and geocoding from street addresses. Challenges of metadata and documentation will have to be addressed before we release the databases to libraries, the Web or classroom; we anticipate a 'beta test version' on CD-ROM in late October 2003.

Preparation: In addition to scanning the cartographic sources [*Adams* 1825; *Cane* 1846; *Goad*

1880: *Ville de Montréal* 1949], we prepared the modern geodatabases for grounding the system. We converted into ArcView 3.2 the initial set of MapInfo files of the SIURS-2000 whose thirty layers include city blocks, building footprints, administrative wards, zoning constraints, and property appraisals for the year 2000[1]. Designed to a tolerance of 30 cm for building façades, it was projected consistent with Quebec cartographic norms. The City of Montreal also supplied the hundreds of computer-assisted drawing files which were used (ca 1990) in creation of the SIURS, identical in georegistry. Known as the Quebec 1:1000 series, the drawing files outlined cadastral lots, as well as trees, railways and docks. In the McGill School of Architecture, the 800 drawing files were indexed and standardized to Autocad14 format, readable in ArcView 3.2. We re-projected the NRCAN orthophoto for convenience of navigation. Layers from the Quebec 1:50,000 digital map series were used to rectify the Sulpician rural *terrier* for the entire *seigneurie* of Montreal and create polygons for farm concessions. Those files provide an Island-wide context, and a bridge to display data for municipalities, parishes and census subdivisions at the scale of the province, anchored in NRCAN coverages at 1:250,000.

For 1881, where databases are very rich for a city of 165,000 people, Jean-François Palomino created a model covering five city blocks, to test the design and step through the processes of scanning, rectification, vectorization, construction of topology and keys to relational databases. After evaluation by a team of ten, directed by David Hanna and Jean-Claude Robert, we revised the design to make the cadastral lot a primary key for geocoding taxroll data, and to generate the file of street addresses from the taxroll, a source more comprehensive than either the atlas [*Goad* 1881] or the city directory [*Lovell* 1880].

Rectification: The most challenging technical problems arose in registering maps which were created at different stages in the evolution of surveying techniques. Each cartographic source presented special problems. As a result of massive destruction in the 1960s, few landmark buildings of 1880 remain today as potential control points, and the problem is yet more severe for 1846. To find suitable control points, we had recourse to property lines. Although these boundaries are invisible abstractions, they are jealously guarded and institutionalized, and often proved more dependable than 'natural' features or stone buildings.

We began with a closely controlled rectification of the 1881 cartographic imagery to the SIURS-2000, then rectified the 1846 imagery [*Cane* 1846] to the rectified images for 1881[2]. Thus, we corrected the 1881 Goad atlas plates, published at the scale 1"=200' and 'of unknown projection', to MTM Zone 8 projection: each of the 43 Goad plates was scanned in two sections; and the TIFF files were warped to match the projected vector data for cadastral lot boundaries, imported into ArcView from the scores of AUTOCAD files, stitched together in blocks of four. Images from the Cane map of 1846 (four 'sheets') were then painstakingly cut into sections corresponding to the 86 half-plates from Goad, and each cutting (saved as JPEG) was warped to match the Goad plate, using landmark buildings which survived 1846-1881, as well as control points on lot boundaries. From the 1825 map [*Adams* 1825], few buildings survived intact to 1881, but the eight digital images were rectified to the SIURS-2000 in a more approximate fashion, to preserve correspondence with the street pattern. As in other cities, the layout of streets as municipal owned public space is a deeply conservative feature.

For 1825 and 1846, buildings, as well as blocks and lots, were individually digitized as polygons on screen. In view of the mushroom growth of the city (doubling every twenty years), we economized on the labour of digitizing by treating 1881 buildings as points, and for the creation of cadastral lots we employed autovectorization. Because the rich colour, elaborate labelling, and visual complexity of the Goad plates militated against automation, we resorted to plans that were published in 1870 at the creation of the cadastral system (today referred to as *le vieux cadastre*). These plans are much simpler, showing lot boundaries and lot numbers alone, in black-and-white. The 25 plans were scanned at the Bibliothèque nationale du Québec; we cleaned the digital images of lot numbers and blemishes; rectified them to match the cadastral lots shown on the modern drawing files (consistent with SIURS-2000); autovectorized them as arcs using ArcInfo8, constructed polygons and matched the edges, with further cleaning and restoration of the cadastral lot numbers as a variable for labels and links to the taxroll databases. They required demanding corrections.

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Error: Systematic and professional procedures for error control provided helpful warnings, but finding satisfactory compromises depended on historians' familiarity with the sources and their past experiences of 'ground-truthing' [cf. *Carey* 2002; *Hanna* 1986]. Errors arise in the original cartographic surveys, in deterioration of the sources (folds, tears, blots, stretching), and in the imaging process (e.g. distortion in the periphery of each Goad half-plate). Further errors are generated in the formulaic rectification process and subsequent edge-matching. The earlier sources (1825 and 1846)

were more at variance with the well-grounded modern map since they were created prior to trigonometric survey by the military in the mid-1860s. Contemporary errors in the layout of a block were more frequent in less developed parts of the city; and beyond the city limits the problem is compounded because we had to substitute plates from a smaller-scale atlas of wider coverage [*Hopkins* 1879].

The challenge was extremely variable from one plate to another, and the interaction between errors in the two successive warps (1881 to 2000, and 1846 to 1881) is not simply additive. Our informal standard is the wish to 'recognize' buildings and lots when they are overlaid, and experiments will have to be performed to see how often a click at the centre of a building or lot in one layer identifies the 'correct' building or lot in another. The archaeologist or the homeowner with a map to buried treasure might want more tests before wielding the pick, but the renovation architect trying to date a building, or the genealogist or historian trying to situate a household in a house is likely to be rewarded.

Metadata and documentation: Carol Marley, with her training and experience in library sciences [*Marley* 2000a, b], focussed our ambitions on finding pathways between high-tech standards and low-tech finding aids, important in an outreach project. Thus metadata generated in ArcInfo8, in conjunction with the building of topology, can be converted by standard crosswalks to a simpler Dublin Core format. With the progress of international committees on standards, it is now easier to generate geomatics properties such as coverage and projection, and to build into the files the essential information about sources, transformations, versions, acknowledgments and licensing restrictions.The SIURS-2000, developed in the 1980s, contained minimal built-in metadata, but Rosa Orlandini, using ArcCatalog, created metadata to FGDC standards, inserted it into the original MapInfo version, and re-introduced it into the ArcView version.

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At the same time, historians, trained to cross-question their sources, uncovered startling ignorance about the objectives and standards employed in creation of the original maps. None of the cartographic sources has yet been thoroughly analyzed in its own right [*Robert* 1994, 88-91], and Montreal would make an excellent choice as a case study for a history of urban survey, with the convergence of French *arpenteurs*, French and British military engineers, British and U.S. architects and developers. Efficient linking of databases demanded compromises which have to be documented: Where two adjoining lots are owned by the same person, should we treat them as a single lot? How reliable are the lot boundaries that appear on the 1846 map?

Every step has reinforced our conviction that sensitivity to users' needs is vital to data discovery, and therefore to the effective adaptation of geomatics to historical research. Some careful pieces of documentation were prepared to ensure quality control in generating the geomatics framework, and others will have to be developed so that users will aspire to a comparable standard for integrating their own work. It is now clear that we will have to produce a handbook for the project.

3. *Bundles of Applications*

The experimental approach to design, together with student initiatives, has provided an exhilirating array of potential applications. As assembly progresses, interest has increased in the representation of property boundaries, and in the way in which layout and distribution of property ownership have affected both the *built habitat* and the *social space*.

Because each source was created under a different logic, with different criteria for inclusion of an individual, we had to adopt different strategies for peopling the maps. John Adams' military map of 1825 identified about 2400 dwellings and a comparable number of workshops, warehouses and outbuildings, with about two buildings on each occupied lot, fronting on 113 different streets. There were no street numbers to connect the people with the polygons on the map, but a detailed listing of 458 'assets' insured against fire in 1820 permitted us to decipher and apply the numbering system that Thomas Doige had developed for his city directories of 1819 and 1820 [*Sweeny* 2002; *Doige* 1819; *Sweeny* 1997]. Like the working of a crossword puzzle, each small success provides additional clues for matching and linking more entries from the census and taxrolls of 1825.

The same kind of ingenuity is required to link people to the 1846 layers. They are based on Cane's commercial map which displayed 6834 buildings, at about two buildings per lot, plus 2800 vacant lots. The first step is to situate owners who are referenced in deeds of commutation (1840-1852), acts which usually specified the ward in which the property was located, the street on which it fronted, and owners of adjoining properties. By unraveling the clues present in 1310 such deeds retrieved from notarial archives[3], we geocode by cross-reference the rather fragmentary addresses of households reported in commercial city directories 1846-1848, the 1842 census, 1847 and 1848 municipal taxrolls, and records of the Catholic cemetery.

The 1881 system is massive: a thousand city blocks, twelve thousand cadastral lots, a point representation of 40,000 buildings (distinguished by wood vs 'permanent' materials), visual reference layers for railways, waterfront and canal, and a table of 700 street names. The taxroll is handled as two linked tables, one for the owners of each lot (name, address, cadastral lot number, assessed value, religion) and one for the 35,000 occupant householders (name, occupation, street address, rental value). Lovell's city directory (32,000 entries) provides additional details on businesses, office buildings, dual entries for home and business affiliation (10%), and offers opportunity for comparing the two sources.

The outstanding challenge is to link the nominal census of April 1881 to the geomatics framework. A complete digital version (100%) has been provided by Lisa Dillon and Chad Gaffield who supervised cleaning and verification of files created over a decade by the Latter-Day Saints and volunteers from genealogical societies[4]. Successful geocoding of census households would offer unprecedented analytic opportunities for combining rental values (a measure of puchasing power) with census data for household structure, religion, origin, and life stage, with applications to mortality and fertility [*Gauvreau* 2001]. Although census-takers moved systematically through the city, they did not record street addresses [*Lauzon* 1990]. The decoding is being undertaken as a two-stage process. First, we placed on the map the 6000 owner-occupants who are clearly identified on the maps and taxrolls. Second, from those points on the map, we discovered the boundaries of the several hundred census subdivisions, so that in the current phase, working within the boundaries of one subdivision at a time, we can search, match and place the remaining census households.

Each component database has intrinsic interest, and from the massive puzzle unexpected patterns emerge, opening up questions which have never been addressed in the historiography. In elaborating the layers for 1825 and 1846, Sweeny was pursuing an interest in property ownership, and subdivision of lots indicated emergence of speculative strategies of owners. The 1846 map, which antedates massive application of steam power to industry, reveals an intense commodification of land suggesting a profound change since 1825 in how people thought about property. Since many of the urban lots were laid out under the seigneurial régime, the Sulpician Order has given permission to study the *terrier* they used to reference deeds of concession, sale or *hypothèque*, and keep track of the dues owing to them as seigneurs [cf. *Young* 1986]. After 1870, such deeds are referenced to cadastral lot numbers, as are annual taxrolls, municipal permits and subdivision plats. The geomatics framework, by matching the cadastre of 1870 with the older *terrier*, will facilitate study of property transfer, commutation of seigneurial rights, inheritance, and subdivision.

The sizes and shapes of lots exerted an important constraint over what could be built on them. Jason Gilliland analyzed the impact of street widenings on the value of lots and the viability of reconstruction [*Gilliland* 1999; 2002], and François Dufaux, in doctoral work on the history of 'plex' housing in Montreal and its syntax of internal room layouts, employs the MAP geomatics framework for managing, locating, dating and analyzing 600 nineteenth-century dwelling plans [*Dufaux* 1999]. To complete their studies, Gilliland and Dufaux rectified early twentieth-century sources for annexed suburbs [*Pinsonneault* 1907; *Goad* 1912]. Rosalyn Trigger's research on Protestant church extension uncovered late nineteenth-century perceptions of the urban challenge to the churches [*Trigger* 2002][5]. Luc Carey is doing research on reconstruction of Montreal after the great fires of 1852, and Sylvie Freney, for comparative study of the *faubourgs* of Montreal and Angers 1750-1825, is using the 1825 MAP layers and creating her own GIS layers from 1810 imagery of Angers (France). Thus the doctoral students, initially designated as 'apprentices', have made MAP their own creation.

...research on reconstruction of Montreal after the great fires of 1852,...

4. *Unfinished Business*

Teamwork itself was a formidable challenge. While the synergy was essential, all of us had to make some compromises. Communication was made easier by the focus on a single urban area, pre-existing links among the several universities, and concentration of technical work in a single lab. In conceiving a system with an 'open architecture' and such diverse applications, the original team is somewhat overwhelmed by the possibilities. Concerns remain with respect to diffusion, documentation of further additions, and protection of the integrity of the system. Three sets of problems are noted here: First, full development of the 1949 layers was postponed for want of resources. Second, effective use of the tool will require sustained and systematic outreach to students, librarians, and instructors at all levels. Third, wider networks of collaboration, already initiated, will have to be pursued with additional specialized partners.

The handsome land use plan of 1949 [*Ville de Montréal* 1949] was created by city planners and

engineers in preparation for a 'Master Plan' exercise by consultant Jacques Gréber, and then shelved for half a century. Its pastel colours detailing sixteen categories of land use enhance an architect's grasp of the genius with which institutional buildings were situated and their influence on streeting. Recognizing its value as a document of the urban fabric prior to the massive demolitions of the 1960s, MAP scholars brokered an arrangement among eight parties to ensure its conservation. The Bibliothèque nationale du Québec contracted for high-quality scanning by Trigonix Inc. From the digital images, the Laboratoire de géomatique de l'Université de Montréal printed a facsimile true to scale and colour for use by city planners who in turn transferred their originals to the municipal archive[6].

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Although the success in providing protection and access is satisfying, the corresponding GIS layers could not be completed with the initial resources. Warping and vectorizing will require injection of funds on a scale comparable with the initial project, since the surviving copy was generated from a mylar patchwork, and each of the seventy metre-square plates is composed of 16 sections, hence 1120 pieces to be rectified and reassembled.

The work done for 1949 is only an appetizer. At the University of Victoria, Larry McCann directed an effort to create Island-wide boundary files suitable for comparing census subdistrict data for 1901 and 1951 [*McCann* 2000a]. From a five percent sample of the census of 1901, he and Ian Buck, using a GIS-based integration index, argue that Canadian cities of the early twentieth century were characterized by a high degree of residential integration rather than segregation, whether we refer to indicators of social class, ethnicity or family structure [*Buck* 2001; *McCann* 2000b]. A paper in preparation considers how large corporate land owners such as Hudson's Bay Company and Canadian Pacific Railway generated middle-class suburbs, through their conceptions of the meaning of socially segregated spaces, and their ability to influence planning in the public realm. Raphael *Fischler* [2002], meanwhile, has amassed documentation for a comparative history of building and zoning regulations in Montreal and Toronto.

5. Opportunities for Teaching

Work of the graduate students identified somewhat diverse learning strategies, and the pilot project was used experimentally in several undergraduate history classes. Initial spread of the tool can operate by the principle 'each one teach one', but its effective use will require a more sustained effort at training at all levels: graduate and undergraduate students, instructors, librarians.

Of the fifteen postgraduate scholars (supported entirely from sources other than NCE), a dozen succeeded in carrying out an application of their own research, and, in the learning process, played problem-solving roles in creation of the MAP framework. Three with prior training in geomatics contributed immeasurably to database design and to *encadrement* of newcomers to the technology. Kevin Henry taught several two-day workshops for beginners; he and Ian Wanyeki coached four professors[7]. Palomino's five-block pilot project, enhanced with hot links to house plans and elevations contributed by Dufaux, provided a demonstration unit for introducing students to strategies of query. Gilliland, in teaching a methods course in geography, combined fieldwork, labwork and archival work to expose sixteen undergrads to the problems of ground-truthing one plate of the 1949 land use map. Their 'Chinatown GIS' was a popular exhibit at an undergraduate 'GIS Day'. McGill historians brought to the lab three successive classes in research methodology (12-17 students on each occasion), and three of their students, by linking family addresses to the geodatabase, explored the identities of people buried in a Protestant 'poor ground' in the 1880s.

The classroom experiments suggest that history students would benefit from a quite different learning sequence from what is usually proposed for instruction in GIS. They need first to gain experience in querying simple databases [cf. *Sweeny* 1997-2002] and to construct one of their own, facing the issues of standardization, formats, and re-coding. They can then move to a truly relational database (which can be effectively explored in ArcView), and from there to a georeferenced system. Modular self-teaching materials proved effective in both workshops and individual settings [e.g. *ESRI GTKAV* 1999], but newcomers need to pay attention to 'old-fashioned' issues of cartography such as colour, map symbols, and labelling conventions, which are rarely covered in GIS texts, and they need cues for exporting and enhancing the map product in CorelDraw or Adobe Illustrator [cf. *Conway et al.* 1998; *Frye* 2001].

The MAP framework was immediately recognized as an instrument for 'the new pedagogy' in Canadian history. Several participants were initially attracted to geomatics as a promising mode of visualization[8]. Seeking to replace a pedagogy of authorities with a more responsive and inclusive

spirit of inquiry, they have become involved in development of the 'virtual museum'. The McCord Museum of Canadian History, working under a SSHRC-CURA grant to generate new media for secondary education, is using its collections as an approach to material history through Web service at a site called ClioClic, with industrialization, urbanization, and living conditions as primary themes consistent with Ministry programs in Quebec and Ontario, grades 10 and 11. 'Web tours' drawn from the MAP geodatabase display the occupational specialties of various parts of the city. The Web site handling of the maps as images does not yet exploit the full potential of geomatics (contrast the experiments at the HAC site *http://Mercator.geog.utoronto.ca*), but it integrates cartographic display with representations of nineteenth-century tools, vehicles, toys and clothing. This in turn opens up an appealing youth perspective. A sequel initiated by the McCord Museum under the Canadian Digital Cultural Content Initiative (CDCCI 2002-2003) sustains our current effort to link all the pieces of the 1881 GIS, so that it can be used to devise virtual 'walks' through Montreal in the 1880s, combining the maps with paintings, photographs, and museum objects. Creative use of geomatics offers alternative paths into the city of the past.

6. Dual Competence: A Challenge to the Geomatics Community

As the GEOIDE network's venture into the humanities, the MAP pilot project issues a challenge to the entire community of Canadian software developers, universities, research funding agencies, and the government agencies which generate key geodatabases. Expansion into the challenging field of H-GIS or 'GIS for History' [*Knowles* 2002] implies that we must continue to target beginners in geomatics, to meet their needs for data, and to offer alternative learning paths. From that starting point we will need to develop a larger pool of specialists with dual competence in geomatics and the humanities.

Familiar to readers of *Geomatica* is Canada's worrying scarcity of personnel with such dual competence. The MAP project identified, at university and postgraduate levels, several interfaces where universities are caught in a classic 'development trap', unprepared to train the kinds of people they need. While scarcity is experienced in all areas of information technology, it is most neglected at the interface with the humanities. University libraries are moving rapidly into electronic data formats, and are providing massive banks of workstations for students, but Canadian schools of library science offer no training in cartographic sources and remotely sensed data, let alone geomatics, its finding aids and its metadata. The scarcity of these double-talented people creates a serious problem for all GIS users, who rely on libraries to manage their basic sources.

Canadian historians are also shortchanged by persistent scarcity of technical resources for experimental teaching of space-sensitive methodologies, whether quantitative, qualitative, symbolic or cartographic[9]. Imagery is increasingly accessible on Web sites, and the MAP geodatabases under construction offer rich local resources to tickle the fancy of eager and opportunity-conscious undergraduates and motivate advanced researchers to master new methods, enter new forms of collaboration, and conceive new research goals. This will create pressure on resources available to the humanities. Making the most of 'the Montreal GIS' will require labs and library facilities equipped with higher-capacity work stations, CD-readers, large-format colour printers, GIS software for various levels of sophistication, and above all, the support of teaching assistants, lab demonstrators and technicians. Tickling the students may cause the institutions to sneeze.

Despite Canada's early initiatives in GIS, the people who design and market the most widely used geomatics software are not visible players in NCE-GEOIDE, and their Canadian subsidiaries are close to invisible as partners in research. If Canada aims at ongoing industry-university partnership in the field (an objective of the Network Centres of Excellence), it is urgent that industrial and institutional leaders come to grips with the problems of learning curves, licensing options, copyright issues, bilingual documentation, and self-teaching programs with Canadian content and historical depth.

Canadian research is seriously hampered by imposition of 'cost-recovery' measures by various levels of government. Vital to the MAP project has been the exceptional collaboration of the Ville de Montréal whose enlightened generosity contrasts sharply with provincial and federal levels that demand substantial cash outlays for standard government data[10]. The notion of cost-recovery on public information is largely illusory since the policy handicaps Canadians relative to U.S. researchers, who have free access to virtually all data generated from public funds. It creates problems even for government agencies who depend on university-based research. Pressure for cost recovery occurs also in university administrations. The MAP project thrived because the McGill Faculty of Science

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extended exemplary hospitality in its GIS labs, entered into a visionary partnership with McGill Libraries, and initiated a university-wide license for software. In some universities, however, GIS labs operate under a rigorous obligation to charge for any service, thereby excluding would-be explorers from the humanities.

Within the short life of this project we have seen improved access, notably NRCan's decision to extend map depository privileges to digital files, new arrangements at the Bibliothèque nationale du Québec for legal deposit of publications in digital formats, and an impressive expansion of their Web site for downloading digital images of historic maps [*www.bnquebec.ca*]. To organize a CD-ROM library with essential documentation, initial experiments suggest that royalty-free software or a simplifying programming initiative could be used for packaging the 1825 and 1846 geodatabases as first-line introductions. As these packages are finalized (summer 2003), researchers can pursue the option of a *dépôt légal* to ensure that all of the databases remain accessible to the public.

Through apprenticeship of advanced students in historical research, MAP has elicited in the research community an eager interest in geomatics technology, and we now foresee options by which larger public groups, including secondary school teachers and their pupils in history classes, will be able to explore Montreal in new ways. To adopt the expression of our partners at the McCord Museum, 'Un lieu de mémoire devient un lieu d'expérimentation'. Conversely, a great deal of experimentation will be needed to develop those virtual spaces in which we can identify our points of reference in the past and test our plans for the future of a city.

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Bibliothèque nationale du Québec
Centre interuniversitaire d'études québécoises (Laval-UQTR)
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CompuSearch Canada (MapInfo)
Foundation for the Advancement of Protestant Education in Quebec
McCord Museum of Canadian History
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http://www.geog.port.ac.uk/gbhgis/gis British historical GIS (Univ. of Portsmouth)

http://Mercator.geog.utoronto.ca Historical Atlas of Canada

www.ecai.org Electronic Cultural Atlas Initiative

www.mccord-museum.qc.ca McCord Museum of Canadian History

www.vieuxmontreal.qc.ca Ville de Montréal, site du Vieux Montréal

www.prdh3.demo.umontreal.ca/dillon Département de Démographie

www.prdh.demo.umontreal.ca Programme de recherche en démographie historique

www.davidrumsey.com David Rumsey Historical Map Collection

Robert Sweeny

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Notes

1. Conversion was based on availability of technical support in the McGill Lab. A MapInfo user could readily re-import the historical layers, and MapInfo in fact contributed to our geocoding experiments.
2. Working with ArcView, we chose the extension Image Analysis, a procedure relatively easy to learn and visualize, but other warping software would give similar results. For ingenious and diverse applications of warping to historic maps of New York, see www.davidrumsey. com.
3. ANQM, repertories of Patrice Lacombe and Edward Lafleur.
4. Dillon is associated with the Canada Century Research Infrastructure, funded by CFI to create samples from twentieth-century censuses (University of Ottawa); IMAG, the International Microdata Access Group who are standardizing occupational codes for comparative work 1880-1881 [*www.//prdh3.demo.umontreal.ca/dillon*]; and the *Projet de recherche en démographie historique*, where Bertrand Desjardins manages vital data for Quebec parishes prior to 1850 [*www.// prdh.demo.umontreal.ca*].
5. See contributions from St-Hilaire, Trigger, Robert, Olson, Watkins and Gilliland to *La Paroisse* [*Courville and Séguin* 2001].
6. Facsimile prints can be consulted at the Canadian Centre for Architecture or the municipal archive in City Hall; the imagery is available also in map collections of the Bibliothèque nationale du Québec, UQÀM and McGill.
7. Henry and Wanyeki expanded their skills in spatial statistics through their efforts to test and apply the SIURS database for case-control studies of tuberculosis, under direction of Kevin Schwartzman, respiratory epidemiologist.
8. See prior work CD-ROM media [*Robert* 2001; *Sweeny* 1997-2001], museum work [*Young* 2000], citizen and environmental advocacy [*Fischler et al.* 2002], and Web site featuring work of Burgess, Lauzon, Sweeny et al. [*www.vieuxmontreal.qc.ca*].
9. Historical geographers are better served, as well as archaeologists, in departments where GIS was rapidly adopted [*http://ahds.ac.uk; Moss et al.* 1998].
10. Similar generosity of local agencies enabled library delivery of geodatabases in a joint project of Carleton and University of Ottawa [*Anon.* 2002] ❑

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