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Capturing Glocality—Online Mapping Circa 2005 Part One: Mapping Territories

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ABSTRACT This two-part paper explores the sources, motivations, and consequences of emergent online mapping activities, circa 2005. Online mapping, defined as mapping software applications and associated cultural practices that utilize the Internet as a primary infrastructural component, arises as an information retrieval technology, twice-over. Its technological ancestors are *maps of territories* in the form of geographic information retrieval technologies originating with remote sensing and Geographic Information Systems (GIS) software, and *maps of information* in the form of Web-based information retrieval technologies that comprise search engines and website classification systems. Online mapping is a product of the convergence of these technologies which each had reached a critical tipping point with regard to data management.

This paper contends that to reduce and manage excessive amounts of information, each adopted strategies that retailored both Web-based and geographic information management to focus on the local as the site for globally scoped information retrieval. During the Cold War, a clash between the U.S. Air Force's directive to amass untold quantities of uncalibrated satellite data and the Army's mandate to systematize and manage that data produced the World Geodetic System and paved the way for the GIS technologies at the heart of Navteq and Google Maps. Now, as the amount of information on the Web grows exponentially, Web-based information retrieval technologies face a similar dilemma. Personalized search (epitomized by Google) and folksonomy (user-contributed keywords) are superceding top-down directory classifications (like the early Yahoo!).

Secondarily, while the cultural practice of mapping remains, above all, a matter of representation, this paper asserts that online mapping departs radically from traditional cartography. Online maps forsake the techniques and precepts of visual representation, as typified in centralized, perspectival systems of optics that aspire to global extent. Instead, engaging distributed, data-centric systems that operate locally, online maps achieve representation through what Philip Agre describes as technologies of informatic capture.

Three case studies (Google Maps, map hacks and mashups, and folksonomy-based neighborhood maps) employ this representational mode to produce *maps of glocalities*, indicating a cultural shift toward merging dominantly optical and dominantly informational worldviews, and toward infusing global networks with local practices.

INTRODUCTION In the history of the Internet, the year 2005 was a moment filled with changing mores and changing technologies. In the early spring of 2004, Dale Dougherty of O'Reilly Media coined the term "Web 2.0" to reflect the shift he and others were observing away from business-as-usual dotcom era standards and toward a collection of new practices rife with memes: Social Software, the Blogosphere, Web Services, the Long Tail, Folksonomy, Small Pieces Loosely Joined, Hackability, Scalability, Glocalization—the list goes on. O'Reilly Media convened its first annual Web 2.0 Conference in October, 2005. But first, in June of that year it arranged another conference, Where 2.0, revealing how the transformation underway with Web 2.0 was, *from its inception*, imbricated with location-based technologies. An example of one such technology was cited in the Where 2.0 conference promotional materials: a veritable renaissance in online mapping was already in full swing that summer.[1]

Online mapping refers to mapping software applications and associated cultural practices that utilize the Internet as a primary infrastructural component. This project seeks to explore the sources, motivations, and consequences of the proliferation of emergent online mapping activities circa 2005. In the ensuing three years, Web 2.0 has congealed into normativity and, while online mapping has found traction and even ubiquity in mobile platforms, the enthusiasm that then surrounded emergent online mapping practices appears now as a faded fad. Nonetheless, to delve deeply into the history leading up to its resurgence allows online mapping to serve as a lens, bringing into focus certain cultural currents that reverberated throughout Internet and mapping technologies during the emergence of Web 2.0. Chief among these is a trend toward glocalization wherein global networks and local usage dovetail in a feedback system. Indeed, given the "global village" meme associated with the Internet's early development, it may be surprising to consider that a main contention of this paper is that, circa 2005, online mapping practices were overwhelmingly oriented to the local. In this way, online maps help to locate Web 2.0 as being, first and foremost, situated.

This project appears in *Parsons Journal for Information Mapping* in two parts, "Mapping Territories" and "Mapping Glocalities,"[2] unified in their treatment of online mapping as an information retrieval technology that is, like all technologies, engineered to accommodate explicit cultural predilections. Yet, technologies enforce and disallow specific forms of behavior on the part of their users. So, just as glocalization implies a continual negotiation between local and global demands, a culture that deploys online maps is also regulated or "programmed" by them.

Online mapping arises as an information retrieval technology, twice-over. Technologically speaking, its direct ancestors are *geographic information retrieval technologies* originating with remote sensing and Geographic Information Systems (GIS) software, and *Web-based information retrieval technologies* that comprise search engines and website classification systems. Online mapping is a product of the convergence of these technologies. Independently of one another, each had reached a critical tipping point with regard to data management. In the need to reduce and manage excessive amounts of information, each adopted strategies that retailored both geographic and Web-based information management to focus on the *local* as the site for globally scoped information retrieval.

In assessing online maps as information retrieval technologies, a central concern must be to analyze the practices through which information is retrieved. In his work concerning technology and privacy, scholar Philip E. Agre draws a distinction between two methodologies for acquiring information: *surveillance* and *capture.*[3] In broad terms, surveillance indicates a cultural model of privacy that includes optical, centralized, coercive techniques for tracking people and things. Capture, an alternate cultural model, refers to informatic, distributed, consensual systems of tracking. This project explores the application of these concepts to emergent models of online mapping, and to the antecedent technologies that comprise it. In general terms, I conclude that online mapping has more to do with capture than surveillance for the reason that surveillance aspires toward a global, total apprehension, whereas capture embodies a local, situated focus. Using these two concepts to think about online mapping leads to a secondary conclusion that although capture engages users' voluntary participation, it arguably creates greater privacy concerns than would be present in a surveillance situation. Even so, because capture operates through an aggregation of loosely affiliated distributed systems instead of a unified monolithic one, local information capture allows for personal interventions into global systems which would otherwise remain impossible or invisible.

In principle, the restructuring of Web-based and geographic information retrieval technologies marked a shift from a surveillance paradigm to a capture paradigm. Attempting to manage people and territories, geographic information retrieval systems relied first on remote sensing and reconnaissance surveillance which eventually gave way to GIS and capture. Just as reconnaissance surveillance is geared toward establishing concrete identities of people, places and things, Web-based information retrieval technologies first sought to facilitate the management of information by developing global systems to traffic definitively identified documents. Like geographic information retrieval systems previously, Web-based information retrieval technologies had, by 2005, begun to shift to relative strategies which, like capture, rest on linkage and relative context, rather than a rarified approach to content.

Online mapping is a hybridized technology, indebted to both information and territorial mapping. As such, it is caught in between, a product of industries generating global geographies and standardized data sources on one hand, and of local users bringing to bear neighborhood territories and personal relevance on the other. While online mapping is a recent phenomenon, the history of factors giving rise to it on the twin fronts of territorial mapping and information mapping suggests that as online maps continue engaging local capture toward globally scoped information retrieval, their technologies can be expected to grow more *glocal* over time.

PART ONE: MAPPING TERRITORIES

Online mapping begins by mapping territories. The idea of a territory should be understood not only in a geographic sense, but also in a cultural sense. Territories can be at once spatial and personal; in this broad definition, they are anything in which a party takes a vested interest. That said, it is through the process of mapping that physical and cultural territories become informational, layered, and hybridized.

This paper starts with a discussion of a principle player in all online activities circa 2005: Google. In the context of online mapping, Google is particularly worthy of attention. The release of the Google Maps API on

June 29, 2005 was a principle condition of possibility to motivate online mapping's renaissance.[4] Outside of information mapping, Google's activities hinge on aggressively mapping territories of offline physical repositories. Google's practices are illuminated by a discussion of Philip Agre's model of surveillance and capture, which this paper examines in detail. Surveillance and capture provide a theoretical model for understanding a series of technological developments that give rise to GIS, one of two main technologies, the other being the Internet, that underlie online mapping. The evolution of GIS shows that, historically, capture is often an outgrowth of surveillance, part of a shift from global absolute reference to local generalized reference. This trend is spurred by the fact that surveillance-type systems create pressing data reduction needs, requiring the reengineering of information retrieval technologies.

In the case of territorial mapping, the technologies in question were quite literally surveillance systems, in the most dramatic sense, developed in the context of military reconnaissance. In the trajectory from surveillance to capture and modern GIS, these geographic information technologies span a gamut from optical technologies related to remote sensing from balloons, spy planes, and panoramic spy satellites, to non-optical remote sensing, such as radar and electronic distance measuring devices (EDMDS). Elements of these technologies were eventually combined and reapplied in data standardization technologies, including the World Geodetic System, ortho-pixels, data layers, compositing, and the Global Positioning System (GPS).

An important aspect of this history of mapping territories is that it evolves from a pursuit of the discrete, absolute identity of the territories being mapped, to a suite of technologies that *render identity general rather than specific.* This process involves a technological intervention that creates, rather than reveals, the territories it maps.

THE "GOOGLIZATION OF EVERYTHING"[5] OR MAPPING "THE WORLD'S INFORMATION."

> *Google's mission is to organize the world's information and make it universally accessible and useful.*[6]
>
> — *Google Corporate Mission*

When Google got its start in August of 1996, its mission "to organize the world's information and make it universally accessibly and useful" seemed by all accounts to be clearly directed toward information that was part of the World Wide Web. At that time, observers would likely have assumed that for Google, the "world's information" was limited to content that already existed online. However, in the ensuing years leading up to 2005, and particularly after Google's IPO on April 29, 2004, Google's releases, betas, acquisitions, and Google Labs projects sought to "organize" an eclectic array of offline services including shopping through Froogle, movies through Google Movies, videos through Google Video, instant messaging through Google Talk, books through Google Library and Google Print, mail-order catalogues through Google Catalogue Search, blogs through Blogger and Google Blog Search, photo-sharing through Picasa, taxi cabs through Google Ride Finder, platforms for local mobile services through Google Mobile Local, scholarly articles through Google Scholar, maps through Google Maps, and the moon through Google Moon, to name but a few. In addition, Google announced plans to provide free WiFi coverage in both San Francisco and Mountain View, California, as well as to enter a partnership with NASA.[7]

In fact Google's co-founders, Larry Page and Sergey Brin, had long been concerned with the potential scope of data available for indexing. In their 1998 paper, "The Anatomy of a Large-Scale Hypertextual Web Search Engine," published while the young entrepreneurs were still at Stanford, Page and Brin saw two potential points of limitation for the scale of their search engine, the race between the capacity to process data and the generation of more data to be processed. They estimated that the first factor, the speed and storage capacity of hardware, would work in their favor according to Moore's Law.[8] The second factor, the persistent generation of new content, represented the only potential stay on the expansion of their search enterprise. In this paper, the authors distinguished between human-generated and machine-generated content types. For practical purposes — the need to keep apace of rising rates of production of information, which could be unpredictable in the case of machine-generated information — Page and Brin determined that Google's energies should be directed toward the former category, the field of human production. In other words, Google would focus on organizing the field of information that, from a humanist standpoint, is traditionally deemed *culture*:

> *Because humans can only type or speak a finite amount, and as computers continue improving, text indexing will scale even better than it does now. Of course there could be an infinite amount of machine generated content, but just indexing huge*

> *amounts of human generated content seems tremendously useful. So we are optimistic that our centralized web search engine architecture will improve in its ability to cover the pertinent text information over time and that there is a bright future for search.*[9]

Interestingly, while Page and Brin limit their concerns here to only text-based human production, they are already setting their sights well beyond the scope of digital documents. The fact that the ceiling for their search engine would be the "finite amount" that humans can "type or speak," not the rate at which humans (or machines) can *publish* content online reveals that their indexing is aimed not at cyberspace but at *the entire field of human cultural production.*

Reading this early statement in light of Google's mission "to organize the world's information and make it universally accessible and useful," one is struck by the fact that Google's recent projects evince a radical expansion of what Google considers "information." No longer limited to the information in cyberspace, Google has come to see its role as the organizer and universalizer of all kinds of information, including cultural artifacts from the offline, physical world.[10] Scholar Siva Vaidhyanathan has connected Google's "rather optimistic and humanistic" mission with Sergey Brin's "more ominous indication of what the enterprise might become: 'The perfect search engine,'" in Brin's words, "'would be like the mind of God.'"[11] Such territorial mapping would know no limits. In point of fact, on October 8, 2005, Google's CEO, Eric Schmidt gave a surprising public announcement: an ETA of 300 years until Google would index and organize all of the world's 5 million terabytes of information, of which he reported that they had presently indexed 170 terabytes.[12] The significance of such a statement lies not in its being an extraordinarily long-range plan, but in its being a plan at all. And in fact, Schmidt avowed that at the time of his statement Google was engaged in "math experiments" to this effect.

MAPS OF CAPTURE, MAPS OF SURVEILLANCE

The process of "making [the world's information] universally accessible and useful" accordingly begins by *first conceiving of the world as information, and secondarily bringing that information online.* For Google, it is a matter of incorporating "huge amounts of human generated content"—i.e., cultural content—into the informational world known as "cyberspace." This two-step process of first modeling the reality and then acquiring the data is precisely the process that Philip Agre defines as informatic capture.[13]

In his 1994 essay, "Surveillance and Capture: Two Models of Privacy," Agre sets out a marked division, separating "surveillance" from what he calls "capture," and arguing that each is a cultural construction for understanding privacy. In Agre's definition, both surveillance and capture are techniques for "tracking" people, objects, and information. Consequently, both evoke cultural concerns and narratives surrounding issues of privacy. However, Agre enumerates several points on which surveillance and capture differ from one another, both culturally and technically.

The surveillance model of tracking is most easily conveyed by the Orwellian formula, "Big Brother is watching you." Culturally, it is characterized by visual and territorial metaphors, such as "someone is watching" or an "invasion of privacy."[14] The dominant cultural referent for surveillance is the information-gathering practices of Nazi and Stalinist totalitarian regimes, lending surveillance the connotation of information's being collected secretly, stored centrally, and controlled by a state organization for politically motivated reasons.[15] The capture model, by way of contrast, follows from the philosophical impetuses behind private enterprise,[16] imparting to it what Simon Davies calls a "more Huxley-like than Orwellian" sensibility.[17] Its practices are typically implemented at distributed institutional sites. Employing linguistic, grammatical metaphors for the acquisition of information, capture is implemented through pervasive, patently evident, real-time instrumentation in local institutional contexts. Information yielded by capture may or may not be centralized after its local acquisition.

Put simply, capture involves a computer set up to model a real world social organization. Entities in the social and computer systems are correlated, allowing for movements on the social end to be tracked and updated on the computer end. The result is a real-time simulation. Agre notes that this process entails restructuring the social system at the level of what he terms "grammars of action," a five-part sequence entailing analysis (the reduction of an activity into ontological units), articulation (the specification of a grammar to syntactically connect those units "to form actual sensible stretches of activity"), imposition (the normative enforcement of that grammar to solicit "parsable" units of activity from participants), instrumentation (the enhancement of the system to facilitate "a running parse of the ongoing activity"), and elaboration (subsequent operations performed on the information produced through this process).[18] The successful correlation of social and computer systems is ensured by grammars of action, which require that the breakdown of component steps in a process must be expressible in computable terms. Participants must learn to understand their actions as being functionally — not metaphorically — informatic.[19]

If surveillance is understood through an Orwellian scenario, the capture model is well exemplified by a technology such as E-ZPass, the automated roadway toll assessment and payment system currently used in twelve American states: Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Virginia, and West Virginia.[20] E-ZPass's analysis and articulation expand on the existing infrastructure of the analog toll system. Drivers are encouraged to establish an E-ZPass account on the premise that they may reap savings of time and money, which would be disallowed by continued use of the analog system. The marketing of E-ZPass, along with enforcing higher toll prices for drivers who pay in cash and the comparative inconvenience resulting from reduced numbers of analog toll lanes, constitutes the imposition of the system.[21] Upon registering, drivers receive a keychain on lease, which contains a Radio Frequency Identification (RFID) tag.[22] In the instrumentation phase, this tag, which contains a unique identifier, is physically coupled with a vehicle and electronically coupled with an account profile in a database. As the vehicle containing the RFID tag moves along roadways and passes sensors, those sensors monitor the RFID tag; by extension, they track the vehicle, and by further extension, track its account-holding driver as well. The database records these movements, producing information "captured" about the user and modeling a real-time accounting of all activities the user articulates within the system's grammar. The elaboration of this information allows the user's account to be debited by the cost of a toll when the RFID tag passes an RFID reader at a tollbooth. It also enables other elaborations of the data, such as the issuance of speeding tickets according to a calculation of elapsed travel time between tollbooths.

For our purposes, it is important to understand how capture makes online mapping different from traditional cartography. Conventional mapmaking, the surveyor's art, is typical of surveillance, but capture, as exemplified in the E-ZPass system, is notably different for two main reasons. First, it is an informational, rather than an optical means of tracking movements. No cameras are involved in E-ZPass, only information passing from RFID tag to RFID reader to computer. Surveillance records data acquired by mechanically extending the human sensory capacity: for example, by using hidden cameras and wiretaps to enhance optical or auditory abilities. Mechanical machines thus replicate and elaborate human abilities. Capture, however, operates neither through human nor mechanical means, but acquires data and produces connectivity between computerized and human activities through informatic techniques. In capture, human activities are one component of an informatic system. Second, whereas surveillance is imposed surreptitiously, capture is an opt-in system. Capture operates on consent, not coercion. A corollary of opt-in complicity suggests a design imperative to make all connections between the computer and human systems as apparent and comprehensible as possible.

Agre's vocabulary makes patent that the "Googlization of Everything" is a two-fold process of informatically capturing human activities. First, this means acquiring offline *cultural* sources as data and integrating that data into the informational model known as *cyberspace.* Second, it means acquiring *clickstreams* as data and modeling an *economic* reality to make that data parsable and profitable.

Companies like Federal Express use capture in commodity logistics systems to track packages through a global shipping network, and WalMart, a major investor in RFID technology, uses capture to streamline the efficiency of its supply network. But Google uses capture in a way that exceeds this type of spatial implementation and, while Google provides a convenient, familiar example, it is far from the only technology to operate in this way. For instance, folksonomy, also called social tagging, is a practice in which groups collaboratively label data through user-contributed keywords. Folksonomy is a bottom-up, non-corporate example of a capture-based information retrieval technology that, like Google, serves as a backbone for online mapping.[23] Opting-in to capture, whether by searching on Google or tagging on a folksonomy site, provides the clickstreams that sustain these models. In an extreme view, to opt-in is to tell Google one's desire, or to tell a social bookmarks site like Delicious how one thinks. It is precisely this ability to capture aspects of human behavior that lie *beyond perception by grammatically parsing* them, and not the size of their databases as such, which makes both Google and folksonomy at once powerful and ubiquitous in *all* network activities, beyond mapping per se. In capturing informatic territories, Google and folksonomy-based sites do not merely collect data, or simply lend an interface to information. By applying algorithmic formulas, they shape the information itself.

GEOGRAPHIC INFORMATION SYSTEMS: STARTING POINTS

Another convergence of informational and territorial mapping, and of surveillance and capture, can be found in Geographic Information Systems (GIS), the technology which supports online mapping. The development of computerized mapping processes that now compose GIS adhered to a familiar passage: from mapping techniques aligned with surveillance, which acquire data through perception, to mapping techniques aligned with capture, which acquire data through procedural parsing. Although GIS emerged from traditions in cartographic practice steeped in both of these techniques, a series of cultural transformations turned surveyors of territories into surveillors of territories, and back again. In the process, informational surveying through capture became a key factor in rendering geographic spaces informational.

GIS are software systems that connect "spatially referenced," or "geocoded" data with computerized means for "capturing, storing, checking, manipulating, analysing and displaying [that] data."[24] In the early 1960s, a team of Canadian researchers lead by Roger Tomlinson developed the first GIS, the Canada Geographic Information System (CGIS)[25] to survey, organize, and interpret geographical data toward the management of Canada's natural resources. Improving ecological knowledge continues to motivate GIS research at companies like Environmental Systems Research Institute (ESRI), the largest GIS software company, which states its mission as "Better Decisions Through Modeling and Mapping Our World."[26] In the United States, GIS research and development was largely directed through the Military-Industrial-Academic-Complex (MIAC)[27] and therefore privileged applications with direct strategic value for the Cold War. From these North American roots, GIS is now a global technology currently used in a wide range of applications, from environmental conservation and military applications to marketing, business resource management, homeland security, health care services, risk management, telecommunications, public transportation, civil government, and more.

From these many uses, "many definitions of GIS" have arisen, leading Michael Goodchild to recommend a general definition of GIS as including "a database in which every object has a precise geographical location, together with software to perform functions of input, management, analysis, and output."[28] Foresman's survey of early GIS developments echoes the centrality of data in Goodchild's definition. But Foresman also indicates that a significant "advance for the automated spatial data model was the development and application of dual data systems that handled graphics and attributes separately,"[29] highlighting a fundamental division contained in GIS between graphic and attribute data. Like traditional cartographic maps, GIS visually represent data, but in GIS software the connection between graphics and attributes is bidirectional. In other words, GIS software provides a means for informatically processing geocoded graphic data, as well as for graphically representing data attributes. The separation of graphic and attribute data amounts to a hybridization within GIS of raster- and vector-based data structures. These typically apply to graphic and attribute data, aligned with remote sensing and geodemographics, respectively. Today's GIS integrate raster and vector information, along with raster to vector conversion.[30]

Because remote sensing and geodemographics correspond to raster- and vector-based data structures, it will be useful to bear in mind the following distinguishing properties of raster and vector data in reviewing the applications of these two forms of GIS. In purely material terms, the *structure of information* associated with each differs drastically.[31] Raster graphics encode information by applying an inflexible rationalist grid over it. This grid segments a field of information into pixel units, orthogonally arranged on x- and y-axes. Vector graphics make use of an opposite approach; they encode information through equations that translate smooth curvatures, which are continuous and transmutable by design. Lastly, while raster pixel arrangements are standardized according to the absolute global coordinate system of a Cartesian grid, the polygon units which compose vector graphic image fields are not absolutely defined. Rather, their position and scale are mathematically expressed as local interrelations.

CYBERNETICS AND REMOTE SENSING

Remote sensing is a principal means of automated raster data acquisition, and was the first step toward developing GIS technology. In 1958, U.S. Office of Navy Research geographer Evelyn Pruitt first characterized the practice as "the science of obtaining information about an object without being in direct physical contract with the object."[32] Broadly defined, remote sensing is data acquisition at a physical distance from the object of study; it may include both optical methods such as aerial and satellite photography or multispectral imaging, as well as non-optical methods like radar.[33]

By definition, remote sensing partakes in the surveillance paradigm's vision of technology as augmenting or extending human capabilities. This view of technology was famously encapsulated by media theorist Marshall McLuhan who wrote of media as being "extensions of man." In McLuhan's view, technologies are prosthetics through which humans design to enhance or extend aspects of themselves. Theorist Katherine Hayles has argued that cybernetic views of technology and humans as essentially compatible are discursively constructed, and that cybernetics as a whole is the product of a convergence between humanist and computational ontologies.[34] From Hayles' perspective, the idea that technologies can be extensions of humans first requires credence in the belief that humans are in principle extendable by machines. This belief is at the root of remote sensing.

Indeed, the McLuhanite concept of media as extensions of man, Hayles's contention that cybernetic intimacy is philosophically rather than mechanically enabled, and Agre's definition of surveillance as a cultural (centralized, optical, covert, politically motivated, etc.) rather than technical matter all come together in a recently declassified statement by CIA nuclear specialist Herbert I. Miller.[35] In a Top Secret memorandum weighing AQUATONE (U-2) intelligence "against [...] possible damage to U.S. international relations," Miller wrote:

> *First, it is of utmost importance to differentiate in our minds, and to cause the Russians to differentiate in theirs, between AQUATONE-type operations and reconnaissance by military aircraft. As a covert intelligence operation AQUATONE has merely substituted high altitude vehicles and precision observation and memory equipment for more prosaic modes of transportation and the eyes and memory of an agent.*[36]

This statement explicitly situates surveillance as a *mindset*, that is, as a cultural practice rather than a technical practice. Further, it lays bare the political mandate for retaining permeable boundaries between human and machinic functionality. Just as Manuel De Landa has offered a history of technologies of war[37] that begins with the claim that "history" is itself a series of symbiotic interfaces between mechanical, motorized, and digital machines and biological, human machines, cybernetic intimacy supports the cultural model of surveillance as extension through command and control. To politically justify remote sensing surveillance, Miller mobilizes a two-part cybernetic rationale toward overtly militaristic ends, insisting first on ontological equivalence between technological agents and human agents, and second on remote sensing as a convenient, efficacious and value-free extension of human sensing.

Cybernetic remote sensing and its compulsory optics are fraught with another cultural spin, also charged through with the surveillance paradigm. The political context in which remote sensing was developed spanned both active world war conflicts and the Cold War. Over the course of this major strategic transformation, the question for remote sensing development became not whether or not to look, but *how to look*. This is not simply a theoretical or existential problem, but as we shall see, it is most of all a technical problem for the reason that, as Helen Nissenbaum argues, *values are embedded in design*.[38] Technologies also extend human capabilities in a less pragmatic way, in that they encode and enact the idiosyncratic personal and cultural values of their designers and implementers.

Continuing in the memorandum stated above, Miller asserted a further distinction: "AQUATONE operations are not intended to be the counterpart of the target-spotting function of military reconnaissance which is an immediate prelude to hostilities." Miller claims that a definitive line can be drawn between "target-spotting" and intelligence gathering as two different *ways* of looking. This claim, subject to dispute on a number of levels, taps into a specific territorial battle between the U.S. Air Force and CIA over who would control reconnaissance data acquisition technologies.

John Cloud, a historian of geographic knowledge production, has expounded in detail the elaborate convolutions of classified and unclassified research and development. Contextualizing Miller's assertion, Cloud explains that an important division of labor occurred following the 1947 separation of the U.S. Air Force from the Army: "[the] U.S. Air Force [...] was assigned the primary task of *data acquisition* systems, and the U.S. Army [...] was to concentrate primarily on *data reduction* systems."[39] This division of labor, which put the Air Force into direct competition with the CIA, inspired a debate, echoed in Miller's statements, over whether remote sensing should be developed to facilitate the Air Force's targeted looking, or the CIA's vacuum-cleaner approach to data acquisition, or to satisfy the Army's requirements for easily analyzable imagery. The way that these conflicting interests factored into the question of *how to look* had concrete effects on the routes and revisions undertaken in remote sensing hardware development, paving the way for GIS software.

SURVEILLANCE HARDWARE: OPTICAL PLATFORMS AND RASTER IMAGE ACQUISITION TECHNOLOGIES

In his analysis of cybernetic military history, De Landa discerns three principle components of what he calls "aerial visual intelligence system[s]": the *platform* and the *imaging apparatus*, which together constitute the hardware aspect of optical remote sensing systems, and *image interpretation*, constituting its software function.[40] De Landa's terminology shows how technological developments proceed unevenly along three simultaneous axes. In the case of GIS, image interpretation ultimately departed from visual intelligence by forging compatibilities with capture.

On the platform side, hardware for remote sensing evolved steadily from kites and hot air balloons to airplanes and, finally, to satellites. But surveillance needs dictated a series of developments in image apparatuses to advance the optical techniques that would be supported by this progression of platforms. Throughout the American Civil and Franco-Prussian Wars, military balloons carried biological imaging apparatuses in the form of human sketch artists.[41] Only in 1909 did Wilbur Wright became the first aerial photographer.[42] Yet within the next decade, aerial photography had become a science. This was driven in large part by World War I, which spurred rapid advancements along all three technical axes: improved planes, improved cameras and photographic techniques, and trained teams of photo interpreters.[43]

Between the wars, imaging apparatuses came to incorporate reusable flashes, infrared photography, long focal length lenses, stereoscopic cameras, and telegraphic image transmission, and enhancements continued with the World War II inventions of high-resolution color film[44] and color infrared film.[45] In addition, WWII produced the non-optical hardware system, Short Range Navigation (SHORAN), implemented in 1943, which used radio frequency as a basic means of geo-positioning for "blind-bombing" missions.[46]

These advancements in automated sight[47] and surveillance technologies were mainly compelled by the need for short-term tactical advantage. Pilots flying in dangerous conditions frequently produced images taken at extreme angles or in sub-optimal weather conditions. Because the optical conditions could not be accurately reproduced, the images were essentially one-offs, ill-suited to standardization or systematic integration of any kind. As noted above, this emphasis on "target-spotting" would later be associated with the priorities of the U.S. Air Force.

Postwar, the nuclear threat shifted the directive for remote sensing research and development from offensive targeting to preemptive intelligence. Considering the cybernetic interdependence of sensory technologies and their remote human designers and operators, the postwar reprioritization of security over aggression can come as no surprise.

In 1947, RAND began testing balloon photoreconnaissance at Holloway Air Force Base in Roswell, New Mexico. Eventually these tests evolved into Project GENETRIX, a 1956 operation in which 560 camera-equipped balloons were released over the Soviet Union. Most were shot down, but film was recovered from 44, and the significance of these images to U.S. intelligence provided a teaser to accelerate further remote sensing research and development. Meanwhile, the joint U.S. Air Force / CIA Project AQUATONE had begun test flights of its "undetectable" U-2 planes in 1955. Project AQUATONE ground to a halt when the U-2's first flight over the Soviet Union on July 4, 1956 was immediately detected by the Soviets. While judged a success in providing an unprecedented visual material "cross section" of Soviet "culture" as well as visual access to five of seven "highest priority" USAF intelligence targets,[48] AQUATONE was temporarily suspended by President Eisenhower who, upon the launch of Sputnik in 1957, pushed further development of American reconnaissance satellites.

The vulnerabilities of GENETRIX and AQUATONE, as well as the cancellation of project SAMOS, a technologically unviable real-time transmission satellite, set the stage for CORONA, a film recovery satellite system, which became the first successful American reconnaissance satellite program. CORONA ran over a decade's worth of reconnaissance missions, from August 1960 to May 1972.[49] Its success stemmed from an original platform and imaging apparatus, both of which were geared toward optimal raster image acquisition, that is, toward retrieving as great a quantity of information as possible. This quantitative imperative proceeded from the fact that photographs are raster graphic data, for which the amount of information can be counted in discrete numbers: the overall number of files and the resolution — i.e., number of pixels or dots per inch — of each individual file.

Itek, a company that, through a series of classified CIA and NRO contracts, would develop nearly every camera system for American satellites,[50] secured the contract to provide CORONA's cameras. Itek's winning bid proposed two technical hardware innovations affecting both the imaging apparatus and platform: a scanning pendulum lens[51] housed in a revolutionary satellite that would use three-axis horizontal stabilization, rather than spin stabilization, in effect causing the satellite to move through its orbit like a balloon, rather than a football.[52] With this proposal, Itek sought to address two principle design challenges. Broad, high-resolution coverage was desirable, but for intelligence purposes it was also necessary that the images be as clear as possible. Lens distortion and destabilization of the satellite both risked blurring. The scanning camera design increased the field of vision without lens distortion, and could "achieve a ground resolution of twenty feet [adequate for ...] photointerpreters at the CIA to identify specific buildings, as well as targets such as missile sites and bombers."[53] Moreover, its three-axis stabilization allowed the camera to face the earth at all times, rather than rotating away from the earth, losing coverage opportunity, and risking destabilization. In effect, Itek's camera design strongly prioritized image acquisition over image interpretation. Moreover, it performed image acquisition in line with the CIA's aspiration for all-over, global coverage, as opposed to in the Air Force's style of targeted, local looking. The resulting unprecedented increase in image coverage would prove to be an unprecedented challenge for image calibration.

On August 18, 1960, the day U-2 pilot Gary Powers was sentenced, Discoverer XIV launched the first successful CORONA mission. As Cloud and Clarke recount, "The very first film roll had captured more imagery of the Soviet Union than all the previous balloon and U-2 flights combined."[54] One of the immediate effects of AQUATONE was to reveal that American intelligence had greatly overestimated the extent of the Soviet Union's missile program. Blending surveying and surveilling, the continual, all-over coverage provided by the CORONA images lent the American intelligence community the confidence of both figurative and literal mastery over the situation. With the immediate sense of threat alleviated, and with a sense of reassurance offered by optical foreknowledge, the American reconnaissance project shifted its agenda from combat-oriented targeted reconnaissance to a program retailored for focal breadth and constant, complete coverage, the result being the accumulation of tremendous quantities of data. Detailing the extent of CORONA imaging over 12 years, Cloud and Clarke tally "800,000 images taken from space, covering 750 million square nautical miles and filling 39,000 film cans containing 2.1 million feet of film."[55]

DATA MANAGEMENT: THE WORLD GEODETIC SYSTEM, IMAGE REGISTRATION, AND DATA LAYERS

This massive quantity of information quickly outstripped existing abilities to effectively interpret it. By pursuing panoramic information retrieval, which produced enormous amounts of uncoordinated data, remote sensing came to face a potentially crippling data management problem.[56] A counter-history to this narrative is posed by De Landa's software function, the image interpretation aspect of aerial visual intelligence systems, and by the Army's task of data reduction. Before GIS software could develop, certain hardware transformations were necessary which would facilitate data management through image registration and standardization. This became possible through the creation of the World Geodetic System (WGS), which in turn enabled the creation of data layers.

For the future of GIS, one of the most significant developments of WWII was not the development of an imaging technique. Rather, it was the 1944 – 45 exploits of a special unit of geodesists called HOUGHTEAM who captured what have become known as The German Materials, "vast quantities of cartographic and photogrammetric equipment, map series at all scales, and geodetic and cartographic data" including a number of human geodetic assets, "'a nucleus of German geodesists and mathematicians.'"[57] Cloud claims that the April 17, 1945 discovery by this same special unit of the German Army's geodetic archives in a Saalfeld warehouse "would change the course of the Cold War."[58]

Geographic information is only able to provide location information to the extent that it can be related to a known point of reference. A system of reference built around a known point on the earth's surface is a "datum."[59] Until the 1980s, American cartography relied on a single point in Meades Ranch, Kansas, which served as the lynchpin to the North American Datum of 1927 (NAD-27).[60] Unconnected local and national datums such as this remained in use following WWII. But to process, reduce, and integrate the volumes of visual data that were being harvested through remote sensing, it was necessary to create a World Geodetic System (WGS) that would connect these local systems into a continuous global standard.[61] Against the WGS standard it would become possible to rectify and geo-reference remote sensing imagery, making its development of highest priority for image interpretation.

Work to develop a WGS began in the late 1950s, building on projects undertaken in the 1940s to extend continental datums, first for territories with "friendly" governments, and subsequently for territories with "unfriendly" governments.[62] The German Materials provided crucial geodetic information to this end. In particular, comprehensive geodetic data on Soviet influenced territories were found among the captured materials because Nazi engineers had been contracted for work on building the Trans-Siberian railroad.[63] The work of the first World Geodetic System, created in 1960, is thus described: "a combination of available surface gravity data, astrogeodetic data and results from HIRAN and Canadian SHORAN surveys were used to define a best-fitting ellipsoid and an earth-centered orientation for each of the initially selected datums."[64]

Meanwhile, the Army's dedication to "dimensional stability" for data reduction purposes had largely been forfeited by the Air Force's four photogrammetric priorities. Recounted by Cloud, these included:

> *(1) high feature resolution; (2) broad area coverage, especially angled non-vertical photography;*
> *(3) novel and untraditional sensors, including flash-illuminated nighttime photography and radar imagery; and finally (4) near-real-time data, generated largely for use under battlefield conditions.*[65]

With techniques such as these, the Air Force privileged unique image acquisition to serve the specific purposes of individual missions. The result was wildly variant imagery which, to be systematically integrated, would require standardization and registration to a base map image. In this light, the Army's advocacy of stability referred to both dimensional stability in the manner of image properties, as well as methodological stability to serve multi-purpose usage requirements.

Technologically, dimensional stability would have been better served by a calibrated camera than by the scanning panoramic cameras Itek had designed. The challenge of registering panoramic images led scientists like Helmut Schmid to pioneer a new series of equations that would mathematically compensate for the optical distortion of panoramic imagery. These calibration adjustments, the first to truly create the so-called view from nowhere, ultimately shifted the development of panoramic technology back toward the principle of dimensional stability. Heralding an important feature of GIS software, the mathematical calibration of panoramic photographic imagery was revolutionary for *replacing an optical view with a data-centric view.*

To improve data analysis, image stabilization also instigated developments toward another chief aspect of GIS software: data layers. The most immediate example of this was the decision to reengineer the CORONA imaging apparatus to use two cameras simultaneously.[66] One calibrated camera would photograph a low-resolution base image and a second panoramic camera would provide high-resolution imagery.

Another precedent for layers came from the convergence of the stabilization mandate with a series of advancements in the fields of geodetic technology and digital computing. As they proceeded toward the WGS, geodetic scientists created a series of technologies, each of which worked through comparison by informatically layering and cross-referencing two sets of raster data. The most telling examples are missile guidance systems that compared remote sensing data being acquired on the fly against a previously acquired set of standard image data held in informatic memory.

The 1958 TERCOM (Terrain Contour Matching) system, an electronic distance measuring device (EDMD) used to guide ICBMs, represented a significant improvement over previous systems in that it relied on a comparison of informatic, rather than visual data to determine location. Based on the assumption that, like fingerprints or snowflakes, the topographic contours of locations on the earth's surface are unique, TERCOM compared "[c]ontour data obtained during the missile's flight [with] reference contour data in the guidance system computer to update and correct the missile's inertial system."[67] Previously, image interpretation had relied on human interpreters to detect changes. The mode of automated comparison through which TERCOM and other EDMD systems operate provides a conceptual precedent for data layers in GIS software.

ORTHO-PIXELS

Finally, these three data management initiatives came together: the initiative to create the World Geodetic System, the initiative to stabilize image acquisition, and the initiative to develop interpretation techniques using data layers for comparison. This culminating data management technology was also the beginning of the software compositing technology at the root of GIS. This technology was a development at the fundamental unit of raster data: the calculation of ortho-pixels.

Ortho-pixels are geo-referenced pixels. Calibrating imagery to ortho-pixels, which are in turn calibrated to the WGS, creates a direct informatic connection, tying together image, data and territory. The most significant aspect of this was Donald Light's proposal to convert remote-sensed rasters to ortho-pixels at the first moment of data processing, rather than after transmission so that image data would be co-registered in all aspects of processing.[68] Through this innovation ortho-pixels would allow remote sensing to generate geographic information in the form of raster data in which "[e]ach pixel is associated with a discrete area on the surface of the Earth, and the area of one pixel is the resolution of the raster."[69]

Ortho-pixels were the pixel-based solution to the problem that, as noted above, raster data does not scale. But once co-registered, converting ortho-pixels into scalable vectors requires no more than applying mathematical transformations to the ortho-pixelated raster data. In the process of transformation from raster to vector, the representational expectations for geographic data undergo a shift as well. The precision of the geo-referenced pixel becomes a point plotted along a curve that represents a mathematical probability rather than a geographical actuality. The entire MGI (Military Geographic Information) project was aimed at creating the most specific visual intelligence possible. It mobilized optical surveillance on two presuppositions: that exactitude was a desirable quality for information, and that informational accuracy can be obtained through visual precision. However, vector techniques, in which data is generalized, averaged, and statistically estimated, propose to eliminate that specificity and the conceit of accuracy attached to it.

LOCATIVE LAYERS: GEODEMOGRAPHICS AND CAPTURE

In the 1970s, while increasing computer sophistication began to permit raster to vector conversion, the U.S. government made an explicit decision upon recognizing that civilian sector investments were duplicating, or worse producing less advanced versions of, classified MGI technology.[70] To rectify this situation, the government engineered a generalization of geographic information away from specific military purposes.[71] Coupled with representational generalization vis-à-vis vector rather than raster data, this disciplinary generalization fostered an environment where an outright civilian project, GIS, could develop. Cloud and Clarke claim that the result produced an unclassified yet unannounced remapping of the United States, apart from the classified mapping of foreign territories toward which CORONA image acquisition was initially aimed.[72] In this process, federal agencies helped to pilot emerging GIS technologies, providing a technological infrastructure and methodology that would be seized upon by civilian mapmakers as well.

Ortho-pixels permit raster information, retrieved by optical surveillance or remote sensing, to be layered with vector information, retrieved by informatic capture, while maintaining standardized location information in every layer of identity data and every layer of indexical meaning. I propose that the remapping of the United States happened twice over, first as a demographic remapping of statistical population clusters, and second as real-time positioning that remaps populations of individuals. Location, standardized and specified through the WGS, is the main currency of both. The resulting maps are maps of markets; the dual remapping of the United States cartographically locates and controls populations for profit.

CAPTURE SOFTWARE: STANDARDIZING AND APPROXIMATING IDENTITY

Geodemographics is a main application for GIS software. It is founded on standardizations that considerably predate the Army's postwar directive to generalize data. In fact, the impetus for geodemographics dates to a period James Beniger has called the "Control Revolution,"[73] the series of cultural transformations following the Industrial Revolution that revolutionized capitalist distribution. A condition of possibility for the Control Revolution, standardization is defined as the pre-processing of objects and information to either forcibly remove or institutionally circumvent all peculiarities and unique features, thereby creating generalized uniformities which facilitate mass processing. On this view, Herman Hollerith's automation of the 1890 U.S. census therefore signals an important precursor for geodemographics.

In 1889, Hollerith faced a massive data reduction problem: a decennial census that could potentially yield more data than existing means would be able to process in a decade's time. As a solution he devised a method for automated data processing, a random-access punch-card tabulating system,[74] which holds dual significance for geodemographics. First, as the direct ancestor of IBM's computer technology, it paved the way to automated information processing and, eventually, digital computers.

But Hollerith's project also targeted the census's mandate to *register people's characteristics to geographic locations.* In this respect, Foresman dates Hollerith's as the first "automated geoprocessing techniqu[e]." In Foresman's view, this indicates a "convincing GIS lineage" from Hollerinth's punch cards to the Census's present system, TIGER (Topologically Integrated Geographic Encoding and Reference), a system Foresman credits with influencing the propagation of GIS throughout the civil sector.[75] Doubly implicated in geodemographic GIS, the Census introduces the principle of standardization to its technological infrastructure, and establishes the cultural practice of geo-coding human characteristics.

DATA PROFILING: VECTOR LAYERS AND COMPOSITING.

The precedents for layered map imagery are varied. Historically, cartography employed transparent overlays to materially layer location information about various resources. Some overlay maps described distributions of environmental resources and the like. Others, more notoriously, were used to outline urban blight and to redline "undesirable" population groups on the basis of ethnicity or income bracket. Yet it is argued that none of these analog overlay maps were pursued beyond the uses for which they were initially designed. Instead, retired Defense Mapping Agency deputy director Lawrence Ayers[76] claims that GIS software layers date back to the captured German Materials, which reportedly included maps "composed of transparent sheets — sometimes 20 or more — showing such things as vegetation, soil, and road surfaces."[77] Having captured the imagination of Department of Defense engineers, layers of these maps are tangibly evident in today's GIS software, where overlays have transmuted into data layers.

Contemporary geodemographics combines data profiling with GIS software's layered map imagery to *map composite identities.* The innovation of vector layers for geodemographics is that, unlike raster data, vector polygons represent tendencies, not objects. On the assumption that similar people live near one another, clustering algorithms, which allocate data into subsets by calculating degrees of similarity with regard to selected characteristics, are used to calculate the boundaries of demographic information.[78] Jon Goss attributes the invention of geodemographics to Jonathan Robbins who applied clustering to two standardization innovations from the 1960s: the ZIP (Zone Improvement Plan) Code system, which restructured the U.S. postal system, providing bounded spatial units against which population resources and associated attributes could be spatially analyzed, and GBR-DIME (Geographic Base Files — Dual Independently Map Encoded) census technology, which digitized urban census tract maps, resolving addresses to their geographic locations. Goss explains that Robbins applied clustering analytics over stabilized data provided by the ZIP and Census standards and consumer surveys, blending Chicago School ecological urbanism "with the related 'number-crunching' factorial ecologies of positivist urban social sciences to produce geodemographic profiles of residential ZIP code areas for the entire United States."[79] Robbins' resulting system, PRIZM (Potential Rating Index for ZIP Markets), derived "40 life-style clusters describing all 36,000 ZIP codes."[80]

Geodemographics maps statistically aggregated "life-styles" — essentially composited stereotypes — to bounded geographic zones. To be clear, GIS may also map populations of endangered species, or averaged penetration of diseased crops, but geodemographic GIS maps human populations as economic markets. Crucially, because the software interface illustrates these *informational* boundaries as *visual* boundaries, serious levels of abstraction are introduced. The first abstraction is evident in "the spatiality of GIS" which John Pickles describes as "a virtual space of data manipulation and representation whose nominal tie to the earth (through GPS and other measuring devices) is infinitely manipulatable and malleable."[81] In Curry's explanation, geodemographics consists of "a set of data units — such as census tracts or even households [...] arrayed in a virtual space where each attribute constitutes a dimension."[82] Curry points out that this introduces a second level of abstraction, the perspectival, or relational aspect to interpretation of geographic space when that space is informatic.[83]

CAPTURE AND GPS

These representational difficulties stem from the way geodemographics clusters information. On one hand, one might say that Hollerinth's innovations enabled the Census to perform informatic capture on a massive scale by processing population information into standardized, geo-referenced data profiles. And as it happens, Hollerith's system was inspired by the "punch photograph," a hole-punch theft deterrent system used by railroad conductors to profile each passenger's physical characteristics on his or her paper ticket. "So you see," Hollerith recalled of his invention, "I only made a punch photograph of each person"[84] — a statement which bares the neat elision by which optical, photographic representation can be transformed into informatic, statistical representation. But modern censuses use geodemographic clustering that, in a sleight of hand, *replaces* individuals with their locations, and so differs from capture.

A system like E-ZPass requires unique identifiers for every object; however, in geodemographics, clustered households or "rooftops" are the system's "primary units." Curry attributes this exception to legislation like the American Fair Credit Reporting Act of 1970, which limited collection of *individual* information.[85] Rooftop geocoding circumvented the Privacy Act, but according to Curry there has been an additional result. Geodemographic profiles are also exempted from the 1974 Computer Matching and Privacy Protection Act, which was designed to prohibit centralized profiles of individuals from being compiled by "matching" data from unconnected sources. As Curry explains, for data matching in geodemographic *data profiling*, "the key used for connecting databases is not the social security number, but rather the geographic coordinate."[86] In theory, it does *not* therefore threaten *individuals'* privacy. Here the specificity of the location, e.g. a geocoded rooftop, trumps that of the individual, whose identity is averaged into a generic stereotype. Unlike capture, which tracks specific individuals, clustering generates geodemographic data profiles based on similarity, rather than identity.

However, another GIS technology combines this attention to geo-coded specificity with a more definitional practice of informatic capture, and that is the Global Positioning System (GPS). As Cloud and Clarke suggested, remapping the United States required the demilitarization of MGIS technology. To this end, a more recent satellite technology, the NAVSTAR GPS, is now more widely used in civilian and commercial than military sectors.[87] The NAVSTAR GPS "nominally consist[s] of 24 satellites," four on each of six orbital planes, and "a worldwide satellite control network and GPS receiver units that acquire the satellite's signals and translate them into position information."[88] GPS supports highly accurate, real-time calculations of time, three-dimensional location, and three-dimensional velocity, for an "unlimited number of users and areas." Moreover, GPS technology is coordinated to "a worldwide common grid that is easily converted to any local grid,"[89] that is, to the WGS. The combination of real-time data and a locally scalable global standard makes GPS a perfect technology for capture.

From its Chicago headquarters, Navteq, a self-identified "world leader in premium-quality digital map data,"[90] coordinates the operations of over a thousand field researchers[91] who use GPS to capture map data in 73 countries across six continents.[92] Navteq's product is an extensive proprietary digital map database, information it leases to developers, who in turn apply the data in "a new generation of important navigation services, including: Internet websites, Enterprise/Fleet/GIS solutions and Location Based Services (LBS)."[93] One of Navteq's many clients is Google, whose leased Navteq data provides a foundational layer for Google Maps.

Navteq prides itself on a database that is "built on the roads of the world"[94] by Navteq employees who "fan out across the globe each day, continually driving and redriving the roads."[95] A statement that appeared on Navteq's website in 2005 exposes how their technology marks a moment of transition from an optical understanding of mapping to one based on informatic capture: "Armed with a high level of training and our proprietary collection technology, they build a database from a driver's view. And it's built to a single global standard."[96] It is easy to recognize the "global standard" as none other than the World Geodetic System. Yet more important is how this language belies the target of Navteq's mapping, which is not mere roads or even a market demographic, but rather, "the world as information" to be explored, charted, and colonized for profit. While the "view" remains "a driver's" this is pure metaphor. Navteq's maps are generated without the use of any optical technologies; no cameras are involved. The perspective from which Navteq's drivers relate to the territory is wholly informatic. Navteq uses neither surveyors nor surveillors to map. Instead they capture territories.

Navteq's data acquisition methods are not unlike the E-ZPass system, but instead of using short-range passive RFID technology, Navteq uses GPS, supplemented by manual data entry. Teams of field researchers drive in cars equipped with GPS receivers on their roofs, which are connected to laptops operated inside the vehicle.[97] The GPS system automatically records the position of the car so that existing data is updated and new information is added to the system everywhere the car drives. Further attributes are added by hand into the laptop. The GPS record of the car's position, point by point as it drives, is translated into vector data by interpolating the connections between discrete GPS readings, taken milliseconds apart, into a continuous vectorized path. Those paths are rendered as roads on a vector data layer.

In this way, capture "continuously update[s]"[98] relevant aspects of the 260 attribute fields in Navteq's database. The database aspires to create a "highly accurate representation"[99] of the landscape by including traffic information, addresses, and proprietary "Points of Interest," all along a "complex road geometry."[100]

As data is acquired and added into the Navteq system, it gets "layered" with other GIS information, remaining properly registered thanks to orthopixels. "[Navteq's] database contains more than a hundred different 'layers' of information that [...] can [be] add[ed] to the digital map, each layer showing different aspects of the landscape. Any piece of information that comes attached to a street address or latitude-longitude coordinates can slide effortlessly into this visualization: a neighborhood's median income, its history of robberies, even its residents' contributions to political campaigns."[101] The software interface registers all of this information in graphical form, allowing different data attributes to be selectively overlaid with one another.

CONCLUSIONS: ON MAPPING TERRITORIES

In summary, mapping territories is a set of cultural practices that transform cultural and geographic territories into information. Complex technological feats of engineering and reengineering contributed to the multiple histories of mapping territories. These began with remote sensing technologies, which narrowed the gap between cultural and informational identities by promoting a cybernetic understanding of the relationship between humans and machines. Such technologies, most notably aerial and satellite photography, were first designed to pursue a global, absolutist perception. However, this goal eventually fell by the wayside as a new paradigm emerged. Forsaking perception, this paradigm prioritized computation, thus spurring the development of technologies to produce geographic and informatic standardizations in the form of ortho-pixels, algorithmic generalizations in the form of geodemographic clustering algorithms, and systemic calibrations in the form of data layering. Mapping territories also traces a passage from surveillance to capture technologies. Navteq, a GIS company that encapsulates the principles of capture, provides a fundamental technology for online mapping. Its practices embody the hybridization of local positioning within a global system. The data Navteq captures both functionally and ideologically support Google's broad definition of the world as an informational territory, paving the way for online mapping.

As representations, technologies for mapping territories depart from the optical, descriptive techniques of traditional cartography in that they are informatic and generative. Rather than standing in a referential relationship to the world, these mapping procedures perform value-added maneuvers, reconstituting the world as information. The history of their development pertains directly to the cultural and political stakes that determine priorities with respect to surveillance and capture. Therefore, the trends we examine with regard to information retrieval in geographic territorial mapping may shed light on the developments now underway in information mapping's endeavors with information retrieval and in online mapping itself.

Indeed, the second part of this project, "Mapping Glocalities," takes up precisely these concerns, exploring how novel online mapping practices circa 2005 contended with seemingly contradictory technical prospects. As online maps emerged, their inherited impulse toward global generalizations, the result of statistical aggregations in GIS software, was retrofitted by local users to chart an unexpected territory. The resulting maps captured glocalities, virtual sites where social identity could reassert itself in the form of subjective expressions that are at once personal and collective. In these online maps, the "view from nowhere" that first originated in compensatory image calibration software can be seen undergoing an "image conversion" of its own, evolving into a truly glocal view: an informatic, non-optical perspective on individual idiosyncrasies, which proceeds from relational, rather than absolute positioning.

BIOGRAPHY

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NOTES

1 On Web 2.0, see Tim O'Reilly's account. Tim O'Reilly, "What is Web 2.0: Design patterns and Business Models for the Next Generation of Software," http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html. On the Where 2.0 conference, see O'Reilly Media, "Where 2.0 Conference — June 29–30 — San Francisco, CA," http://conferences.oreillynet.com/where2005/.

2 The second part of this project will appear in the forthcoming July issue of *Parsons Journal for Information Mapping.* Katherine Behar, "Capturing Glocality — Online Mapping Circa 2005: Mapping Glocalities," *Parsons Journal for Information Mapping* 1, no. 3 (July, 2009): forthcoming.

3 Philip E. Agre, "Surveillance and Capture: Two Models of Privacy," in *The New Media Reader*, ed. Noah Wardrip-Fruin and Nick Montfort (Cambridge: MIT Press, 2003) 737–760.

4 In fact, both Google and Yahoo timed the release of their Maps APIs to coincide with O'Reilly's Where 2.0 conference. For a full discussion of Google Maps, see Behar, "Capturing Glocality — Online Mapping Circa 2005: Mapping Glocalities."

5 I borrow this phrase from an essay by Siva Vaidhyanathan on the subject of the controversy surrounding Google's Library project. Vaidhyanathan's assessment of Google Library identifies the three principle concerns, "privacy, privatization, and property," resulting from a corporation's treading into sectors of public service that are traditionally governmental responsibilities, a potential source of conflict with corporations' primary responsibility to be profitable. Vaidyanathan maintains that the latter leads to two imperatives for Google: "to convince the world that it is the anti-Microsoft [and to] find more things to index and expose to the world." See Siva Vaidhyanathan, "A Risky Gamble With Google," *The Chronicle of Higher Education*, 52, no. 15 (December 2 2005): B7.

6 Google, "Corporate Information: Company Overview," http://www.google.com/intl/en/corporate/index.html.

7 There is no definitive catalogue of Google's product offerings, however they may be inferred from several online resources. See Google's own telling of its history, although it should be noted that this is only a partial account: Google, "Corporate Information: Google Milestones," http://www.google.com/corporate/history.html. Wikipedia has compiled a listing available at: Wikipedia, "List of Google services and tools," http://en.wikipedia.org/wiki/List_of_Google_products. Lastly, Google's company blog contains product releases in its archives, although only dating from April, 2004: Google, "Official Google Blog," http://googleblog.blogspot.com/.

8 See "Section 9.2 Scalability of Centralized Indexing Architectures" in Sergey Brin and Lawrence Page, "The Anatomy of a Large-Scale Hypertextual Web Search Engine," *WWW7 / Computer Networks* 30, no. 1–7 (1998): 107–117.

9 See "Appendix B: Scalability" in Brin and Page "The Anatomy of a Search Engine."

10 To be clear, I refer to information in a definitional, non-metaphoric sense, as for example, the concept is applied in communications theory with regard to signal to noise ratio. Conceiving of the world as information means understanding the world as *materially* informatic. This issue remains separate from the post hoc *cultural* interpretation of the world as information, insightfully discussed by geographer Michael Curry. Michael R. Curry, *Digital Places: Living with Geographic Information Technologies* (New York: Routledge, 1998).

11 Vaidhyanathan, "A Risky Gamble With Google."

12 See Elinor Mills, "Google ETA? 300 years to index the world's info," http://news.cnet.com/Google-ETA-300-years-to-index-the-worlds-info/2100-1024_3-5891779.html. For a similar, earlier statement by Schmidt see Scott Ard, "Google's 300-year plan," http://news.cnet.com/8301-10784_3-5770305-7.html. See also a comparison of the two statements: Gary Price, "Schmidt Talks To Advertisers, Mentions 300 Year Timeframe (again) Before Google Makes it "All" Searchable," http://blog.searchenginewatch.com/blog/051008-193944.

13 Agre, "Surveillance and Capture."

14 Ibid., 743.

15 One might argue that this explanation is an overly Anglo-centric. As we will discuss, democratic regimes have been equally as invested in some of surveillance's tactics. Ibid., 743.

16 Refining this point, Agre explains that the "philosophical metaphor" for understanding activities of capture is not at odds with the "political aspects" of those "actual institutional sites to which the capture model might be applied." Ibid., 744.

17 Simon G. Davies, "Re-Engineering the Right to Privacy: How Privacy Has Been Transformed from a Right to a Commodity," in *Technology and Privacy: The New Landscape*, ed. Philip E. Agre and Marc Rotenberg (Cambridge: MIT Press, 1997) 144.

18 Agre, "Surveillance and Capture," 746–7.

19 Agre reminds his readers that while automation and Taylorism use grammars of action, they are not forms of capture. In capture, grammars of action are used for instrumentation, whereas in automation and Taylorism they are employed toward rational optimization. Successfully optimized actions by definition need no capturing because they are entirely predictable. The imperative for predictability results in a "highly inflexible" experience for those using such grammars, while "[c]apture, by contrast, permits efficiency and control to be treated separately, so that people who engage in heavily captured activity have a certain kind of freedom not enjoyed by people in Taylorized work." Ibid., 751–752.

20 See E-ZPass, "E-ZPass Information," http://www.ezpass.com/static/info/index.shtml and E-ZPass, "Summary of Facilities Accepting E-ZPass," http://www.ezpass.com/static/info/facilities.shtml.

21 Simon Davies's essay "Re-Engineering the Right to Privacy: How Privacy Has Been Transformed from a Right to a Commodity" provides a survey of the negotiations of social affect involved in adopting capture and surveillance systems.

22 The website http://www.zapped-it.net/, prepared by the tactical media group, Preemptive Media, contains an excellent layman's explanation of RFID technology. See Preemptive Media, "zapped! Background Info," http://www.zapped-it.net/info.html. The site also contains a discussion of potential RFID misuses. Preemptive Media, "zapped! FAQs," http://www.zapped-it.net/faqs.html.

23 Popular websites that use folksonomy include Delicious, Flickr, and YouTube. Folksonomy is discussed in detail in the second part of this paper. Behar, "Capturing Glocality — Online Mapping Circa 2005: Mapping Glocalities."

24 Hilary M. Hearnshaw and David J. Unwin, "Introduction," in *Visualization in Geographical Information Systems*, ed. Hilary M. Hearnshaw and David J. Unwin (New York: John Wiley and Sons, 1994) XIII.

25 Roger Tomlinson, "The Canada Geographic Information System," in *The History of Geographic Information Systems: Perspectives from the Pioneers*, ed. Timothy W. Foresman (Upper Saddle River: Prentice Hall PTR, 1998) 21-32.

26 ESRI's founder and president, Jack Dangermond, is a major advocate of this view. Environmental Systems Research Institute (ESRI), "ESRI—The GIS Software Leader," http://www.esri.com/.

27 John Cloud, "American Cartographic Transformations During the Cold War," *Cartography and Geographic Information Science*, 29, no. 3 (2002): 264.

28 Michael Goodchild, "Geographic Information Systems and Geographic Research," in *Ground Truth: The Social Implications of Geographic Information Systems*, ed. John Pickles (New York: The Guilford Press, 1995) 35.

29 Timothy W. Foresman, "GIS Early Years and the Threads of Evolution," in *The History of Geographic Information Systems*, op. cit., 11.

30 Ibid., 12. See also Nickolas Faust, "Raster Based GIS," *The History of Geographic Information Systems*, op. cit., 71.

31 In digital imaging, rasters and vectors are two systems for encoding graphic files. Raster graphics store information by decomposing the image surface into a two-dimensional grid of pixels. Information values for hue, saturation, and brightness are stored for each pixel, such that the image's size and resolution (its total information) are determined by the sum total of pixels in the file. Thus, the more pixels in a file, the more information it contains. This remains true regardless of whether those pixels are ascribed toward greater size or higher resolution.

Vector graphics, however, store information in the form of mathematical equations. As opposed to a set of pixels, vector images are structured as a relational assemblage of bounded areas, or polygons. Each is associated with a mathematical expression indicating its color value and an equation that plots the curvature, or path, outlining its shape. Because vector graphics are mathematically scaleable, they are resolution-independent. The information content of a vector image is not linked to its dimensional size. This allows a single vector file to be used for printing a graphic on a letterhead or on a billboard with no loss of image quality — that is, with no loss in its graphic information content.

A post-script font is a prime example of a vector graphic, but most any form of computer-generated imagery can stand as well to exemplify the vector-based image format. By comparison, the most common type of raster-based digital graphics is photographic imagery. While raster graphics are sampled from analog sources, vector graphics are natively digital, that is, first composed on a computer.

32 Cited in John E. Estes and John R. Jensen, "Development of Remote Sensing Digital Image Processing and Raster GIS," *The History of Geographic Information Systems*, op. cit., 164.

33 Faust notes a conventional distinction between "passive" and "active" remote sensing techniques. Sensing that relies on any form of reflected (solar) or self-emitted (earth) energy sources is considered passive. Active remote sensing records energy emitted from a "manmade source such as a radar." Faust, "Raster Based GIS," 65.

34 Hayles' discussion focuses on the discourse of cybernetic engineers surrounding the development of the field of cybernetics during the 1950s. While Hayles does not address McLuhan's media theory, her argument that cybernetics is founded on a narrowing of the common-sensical gap between humans and machines applies to the concept of media as extensions of man, as well as to the formal definition of cybernetics as command and control. See Marshall McLuhan and Lewis H. Lapham, *Understanding Media: The Extensions of Man* (Cambridge: MIT Press, 1994) and N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

35 John Helgerson, "Truman and Eisenhower: Launching the Process," *Central Intelligence Agency, Center for the Study of Intelligence*, https://www.cia.gov/library/center-for-the-study-of-intelligence/kent-csi/docs/v38i-5a08p.htm.

36 Herbert I. Miller, "Memorandum for: Project Director, Subject: Suggestions re the Intelligence Value of AQUATONE, July 17, 1956. Top Secret," National Archives, CIA, Released 2000, http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB54/st04.pdf, emphasis added.

37 See Manuel De Landa, *War in the Age of Intelligent Machines* (New York: Zone Books, 1991).

38 Nissenbaum's argument concerning search engines can be applied to all technologies. See Helen Nissenbaum, "How Computer Systems Embody Values," *IEEE Computer*, 34, no. 3 (March 2001): 120,118-119.

We will return to Nissenbaum's claims in the context of search engine design in the second part of this paper. See Behar, "Capturing Glocality — Online Mapping Circa 2005: Mapping Glocalities."

39 Cloud, "American Cartographic Transformations," 268.

40 De Landa, *War in the Age of Intelligent Machines*, 195.

41 Ibid., 195.

42 Roger M. Hoffer, "Remote Sensing and GIS in Agriculture and Forestry — The Early Years" *The History of Geographic Information Systems*, op. cit., 147.

43 Ibid., 148.

44 De Landa, *War in the Age of Intelligent Machines*, 196-197.

45 Hoffer, "Remote Sensing and GIS in Agriculture and Forestry," 148.

46 Cloud, "American Cartographic Transformations," 262.

47 For a discussion of this history, see Lev Manovich, "The Automation of Sight: From Photography to Computer Vision," in *Electronic Culture*, ed. Timothy Druckrey and Allucquere Rosanne Stone (New York: Aperture, 1997) 229–239.

48 Miller, "Suggestions re the Intelligence Value of AQUATONE," 2.

49 John Cloud and Keith C. Clarke, "Through a Shutter Darkly: The Tangled Relationships between Civilian, Military and Intelligence Remote Sensing in the Early U.S. Space Program," in *Secrecy and Knowledge Production*, ed. Judith Reppy (Ithaca: Cornell University Peace Studies Program, 1999) 36-56. See 40.

50 Jonathan E. Lewis, *Spy Capitalism: Itek and the CIA* (New Haven: Yale University Press, 2002).

51 Ibid., 76.

52 Ibid., 65.

53 Ibid., 105.

54 Cloud and Clarke, "Through a Shutter Darkly," 41.

55 Ibid., 41.

56 How this problem was later mirrored by first-generation search engines and classification systems in the early growth of the Web will be discussed in the second part of this paper. See Behar, "Capturing Glocality—Online Mapping Circa 2005: Mapping Glocalities."

57 Cloud, "American Cartographic Transformations," 264.

58 Ibid., 266.

59 This definition is considerably simplified. For a more technical definition and further detail see Defense Mapping Agency, "Chapter VI: Geodetic Systems," *Geodesy for the Layman*, http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003B.HTM#ZZ7.

60 Curry, Digital Places, 43.

61 Of this undertaking, Cloud and Clarke write, "[i]t can now be appreciated that the intellectual exercise of identifying a Soviet missile site pales in comparison to the exercise of determining the missile site's position in the vast Eurasian landmass, across the Pacific from North America." Cloud and Clarke, "Through a Shutter Darkly," 42.

62 Cloud, "American Cartographic Transformations," 266.

63 Ibid., 267.

64 Defense Mapping Agency, "Chapter VIII: The World Geodetic System," *Geodesy for the Layman*, http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003E.HTM#ZZ11. The major difference between the WGS and previous datums was that it was a mass-centered datum, based on the Earth's gravity, rather than its surface. Curry has noted that while the conceit of the WGS is to be a universal system, in actuality, the system is far "messier," and in some ways is better understood as an attempt to fit together a group of local surfaces. For the purposes of this discussion, it is important to note the tension that arises from bringing together these two views: on one hand, a view of the Earth as a mass-centered territory, a view which facilitated launching satellites and guiding ICBM, and on the other, a view of the Earth as a montage of locally mappable surfaces. See Curry, *Digital Places*, 44.

65 Cloud, "American Cartographic Transformations," 269.

66 Ibid., 271.

67 Ibid., 275.

68 Ibid., 278 (emphasis added by Cloud).

69 Faust, "Raster Based GIS," 60.

70 Cloud, "American Cartographic Transformations," 276.
71 Cloud and Clarke, "Through a Shutter Darkly," 45.

72 Ibid., 50.

73 James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge: Harvard University Press, 1986) 434.

74 Ibid., 410.

75 Foresman, "GIS Early Years," 5.

76 Daniel Charles, "Do Maps Have Morals?" *Technology Review* 108, no 6 (June 2005): 77-79.

77 Ibid., 3.

78 For a discussion of how clustering algorithms are also used by folksonomy and meta-search engines, see Part Two of this project. Behar, "Capturing Glocality—Online Mapping Circa 2005: Mapping Glocalities."

79 John Goss, "Marketing the New Marketing: The Strategic Discourse of Geodemographic Information Systems," in *Ground Truth: The Social Implications of Geographic Information Systems*, ed. John Pickles (New York: The Guilford Press, 1995)134.

80 Ibid., 134.

81 John Pickles, "Representations in an Electronic Age: Geography, GIS and Democracy," in *Ground Truth: The Social Implications of Geographic Information Systems*, ed. John Pickles (New York: The Guilford Press, 1995) 7.

82 Curry, *Digital Places*, 46.

83 Curry warns that as a representational method, abstraction can have negative ramifications on privacy. Curry argues that GIS threatens privacy because its maps visually portraying statistical aggregates as "inhabiting" a geographical area, risk asserting a misleadingly perspicuous truth-value that "statistical work [...] displayed in [...] tabular form" does not. Ibid., 122–126; Viewed from another perspective, this representational problem confuses relative and absolute representational modes. Visual representations of informational boundaries are illusory because no inherent boundaries exist in data until clustering algorithms draw those boundaries as vectorized paths. GIS uses clustering to approximate, average, and draw zones in data and then attributes averaged approximate characteristics to zones. The difficulty arises when averaged zones are taken to be absolute representations when in fact they are relative representations. Vectors draw lines around the "like" on a principle of being "close-enough;" rasters insist on precision, correspondence, and verisimilitude. Thus GIS represents relative characteristics as opposed to absolute identities.

84 Quoted in James Beniger, *Control Revolution*, 412.

85 Curry, *Digital Places*, 46.

86 Ibid., 121.

87 President Bill Clinton's May 1, 2000 mandate to provide accurate signals to all users partially accounts for this pattern. Currently, NAVSTAR "support[s] civilian users at a slightly less accurate level." See Air Force Link, "Global Positioning System Fact Sheet," http://www.af.mil/factsheets/factsheet.asp?fsID=119. Prior to Clinton's termination of "Selective Availability," civilian users received a "degraded" signal with inferior accuracy to an approximate factor of 10. Encyclopedia Astronautica, "Navstar," http://www.astronautix.com/project/navstar.htm. It should be noted, however, that MILSTAR, "the most advanced military communications satellite system to date" now provides superior service reserved "for high priority military users." Air Force Link, "Milstar Satellite Communications System Fact Sheet," http://www.af.mil/factsheets/factsheet.asp?id=118.

88 Encyclopedia Astronautica, "Navstar."

89 Air Force Link, "Global Positioning System Fact Sheet."

90 Navteq, "Welcome to Navteq," http://www.navteq.com/about/index.html.

91 Navteq, "The Navteq Difference," http://www.navteq.com/about/whatis_difference.html.

92 Navteq, "Navteq Data," http://navteq.com/about/data.html. Navteq's captured territories have continued to grow since 2005, when Navteq advertised having mapped data on 52 countries on four continents. Navteq, "Navteq Data," http://web.archive.org/web/20060323133107/www.navteq.com/data/data.html.

93 Navteq, "Welcome to Navteq."

94 Navteq, "The Navteq Difference."

95 Navteq, "The Navteq Database," http://www.navteq.com/about/database.html.

96 Navteq, "Welcome to Navteq," http://web.archive.org/web/20050915065709/http://www.navteq.com/.

97 The following account is taken from Charles, "Do Maps Have Morals?" 77.

98 Navteq, "What is Navteq Data," http://www.navteq.com/about/whatis.html.

99 Ibid. See also Navteq, "The Navteq Database." Navteq, "Benefits," http://www.navteq.com/about/database_benefits.html.

100 Navteq, "Benefits," http://www.navteq.com/about/database_benefits.html.

101 Charles, "Do Maps Have Morals?" 77.

BIBLIOGRAPHY

Agre, Philip E. "Surveillance and Capture: Two Models of Privacy." In *The New Media Reader*, ed. Noah Wardrip-Fruin and Nick Montfort (Cambridge: MIT Press, 2003), 737–760.

Air Force Link. "Global Positioning System Fact Sheet." http://www.af.mil/factsheets/factsheet.asp?fsID=119 (accessed December 4, 2008).

Air Force Link. "Milstar Satellite Communications System Fact Sheet." http://www.af.mil/factsheets/factsheet.asp?id=118 (accessed December 4, 2008).

Ard, Scott. "Google's 300-year plan." http://news.cnet.com/8301-10784_3-5770305-7.html (accessed December 4, 2008).

Behar, Katherine. "Capturing Glocality — Online Mapping Circa 2005: Mapping Glocalities." *Parsons Journal for Information Mapping* 1, no. 3 (July 2009): forthcoming.

Beniger, James R. *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge: Harvard University Press, 1986).

Brin, Sergey and Lawrence Page. "The Anatomy of a Large-Scale Hypertextual Web Search Engine." *WWW7 / Computer Networks* 30, no. 1–7 (1998): 107–117.

Charles, Daniel. "Do Maps Have Morals?" *Technology Review* 108, no 6 (June 2005): 77–79.

Cloud, John. "American Cartographic Transformations During the Cold War." *Cartography and Geographic Information Science*, 29, no. 3 (2002): 261-282.

Cloud, John and Keith C. Clarke, "Through a Shutter Darkly: The Tangled Relationships between Civilian, Military and Intelligence Remote Sensing in the Early U.S. Space Program." In *Secrecy and Knowledge Production*, ed. Judith Reppy (Ithaca: Cornell University Peace Studies Program, 1999), 36–50.

Curry, Michael R. *Digital Places: Living with Geographic Information Technologies.* New York: Routledge, 1998.

Davies, Simon G. "Re-Engineering the Right to Privacy: How Privacy Has Been Transformed from a Right to a Commodity." In *Technology and Privacy: The New Landscape*, ed. Philip E. Agre and Marc Rotenberg (Cambridge: MIT Press, 1997), 143–166.

Defense Mapping Agency. "Chapter VI: Geodetic Systems," *Geodesy for the Layman.* http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003B.HTM#ZZ7 (accessed December 4, 2008).

Defense Mapping Agency. "Chapter VIII: The World Geodetic System," *Geodesy for the Layman.* http://www.ngs.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003E.HTM#ZZ11 (accessed December 4, 2008).

De Landa, Manuel. *War in the Age of Intelligent Machines* (New York: Zone Books, 1991).

E-ZPass. "E-ZPass Information." http://www.ezpass.com/static/info/index.shtml (accessed December 2, 2008).

E-ZPass. "Summary of Facilities Accepting E-ZPass." http://www.ezpass.com/static/info/facilities.shtml (accessed December 2, 2008).

Encyclopedia Astronautica. "Navstar." http://www.astronautix.com/project/navstar.htm (accessed December 4, 2008).

Environmental Systems Research Institute (ESRI). "ESRI — The GIS Software Leader." http://www.esri.com/ (accessed December 2, 2008).

Estes, John E. and John R. Jensen. "Development of Remote Sensing Digital Image Processing and Raster GIS." In *The History of Geographic Information Systems: Perspectives from the Pioneers*, ed. Timothy W. Foresman (Upper Saddle River: Prentice Hall PTR, 1998), 163–180.

Faust, Nickolas. "Raster Based GIS." In *The History of Geographic Information Systems: Perspectives from the Pioneers*, ed. Timothy W. Foresman (Upper Saddle River: Prentice Hall PTR, 1998), 59-72.

Foresman, Timothy W. "GIS Early Years and the Threads of Evolution." In *The History of Geographic Information Systems: Perspectives from the Pioneers*, ed. Timothy W. Foresman (Upper Saddle River: Prentice Hall PTR, 1998), 3–17.

Goodchild, Michael. "Geographic Information Systems and Geographic Research." In *Ground Truth: The Social Implications of Geographic Information Systems*, ed. John Pickles (New York: The Guilford Press, 1995), 31–50.

Google. "Corporate Information: Company Overview." http://www.google.com/intl/en/corporate/index.html (accessed December 4, 2008).

Google. "Corporate Information: Google Milestones." http://www.google.com/corporate/history.html (accessed December 4, 2008).

Google. "Official Google Blog." http://googleblog.blogspot.com/ (accessed December 4, 2008).

Goss, John. "Marketing the New Marketing: The Strategic Discourse of Geodemographic Information Systems." In *Ground Truth: The Social Implications of Geographic Information Systems*, ed. John Pickles (New York: The Guilford Press, 1995), 130–170.

Hayles, N. Katherine. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

Hearnshaw, Hilary M. and David J. Unwin. "Introduction." In *Visualization in Geographical Information Systems*, ed. Hilary M. Hearnshaw and David J. Unwin. (New York: John Wiley and Sons, 1994).

Helgerson, John. "Truman and Eisenhower: Launching the Process." *Central Intelligence Agency,* Center for the Study of Intelligence. https://www.cia.gov/library/center-for-the-study-of-intelligence/kent-csi/docs/v38i5a08p.htm (accessed December 4, 2008).

Hoffer, Roger M. "Remote Sensing and GIS in Agriculture and Forestry — The Early Years." In *The History of Geographic Information Systems: Perspectives from the Pioneers*, ed. Timothy W. Foresman (Upper Saddle River: Prentice Hall PTR, 1998), 147–160.

Lewis, Jonathan E. *Spy Capitalism: Itek and the CIA* (New Haven: Yale University Press, 2002).

McLuhan, Marshall and Lewis H. Lapham. *Understanding Media: The Extensions of Man* (Cambridge: MIT Press, 1994).

Manovich, Lev. "The Automation of Sight: From Photography to Computer Vision." In *Electronic Culture, ed. Timothy Druckrey and Allucquere Rosanne Stone* (New York: Aperture, 1997), 229–239.

Miller, Herbert I. "Memorandum for: Project Director, Subject: Suggestions re the Intelligence Value of AQUATONE, July 17, 1956. Top Secret." *National Archives*, CIA, Released 2000. http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB54/st04.pdf.

Mills, Elinor. "Google ETA? 300 years to index the world's info." http://news.cnet.com/Google-ETA-300-years-to-index-the-worlds-info/2100-1024_3-5891779.html (accessed December 4, 2008).

Navteq. "Benefits." http://www.navteq.com/about/database_benefits.html (accessed December 2, 2008).

Navteq. "Navteq Data." http://navteq.com/about/data.html (accessed December 2, 2008).

Navteq. "Navteq Data." *Internet Archive*. http://web.archive.org/web/20060323133107/www.navteq.com/data/data.html (accessed December 2, 2008).

Navteq. "The Navteq Database." http://www.navteq.com/about/database.html (accessed December 2, 2008).

Navteq. "The Navteq Difference." http://www.navteq.com/about/whatis_difference.html (accessed December 2, 2008).

Navteq. "Welcome to Navteq." http://www.navteq.com/about/index.html (accessed December 2, 2008).

Navteq. “Welcome to Navteq.” Internet Archive. http://web.archive.org/web/20050915065709/http://www.navteq.com/ (accessed December 2, 2008).

Navteq. “What is Navteq Data.” http://www.navteq.com/about/whatis.html (accessed December 2, 2008).

Nissenbaum, Helen. “How Computer Systems Embody Values.” IEEE *Computer*, 34, no. 3 (March 2001): 120, 118–119.

O’Reilly Media, “Where 2.0 Conference — June 29 – 30 — San Francisco, CA.” http://conferences.oreillynet.com/where2005/ (accessed December 2, 2008).

O’Reilly, Tim. “What is Web 2.0: Design Patterns and Business Models for the Next Generation of Software.” http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html (accessed December 2, 2008).

Pickles, John. “Representations in an Electronic Age: Geography, GIS and Democracy.” In *Ground Truth: The Social Implications of Geographic Information Systems*, ed. John Pickles (New York: The Guilford Press, 1995), 1–30.

Preemptive Media. “zapped! Background Info.” http://www.zapped-it.net/info.html (accessed Dec. 4, 2008).

Preemptive Media. “zapped! FAQs.” http://www.zapped-it.net/faqs.html (accessed December 4, 2008).

Price, Gary. “Schmidt Talks To Advertisers, Mentions 300 Year Timeframe (again) Before Google Makes it ‘All’ Searchable.” http://blog.searchenginewatch.com/blog/051008-193944 (accessed December 4, 2008).

Tomlinson, Roger. “The Canada Geograp hic Information System.” In *The History of Geographic Information* Systems: Perspectives from the Pioneers, ed. Timothy W. Foresman (Upper Saddle River: Prentice Hall PTR, 1998), 21–32.

Vaidhyanathan, Siva. “A Risky Gamble With Google.” *The Chronicle of Higher Education*, 52, no. 15 (December 2, 2005): B7.

Wikipedia. “List of Google services and tools.” http://en.wikipedia.org/wiki/List_of_Google_products (accessed December 4, 2008).