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Prudence S. Adler is the Associate Executive Director of the Association of Research Libraries. Her responsibilities include federal relations with a focus on information policy, intellectual property, public access policies including open access, accessibility for persons with disabilities and issues relating to access to government information. Prior to joining ARL in 1989, Adler was Assistant Project Director, Communications and Information Technologies Program, Congressional Office of Technology Assessment where she worked on studies relating to government information, networking and supercomputer issues, and information technologies and education.

Adler has an M.S. in Library Science and M.A. in American History from the Catholic University of America and a B.A. in History from George Washington University. She has participated in several advisory councils including the Depository Library Council, the National Satellite Land Remote Sensing Data Archive Advisory Committee, the Board of Directors of the National Center for Geographic Information and Analysis, the National Research Council's Steering Committee on Geolibraries, the National Research Council Licensing Geographic Data and Services Committee, the National Institutes of Health PubMed Central National Advisory Committee, and the National Academy of Sciences Forum on Open Science.

Perspective Statement

The growing understanding of the value of open data in support of research, teaching and learning presents an important opportunity for research institutions and their libraries. Be it funder policies such as the February 2013 OSTP memo on access to federally funded research resources or journal policies requiring the deposit of digital data associated with an article—for purposes of validation and reuse—in a trusted repository, some data require long-term preservation and access. The Alexandria Digital Research Library is well positioned to serve as a model for other repositories as a campus-wide platform that integrates spatial data and resources across the institution so that data is discoverable, curated and used and re-purposed. Such a platform would allow these data to be harvested leading to new research, integration into the classroom and importantly, and foster new interdisciplinary and computational research. Finally, ADRL can showcase the intellectual assets of the university.

Selected issues of interest to other institutions include: cost of implementation; staff requirements; demonstration of the value to the user/ campus community leading to, adoption and use including deposit; services; interoperability; how to successfully engage the campus community, e.g., stakeholder analysis and outreach; timeline for implementation and adoption; if copyrighted information is included in the repository, is use limited to a campus; sustainability; technological compatibility and scalability; institutional policies; and more.

JOHN ADWALE AJAO

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John Ajao is the Director for Systems & Repository Operations at the University of California, Santa Barbara Library. He is primarily responsible for managing the Library IT operations including Alexandria Digital Research Library Project. The UCSB Library maintains a unique and complex Information Technology (IT) environment, and offers a number of services both internally and to the campus as a whole. The organization has a strong online presence, with a large, complex, mission-critical website offering dynamic content and 24 hour access to online catalogs. Continual scanning efforts have yielded a growing collection of Terabytes of digitized aerial photography and maps and depend heavily on in-house workflow software. The Library is an active participant in the field of digital library development, with ongoing research projects emphasizing geospatial data search, digital archiving, and logistical networking. As the IT unit responsible for managing the library geospatial data and past involvement with Library of Congress NDIIPP/NGDA project, the challenges we identified with developing a comprehensive spatial discovery solution locally at the time are real today.

Perspective Statement

Spatial Data presents unique sets of data management challenges such as lacking the tools that enable librarians, curators, and others who are responsible for spatial data management to create attractive, feature-rich portals that highlight these collections. ADRL framework utilizes the www.ProjectHydra.org and the <http://geoblacklight.org/projects.html> framework. I would like to see a consolidated effort put toward addressing the need for building a sustainable Open-source tool that provides comprehensive management solution for spatial data from acquisition to dissemination, including preservation needs. The ideal systems should integrate with the current Library catalog and allow for enhancements, management, and discovery of spatial data to meet the university's research and instructional goals.

JAMES BOXALL

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James Boxall teaches geography and GIS at Dalhousie University where he holds appointments in: School of Planning; School of Information Management; Earth Sciences; Environmental Programmes; and Marine Affairs. In 1997 he participated in the Alexandria Digital Geolibrary review. He is a Fellow of both the Royal Geographical Society and the Royal Canadian Geographical Society (RCGS), and is currently a Governor of the RCGS, chairing the Research Grants Committee, also receiving the RCGS Education Medal in 2012. He is also on the Board of Governors for the Nova Scotia Museums. He is on the local committee for Digital Earth 2015 to be held in Halifax, Nova Scotia. He is on the review board for the *Journal of Map and Geography Libraries*, and currently co-chairs the International Network for Learning and Teaching Geography in Higher Education (INLT). He recently completed two years as co-chair of the Canadian Round Table on Geomatics (NRCan), and is presently co-editing a book on *GIScience Research and Education in Canada*. As a geographer and librarian, his interests tend to focus on bridging gaps in geoliteracy through geolibraries; as a native Atlantic Canadian, his passion is with how to merge geoliteracy and geospatial information with saving the oceans. He proudly accepted the Esri SAG Award for Dalhousie University Libraries in 2012.

Presentation Abstract: Re-positioning Spatial Discovery

Two decades ago we saw the rise of some innovative visions for spatial discovery. We also were presented with a stark cautionary note: “It is possible that libraries will be the principal means whereby citizens gain access to the services of the distributed geolibraries of the future; it is also possible that libraries will play no significant part in that process” (Mapping Science Committee, 1999). For those in the knowledge management sector (libraries, archives, museums) it raises the blunt question of the status and future of our position in the discovery process; simply put, where are we on this continuum of “significance” in light of current and likely “futures of spatial.” Spatial has become so widespread that we need to take the time to think through what we can let go, what we need to do, and what emerging areas deserve some attention. Most importantly, it is a good time to reconsider the value of spatial and how we, as a community of experts, make the case for the value.

TOM BRITTNACHER

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Tom Brittnacher coordinates UCSB Library's efforts to manage and curate its digital geospatial data holdings, especially by developing processing workflows and creating metadata using AACR2, RDA, FGDC (CSDGM), and ISO 19115 standards. He is interested in the evolution of geospatial metadata and the incorporation of linked data for controlled vocabularies, as well as the development of map-based interfaces for discovering geospatial datasets. He is also active in developing research data management services provided by UCSB Library through pilot projects that assist researchers with managing and describing their data and preparing datasets for ingest into a repository.

Brittnacher is a member of the Open Geoportal Metadata Working Group, a multi-national effort to develop best practices for geospatial metadata creation, and participates in the subcommittee tasked with developing best practices using the ISO 19115 standard. (Open Geoportal is an open source web application for discovering, previewing, and downloading geospatial data.)

In his previous positions as the GIS Librarian at the University of British Columbia and the University of Wisconsin-Milwaukee, he managed geospatial data and metadata in library repositories using DSpace and Dataverse software that apply the Dublin Core metadata schema. He explored other possibilities for geospatial discovery, such as through geoportals with federated searching capabilities, as a way to improve findability of data in the library's collection and beyond. Prior to his work in academic libraries, he worked extensively with geospatial data as a GIS analyst, urban planner, and cartographer.

Brittnacher has a B.S. in Geography from UC Davis, a Master of Arts in Urban Planning from UCLA, and a Master of Library and Information Science from the University of Wisconsin-Milwaukee.

Perspective

The value of metadata lies not only in its completeness, but in the quality of the information being recorded. Consistency in content as dictated by standards and schema go a long way in helping us discover and reuse data. However, it is not always clear to the metadata creator how to apply standards. And in many cases, there is little incentive for data producers to create detailed metadata.

My interests lie in the development of best practices for geospatial metadata creators, whether they be library catalogers, researchers, or government agencies. How can we best guide people to understand what should be entered in metadata fields, which fields are the most important (or required by standards), and how should controlled vocabularies be used? In developing these best practices with respect to data discovery, I think it's important to understand how the fields are being used by search technology. For example, with spatial data,

geographic extents expressed through keywords vs. rectangular bounding boxes vs. polygons can affect which datasets are discovered, depending on the design of the technology, the quality of the values expressed in the metadata, and the choices made by the searcher. How can we improve the findability of datasets through metadata creation workflows?

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Savannah Cooley is a senior undergraduate student at Clark University in Massachusetts, majoring in Economics and minoring in Math and Geography with a concentration in Computational Science. She is an M.S. candidate for Clark's accelerated M.A. program in Geographic Information Science (GIS). The cross-disciplinary education Cooley pursues reflects her passion for recognizing the inter-connected nature, particularly the spatial relationships, of environmental and human systems. Cooley's applications of GIS range from working with a non-profit in the Brazilian Atlantic Rainforest to create the region's first web-based GIS application, to working with the Central Massachusetts Regional Planning Commission to identify priority road segments to improve in order to increase Worcester County's food system connectivity by using road-condition data and modeling the routes farmers would take to transport food to regional farmer's markets.

Cooley is currently an intern at the Center for Spatial Studies at the University of California, Santa Barbara (UCSB) working on a project with the UCSB Library to coordinate an integration of spatial data into the university's online GIS application. The project seeks to resolve the challenges that libraries and researchers face in trying to discover spatial data via metadata on diverse platforms and in a variety of environments.

ANABEL FORD

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Anabel Ford is the Director of the MesoAmerican Research Center at the University of California at Santa Barbara, as well as President of the nonprofit organization Exploring Solutions Past (ESP~Maya). She is a distinguished Maya archaeologist who has decoded the ancient Maya landscape. Her discovery of the ancient Maya city center of El Pilar on the contemporary border of Belize and Guatemala promises to be the first cultural and natural Peace Park of the world. Her passion for the common people of the ancient Maya together with contemporary international politics, conservation and development, and interdisciplinary research has inspired the vision of Archaeology Under the Canopy. With decades of field experience and a broadly inquisitive mind, she sees the Maya forest as a garden created by the ingenious Maya. Ford has developed the Maya forest GIS with her geography colleague, Keith Clarke, and their first version was archived in the Alexandria Digital Library. Since 2000 research and development of the Maya forest GIS has expanded original data collection and compilation from diverse fields and sources in MesoAmerica and the Maya area. The analytical results and integrated data sets increase the value of these focused regional, local and site specific spatial data.

Presentation Abstract:

Discovering the Complexity of Spatial Data: Evolution and Organization of the UCSB Maya Forest GIS

Initiated as a working base for the Maya forest research of Anabel Ford and Keith Clarke, the project has collected spatial data sets in the Geographic Information System format for Belize, Guatemala, and Mexico. Familiar with the concept of layers and the use of scale in the paper scheme of things, the creation and development of digital layers into the UCSB Maya Forest GIS has proved a challenge in maintaining consistency and tracking of sources. Particularly difficult is the establishment of metadata that meets our uses and adheres to standards, particularly with changing student and intern users! We are now teaming with the UCSB Library to develop our metadata and descriptions for our growing and valuable compilation of digital data for the Maya forest.

The foundation of the Maya Forest GIS was based on a regional data set developed by USAID in 1996 for the Maya forest under the auspices of Paseo Pantera Consortium at University of Florida. Our specific agenda was to bring together data to test geographic bases of Maya archaeological site location. On the Paseo Pantera regional scale of 250K, we began to accumulate GIS data sets at the 50K local scale by digitizing relevant maps and acquiring data from government institutions of the Land Information Center in Belize and the Consejo Nacional de Areas Protegidas in Guatemala, as well as academic institutions in Mexico.

Through the course of the integration of diverse data sets, we developed our own site-specific data, ($\leq 10K$) focused at the binational protected area of El Pilar, including detailed LiDAR and air photos for the 20 sq km protected area in Belize and Guatemala. We can now manage geographic data organized at the regional, local, and site-specific scale for soil, hydrology, roads, protected area boundaries, topography, air and satellite imagery, cities, as well as archaeological sites. In addition, we have created analytical layers with these geographic inputs aimed at understand land use change past and present as we discover the complexity of spatial data.

MARCEL FORTIN

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Marcel Fortin is the Head of the Map and Data Library at the University of Toronto. He and his team support geospatial research and teaching across all three campuses of Canada's largest post-secondary institution. Fortin teaches the course, *The Power of Maps and Geographic Information* in the Geography Department at the University of Toronto. He also teaches a course on GIS Librarianship at the U of Toronto's Faculty of Information. In 2014 Fortin co-edited the book *Historical GIS Research in Canada*, published by the University of Calgary Press.

Presentation Abstract: Spatial Data Discovery and Support in a Library Setting

It is no secret that there have been massive developments in geospatial data and technology worldwide over the past twenty years, with a tremendous explosion ten years ago with the adoption of a now ubiquitous worldwide mapping system, Google Maps. Libraries have played a large role in supporting this increase in demand for geospatial technology in the academic community. This presentation will examine the continued growth in demand for library geospatial services, and will also focus on some of the strategies, challenges, and policies libraries are adopting in order to continue to meet these demands.

MARYLYNN FRANCISCO

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MaryLynn Francisco serves as the Chief Librarian, GEOINT Research Center (GRC) at the National Geospatial-Intelligence Agency (NGA) in the DC area. The GRC provides geospatial intelligence materials, research services and access to open source information resources to support internal NGA and external government customers. There are two libraries— Springfield, VA (East) and St. Louis, MO (West). The GRC collection is made up of 5 million items maps, charts, hand-held imagery, commodity data, and books.

Francisco has worked in federal libraries in varied positions since 1992 with Defense Mapping Agency (DMA), National Imagery and Mapping Agency (NIMA) and NGA. Present responsibilities are oversight of outreach projects with the Library of Congress (Geography and Map Division), Foreign Partners, State Dept. Map Library, and varied Federal Libraries.

Francisco received the 2011 Federal Librarian of the Year award from the Library of Congress on behalf of the Federal Library and Information Network (FEDLINK). She was responsible for consolidating three separate physical collections and locations into one 32,400 square foot collaborative workspace. With her oversight of metadata standardization resulted in the center's records being integrated into a larger project and completion of a data-integrity project, resulting in more than 5,000 records being purged before migrating into the libraries new Geospatial Integrated Library System and visualization tool.

Francisco was present at the Balkan Proximity Peace Talks held at Wright-Patterson Air Force Base located in Dayton, Ohio in 1995. She was the only research librarian in attendance. She developed the mechanism to track the multiple map versions during the Peace Talks. The Peace Talks produced an Atlas which was then signed by the three country delegates; the Republic of Bosnia and Herzegovina, the Republic of Croatia and the Federal Republic of Yugoslavia (FRY). The Agreement was witnessed by representatives of the Contact Group nations—the United States, Great Britain, France, Germany, and Russia—and the European Union Special Negotiator. Francisco was instrumental in getting a copy donated to the Library of Congress.

Francisco received her M.A. in Library and Information Science Degree from San Jose State University-Library School in San Jose, California. She also acquired a B.S. in Home Economics from the California State University, Sacramento, California. Francisco resides in Maryland with her husband, Jack, and their three children.

Perspective Statement

As an NGA federal librarian working in a geographic and geospatially visual world there is the need to develop an Enterprise Search capability that can access and probe multiple, disparate databases or repositories. To be able to implement a successful search engine

requires an agreed-upon set of standards and data structure coupled with content to which metadata tagging have been liberally applied at the data level. I work with a wide variety of federal libraries that have been discussing this need from many years. When our customers are in the need of geospatial data and are assisting in the middle of a natural disaster or dealing with non-pleasant folks at their flank searching one time across multiple, disparate databases is a necessary need.

My team has been working on a standard that has encompassed the Dublin Core Metadata Standards, International tagging standards and our federal systems metadata standards to probe the multitude of federal geospatially enabled databases. We discovered that providing co-ordinates (latitude & longitude) to the tagging requirements assisted the item to be retrieved at the same search along with subject probes. Many of the digital objects we use have imbedded metadata that starts the long content tagging process. In the library world this search capability has been tagged with "federated search". Definition - Federated search is an information retrieval technology that allows the simultaneous search of multiple searchable resources. A user makes a single query request which is distributed to the search engines participating in the federation.

The "search engine" is the where we librarians are at now with the investigating process. The NGA Library has recently purchased a new system which is an enterprise content management solution that combines geospatial data management with a browser-based search interface.

JAMES FREW

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James Frew is Associate Professor of Environmental Informatics in the Bren School of Environmental Science & Management at UCSB. Trained as a geographer, he has worked in remote sensing, image processing, software architecture, massive distributed data systems, and digital libraries. He was a principal investigator for the Sequoia 2000 Project (one of the first “big data” projects) and the original Alexandria Digital Library (the first online geospatial information library.) His current research is focused on geospatial information provenance, science data curation, and applications of array databases, using remote sensing data products as operational test beds. He was a founder of the Federation of Earth Science Information Partners (ESIP), and served for two years as its president.

Perspective Statement

The baselines for spatial data discovery are a carefully-crafted web search, or the implicit incorporation of spatial data into services like commerce or navigation. Discussions about spatial data discovery in the context of a **library** should focus on the unique value a library adds:

- **Depth:** University research libraries should make their own scholars' spatial data products accessible and discoverable. If a scholar is affiliated with a university, then its library is where we should discover and access their scholarly output.
- **Consistency:** Libraries provide both a single point of discovery and (more importantly) uniform catalog semantics. Library users should be confident that, if they know how to describe something, they'll find it if it exists.
- **Authority:** We expect libraries to have vetted their contents, and in this case, “contents” extends to all information provided through library interfaces. We should have much more confidence in a library search than in a Google search.
- **Stability:** Nearly unique among human institutions, libraries address the trans-generational survival and usability of information. We will increasingly rely on libraries for access to *historic* digital information.

CHRISTOPHER GIST

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Chris Gist is the GIS Specialist in the University of Virginia Library where he builds spatial data collections, teaches GIS courses, consults on research projects and provides GIS user support. His research work includes various demographic, neighborhood indicator, alternative transportation, environmental science and humanities GIS projects. Gist has a B.S. in Environmental Science and an M.S in Information Systems from Virginia Commonwealth University and is a certified GIS professional (GISP).

Presentation Abstract: History of Geodata and Metageodata at the University of Virginia Library

Dealing with geodata is a continuing issue for university libraries. The University of Virginia Library has a long history of making spatial data available to end users in usable formats. Starting with projects like the Historic Census Browser, the Library's work on spatial data curation, management, discoverability, and ease of use continue to be a driving force. The Scholars' Lab pioneered the use of open source applications to create spatial data portals that make end use of spatial data practical. These efforts, in combination with our partner universities, have led to GeoBlacklight which is a project to integrate a geoportal into library catalogs. To me, seamless integration into the Library catalog is the end goal.

MICHAEL GOODCHILD

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Michael F. Goodchild is Emeritus Professor of Geography at the University of California, Santa Barbara, where he also holds the title of Research Professor. He also holds an affiliate appointment in the Department of Geography at the University of Washington. Until his retirement in June 2012 he was Jack and Laura Dangermond Professor of Geography, and Director of UCSB's Center for Spatial Studies. He received his BA degree from Cambridge University in Physics in 1965 and his PhD in geography from McMaster University in 1969, and has received four honorary doctorates. He was elected member of the National Academy of Sciences and Foreign Member of the Royal Society of Canada in 2002, member of the American Academy of Arts and Sciences in 2006, and Foreign Member of the Royal Society and Corresponding Fellow of the British Academy in 2010; and in 2007 he received the Prix Vautrin Lud. He was editor of *Geographical Analysis* between 1987 and 1990 and editor of the Methods, Models, and Geographic Information Sciences section of the *Annals of the Association of American Geographers* from 2000 to 2006. He serves on the editorial boards of ten other journals and book series, and has published over 15 books and 500 articles. He was Chair of the National Research Council's Mapping Science Committee from 1997 to 1999, and of the Advisory Committee on Social, Behavioral, and Economic Sciences of the National Science Foundation from 2008 to 2010. His research interests center on geographic information science, spatial analysis, and uncertainty in geographic data.

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Perspective on Spatial Discovery

In thinking about the topic of this meeting, I like to begin at the beginning, by asking why someone might want to search for spatial data. Otherwise we risk our thinking being constrained by the legacy of previous approaches to spatial discovery, without the liberating effects of newer technology. The old media for disseminating spatial data included the map, the globe, the remotely sensed image, and the atlas. They provided a compact, filtered synthesis of a vast amount of original data that could not reasonably be produced, stored, and disseminated in any other way. These arrangements were copied into the digital world, by structuring our spatial-information technologies around *layers*, which simply replicated the contents of the old analog media in digital form. Even today the layer concept persists, often in the form of a list of layers occupying a panel on the left-hand side of the screen.

I find it helpful to think of layers as integrating spatial information horizontally, by storing one type of attribute, feature class, or variable over a spatial extent. But was this driven by a careful analysis of what users needed spatial data for, or was it a legacy of the earlier media, driven in

part by the economics of spatial data production? It makes it easy to compare places with respect to the same attribute, feature type, or variable. But it makes it comparatively difficult to assemble multiple attributes or variables for *one* location. Despite this we persist in claiming that GIS is the answer to spatial data integration, but in reality we have made it remarkably difficult to integrate across layers, or what we might think of as vertical integration. Moreover integration based on location only works perfectly if location is measured perfectly, which it never is.

So let's begin with the use cases, or the reasons why users might want spatial data. How many queries concern "What is at *x*?" Retrieving separate spatial data sets and integrating them vertically provides a very expensive, tedious, and ultimately inexact answer. The query "Where is *z*?" on the other hand is best answered by accessing a single layer that can be searched for instances of *z*. A query "How high is Mt Everest?" has a spatial answer, but it is likely not best obtained by searching a DEM, which will not readily identify features or their names. The query "How do we know that Everest is 8848m high?" is similarly not readily suited to traditional spatial search and discovery, because it asks for information about provenance that is typically not available through the traditional process of spatial data production.

This line of inquiry is especially important to the potential users of the planned facility. We risk artificially limiting the potential of the facility if we model it on the processes of the past. However successfully we deal with metadata and semantics, we will still be locked into the old model of delivering an entire, horizontally organized data set.

The Center for Spatial Studies is already the hub of a campus network, and has tapped into many if not most of the applications of spatial thinking in the various disciplines. I suggest that as part of the plan for the new facility the center institute a systematic study of the use cases, the tasks for which researchers and instructors need spatial data. Two to three months of a dedicated person should be sufficient to tease out some interesting perspectives on the problem, and to produce a publishable analysis.

I published an article in *D-Lib Magazine* (Goodchild, 2004) that reflected on the Alexandria Project (which is now more than a decade in the past), discussed its limitations, and raised some of these issues.

Reference

M. F. Goodchild (2004) [The Alexandria Digital Library: Review, Assessment, and Prospects](#). *D-Lib Magazine* 10(5).

KARL GROSSNER

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Karl Grossner (Ph.D. 2010, University of California, Santa Barbara), is a geographer working since 2012 as a Digital Humanities Research Developer at Stanford University Libraries' Center for Interdisciplinary Digital Research (CIDR). His research interests are principally concerned with the distinctive representational and computational requirements for digital historical atlas applications, and the historical gazetteers integral to that emerging genre. In his current position Grossner works on faculty-led projects in the humanities and social sciences, collaborating in research and designing and developing digital publications of results. In 2013 he co-founded the GeoHumanities SIG within the Alliance for Digital Humanities Organizations, to help foster constructive discussions between humanities scholars and GIScientists.

blog: <http://kgeographer.org>

SIG: <http://geohumanities.org>

A Next Stage Digital Geolibrary

I am particularly interested in the long-term goal of developing spatial-temporal interfaces to all library holdings, and view the core challenge to be development of a global, distributed, and truly historical gazetteer. There are several existing projects under way working very pragmatically towards that goal, and it would be very exciting to see the next stage of work at ADRL contribute to them. Among these is an effort coordinated by the Pelagios group [1] to develop a simple core format and technologies to permit the coupling of an unlimited number of gazetteers specialized for particular regions and periods. Another promising project is PeriodO (Periods, Organized) [2], which is taking a similar lightweight approach to building a gazetteer system devoted to historical periods. Places and periods share many representational requirements, as their spatial and temporal dimensions are of co-equal importance. I have been actively involved in these and other gazetteer development projects as a discussant and advisor over the past few years.

In preparation for this meeting I have begun analyzing the Library of Congress Classifications (LCC) [3] for their spatial and temporal content, and will be able to discuss and display preliminary results. There is a strong likelihood that a basic but useful historical gazetteer interface to the entire library can be developed relatively quickly (given resources) by leveraging that existing metadata system. The LC subject headings are a further, much larger source of data that can be an instrumental element of more sophisticated systems in the longer term.

[1] <http://pelagios-project.blogspot.com/>

[2] <http://perio.do/>

[3] [http://www.loc.gov/catdir/cpsolcco/](http://www.loc.gov/catdir/cpsolcc/)

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Jon Jablonski is head of the UCSB Library's Map & Imagery Laboratory (MIL). With graduate degrees in Geography and Library Science, Jablonski is responsible for collecting, organizing, and providing access to the Library's geospatial content. MIL includes the largest collection of historic aerial photography in an academic institution, hundreds of thousands of topographic maps and thousands of basemap data layers from countries around the globe, and a huge selection of thematic layers collected since the early 1990s, when the original Alexandria Digital Library was conceived. Since coming to UCSB in 2010, Jablonski has fostered close working relationships with both computational scientists and digital humanists on campus while helping to increase the variety of data services available to Library users. His personal research focuses on how Internet and Communications Technologies (ICTs) affect culture, economy, libraries, and how individuals navigate the world around them.

Perspective Statement

Academic Libraries have struggled to build systems that offer effective access to spatial data. A very small number of very large institutions have managed to construct and maintain usable geoportals, despite rapid advances in server-side GIS technologies. For example, libraries devote significant financial and human resources to the library catalog—frequently paying tens-of-thousands of dollars per year on maintenance contracts for these commercial “integrated library systems.” There are typically entire departments whose employees spend their days populating the database with metadata. Digital repository systems to host digital content are typically viewed as projects that can be developed and then forgotten. Rarely are significant numbers of metadata creators, system administrators, and software engineers dedicated to the task full time.

No academic library has surplus personnel ready to be re-tasked. And no matter how widespread the use of GIS systems becomes, the number of people who have a conscious need and desire to find and use spatial data is considerably smaller than the population as a whole. However, in my work I encounter people daily who have information needs that would best be met by a mapped dataset. My task is to connect them not only with that data, but also with the skills and tools required to use that data.

Progress has been made in recent years as data services have become more widespread and more library personnel have become involved with the data enterprise, however, more work needs to be done. Remote, unmediated access to digital content has been the preference of our users for at least fifteen years. We have started down the path and made significant progress,

but only through significant re-tooling, re-training, collaboration, and investment will it be possible for libraries to transition to the place where our users already live.

DONALD JANELLE

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Donald Janelle is a Researcher Emeritus at the University of California, Santa Barbara and Professor Emeritus with the University of Western Ontario. His research focuses largely on issues in transportation and urban geography. In the period since 2000 he served as Program Director for the Center for Spatially Integrated Social Science and the Center for Spatial Studies at UCSB. He retired in 2014 but has been called back to archive the Center's documents on eScholarship.

Perspective Statement

I am currently working on the development of an archival resource to document the research outcomes of three explicitly spatial initiatives from UCSB—the National Center for Geographic Information and Analysis (1988–1999), the Center for Spatially Integrated Social Science (1999–2013), and the Center for Spatial Studies (2007–). The objective of this effort is to enhance the “discoverability” of scholarship from UCSB that has been important to the emergence of geographic information science (GIS) and spatial thinking across academic disciplines.

The archive makes use of the escholarship.org facility to provide open access dissemination of publications and research associated with individual scholars and academic units of the University of California.

KRZYSZTOF JANOWICZ

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Krzysztof Janowicz is an Assistant Professor for Geographic Information Science and Geoinformatics at the Geography Department of the University of California, Santa Barbara. He is the program chair of the Cognitive Science Program, one of two Editors-in-Chief of the *Semantic Web Journal*, a Faculty Research Affiliate of the Center for Information Technology and Society, and the community leader of the 52° North semantics community. Janowicz is running the STKO Lab, which investigates the role of space and time for knowledge organization. Prior to coming to UCSB, Janowicz was an Assistant Professor at the GeoVISTA Center, Department of Geography at The Pennsylvania State University. Before that he was working as postdoctoral researcher at the Institute for Geoinformatics (ifgi), University of Münster in Germany for the international research training group on Semantic Integration of Geospatial Information and the Münster Semantic Interoperability Lab (MUSIL). Methodologically, Janowicz's niche is the combination of theory-driven (e.g., semantics) and data-driven (e.g., data mining) techniques.

Perspective on Spatial Discovery

While catchphrases such as big data, smart data, data-intensive science, or smart dust highlight different aspects, they share a common theme: Namely, a shift toward a data-centric perspective in which the synthesis and analysis of data at an ever-increasing spatial, temporal, and thematic resolution promises new insights, while, at the same time, reducing the need for strong domain theories as starting points. In terms of the envisioned methodologies, those catchphrases tend to emphasize the role of predictive analytics, i.e., statistical techniques including data mining and machine learning, as well as supercomputing. Interestingly, however, while this perspective takes the availability of data as a given, it does not answer the question how one would discover the required data in today's chaotic information universe, how one would understand which datasets can be meaningfully integrated, and how to communicate the results to humans and machines alike. Semantic Web technologies and Linked Data addresses these questions. However, they do not scale very well, have difficulties dealing with noisy data, and require declarative domain models. Thus, making sense of data and gaining new insights works best if inductive and deductive techniques go hand-in-hand instead of competing over the prerogative of interpretation.

WERNER KUHN

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Werner Kuhn holds the Jack and Laura Dangermond Endowed Chair in Geography at the University of California, Santa Barbara, where he is professor of Geographic Information Science. He is also the director of the Center for Spatial Studies at UCSB. His main research and teaching goal is to make spatial information and computing accessible across domains and disciplines. Before joining UCSB in late 2013, Kuhn was a professor of Geoinformatics at the University of Munster, Germany, where he led MUSIL, an interdisciplinary semantic interoperability research lab. Kuhn is described as a leading expert in the area of geospatial semantics and especially known for his work on Semantic Reference Systems as well as his work on interaction metaphors for Geographic Information Systems. Recent research projects include the Linked Open Data University of Muenster (together with the university library), and a series of EU projects on geospatial services in the semantic web.

Kuhn holds a doctorate from ETH Zurich (1989) and was a post-doctoral researcher with the National Center for Geographic Information and Analysis (1989–1991) as well as with the Vienna University of Technology (1991–1996). He is a co-founder of the COSIT Conference Series (since 1993) and of the Vespucci Initiative for Advancing Science through Geographic Information. He has been a visiting scientist at UCSD's Meaning and Computation Lab (2002/03), the UK eScience Center at Edinburgh (2007), and the Brazilian Institute for Space Research, INPE (2011). His publications range from GIScience and usability engineering through cognitive science to formal ontology.

Kuhn was an elected member of the Council of AGILE (Association of Geographic Information Laboratories in Europe, from 1998 to 2002), the international member of the Research Management Committee of the Canadian GEOIDE network (2001 to 2003), the Technical Director Europe of the Open GIS Consortium (1998 to 2001), and an Austrian delegate to CEN TC 287 on Geographic Information (1992 to 1995). He is a member of several editorial boards of peer-reviewed international journals, such as the *International Journal of Geographical Information Science* (IJGIS), the *Semantic Web Journal* (SWJ), *Applied Ontology* (AO), *Spatial Cognition and Computation* (SCC), the *International Journal of Spatial Data Infrastructures Research* (IJS DIR) and the *Journal of Spatial Information Science* (JoSIS).

Perspective on Spatial Discovery

The role of university libraries is changing dramatically. With data-driven science spreading to all academic fields, the sharing, discovering, and linking of data has become a key enabler of interdisciplinary research, and libraries are the nexus destined to enable it. The University of California Santa Barbara (UCSB) has been at the forefront of earlier library innovations, such as with the pioneering Alexandria Digital Library project. Now, it is spearheading the transition to *spatially enabled libraries*, where spatial data are not just special

collections, but link disparate disciplinary contents through shared location. As the linking involves specialized techniques and informed choices, the library is also reinventing itself as a *social space* where researchers interact with each other and get assisted in sharing, discovering, and integrating data.

In a unique cooperation between the UCSB Library and Center for Spatial Studies, supported by a private donation, we explore how to link disciplinary perspectives through location and semantic technologies. Later this year, the library will open an Interdisciplinary Research Collaboratory, in which spatially referenced contents support data discovery, sharing, and integration. In our research, we want to find out how spatial lenses on library contents support seamless data flows for librarians as well as for researchers, who have become producers and users of library content. More specific research questions center on how to exploit web-based technologies (such as GIS, Linked Data, and gazetteers) in workflows of researchers and librarians. This also raises questions about new forms of spatial indexing. For example, we ask what it takes to make library searches as powerful for place names as they are for names of people.

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Sara Lafia is a graduate student studying Geographic Information Sciences in the Department of Geography at the University of California, Santa Barbara. She is interested in increasing the utility of geospatial data by making it “discoverable.” Lafia’s past work experiences—including environmental vulnerability assessment at Region 10 EPA and disaster management mapping at NASA JPL—have motivated her to learn more about what the future holds for spatial data solutions.

ANGELA LEE

Business Development Team
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Angela Lee is an Education Manager within Esri's Business Development Team. She serves as a liaison between educational institutions and Esri's Software Products, Training, Customer Service, and other teams. She is active within the American Library Association's Maps and Geospatial Information Round Table (MAGIRT), serving on the GeoTech and Education Committees and chairing the GIS Discussion Group. She has an MA in Geography from the University of Minnesota. While at UMN, she worked as a library assistant in the John R. Borchert Map Library.

Perspective

As a member of Esri's Business Development Team, my responsibilities include outreach to educators, librarians, and scholars to raise awareness of Esri's technologies, as well as communicating market needs to Esri's software development teams. My interest in the Spatial Discovery meeting is to facilitate greater interoperability between library systems and best practices and Esri products.

ALAN LIU

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Alan Liu is Professor in the English Department at the University of California, Santa Barbara. He has published books titled *Wordsworth: The Sense of History* (1989); *The Laws of Cool: Knowledge Work and the Culture of Information* (2004); and *Local Transcendence: Essays on Postmodern Historicism and the Database* (2008). Recent essays include “The Meaning of the Digital Humanities” (2013), “From Reading to Social Computing” (2013), “Where is Cultural Criticism in the Digital Humanities?” (2012), “The State of the Digital Humanities: A Report and a Critique” (2012), and “Friending the Past: The Sense of History and Social Computing” (2011). Liu started the Voice of the Shuttle web site for humanities research in 1994. Projects he has directed include the University of California Transliterations Project on online reading and the RoSE (Research-oriented Social Environment) software project. Liu is founder and co-leader of the 4Humanities.org advocacy initiative.

Perspective

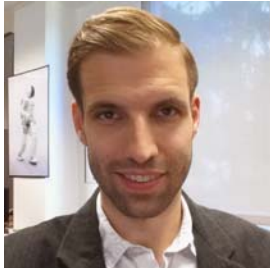
I am participating in this “Spatial Discovery” event not as an expert in spatial research, linked data, or libraries but instead as a “digital humanist” offering a reflection on some of the themes of the event from a humanist perspective.

With the advent of digital media and collections, the traditional “knowledge space” of the humanities disciplines has been eroding. At the interface, that space consisted of such spatially organized structures as the “page,” “book,” and associated finding aids. More foundationally, the knowledge space of the humanities depended on the tacit orientation provided by place-based collections and the spatial-juridical architecture of archives (with their hybrid physical-conceptual notions of the “archival threshold,” “respect des fonds,” “original arrangement,” etc.). This talk considers methods and practices in the digital humanities that at once further the erosion of the knowledge space of the humanities and attempt to reconstitute that space in new ways, including through maps, network, and provenance structures serving as way-finding aids.

MATTHEW MCKINLEY

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As Digital Project Specialist at the University of California, Irvine, **Matthew McKinley** manages services related to digital object preservation and access, including DSpace and CDL services, and oversees digital preservation procedures including ingest, monitoring and lifecycle management for faculty and special collections. McKinley also creates and consults on digital curation workflows, best practices, policies and procedures, both locally and UC system-wide.

Web: <https://www.linkedin.com/pub/matthew-mckinley/23/386/314>

Perspective Statement

I have recently served as technical lead on a project to add geospatial functionality to Dash, CDL's data-sharing and preservation service. With input from campus stakeholders, I designed and supervised the development of map interfaces for (1) adding geographic metadata to a dataset's DataCite metadata record and (2) faceted search/browse/map-based metadata display of Dash data records. Together with CDL colleagues, I am now investigating ways to enhance this map interface, including integration of geographic name authority tools and a possible rebuild utilizing the open source GeoBlacklight software.

ANTONIO MEDRANO

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Antonio Medrano is a postdoctoral researcher at the Center for Spatial Studies at the University of California, Santa Barbara (UCSB). He is working with the UCSB Library to coordinate an integration of spatial data protocols into the campus ArcGIS Online offering, as well as to establish a collaboratory for implementing good spatial analysis practices for on-campus research outside of the Department of Geography. Medrano completed his Ph.D. in Geography at UCSB, where he partnered with Argonne National Laboratory to research spatial optimization methods for corridor location for new transmission lines.

Augmenting Dissertations with Hosting and Publishing Data

The Alexandria Digital Research Library¹ (ADRL) was created with the intention of collecting and providing digital research materials associated with the UC Santa Barbara Library. It currently has completed its phase one capabilities of hosting theses and dissertations at UCSB, with a planned phase two of hosting a representative subset of several thousand objects in the UCSB Library's existing digital collections. One item that is not mentioned in the ADRL plan but that would add great value would be to augment the dissertation listings by also hosting data used in the dissertations themselves. This capability would add substance to the content of the dissertations, allowing others to confirm the results and repeat the analysis of the research. Many candidates may have spent countless hours assembling data sets for their dissertations, and it would be a shame to let this effort go to waste by not providing access of this valuable data to others. In addition, many dissertations have a spatial component in their topics or in the data itself, which could be incorporated with the larger scope of the cataloging and search of the Spatial Discovery project. This feature could be considered extremely low hanging fruit for beginning to expand on the spatial holdings and capabilities of the ADRL and the UC Santa Barbara Library.

¹ <http://alexandria.ucsb.edu/>

ERIN MUTCH

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Erin Mutch is the manager of the Spatial Analysis and Research Center (SpARC) at University of California, Merced (UC Merced). She supports project development, grant applications, and research support campus wide for projects needing spatial analysis support and implementation. Mutch has also developed and conducted workshops for UC Merced students, faculty, staff and off-campus partners and provides consultation to faculty and student research projects. Mutch completed her MGIS at Pennsylvania State University in 2007, with a capstone focus on Geographic Information System (GIS) enterprise implementation for new and growing organizations.

Perspective Statement

The mission and goals of SpARC is to be the hub for spatial science, research, analyses, education, visualization, spatial data archiving and access to spatial science software. Our focus is to enhance our ability to support spatial data archiving with the collaboration with the UC Merced library and are currently developing projects archiving historical maps and integrating historical data into an accessible GIS. My challenge is to manage spatially pertinent research data, maintain data quality and integrity through documentation and data archiving through coordination with our library staff. As the nation's first doctoral research university of the 21st century, our goal is to utilize spatial analysis applications to integrate and support data archiving and provide spatially oriented portals to access library information.

SUSAN POWELL

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As the GIS & Map Librarian in the Earth Sciences & Map Library at the University of California, Berkeley, **Susan Powell** manages the geography and geospatial library collections, teaches workshops, and provides reference and research support. Before coming to Berkeley she was a GIS Specialist at the Yale University Library where she worked on spatial discovery projects. She has M.A. degrees in both Geography and Library Science from Indiana University, and is interested in data accessibility, digital humanities, and Mongolia, among other things.

Perspective

Everything seems to come back to appropriate metadata, and to scale. The geospatial community has been wrestling with metadata for years, and libraries have long-held standards for cataloging physical maps, which are excellent places to start. I think, though, that we have not yet sufficiently tackled the problems of creating spatial metadata that answer the questions that library discovery systems need in order to best make data discoverable. We also do not have the human resources available to catalog each dataset created. By focusing on collections of data, we can sidestep this issue in part, but this too becomes a decision of metadata and scale: at what level in space/time/topic granularity do you define your collection? The recurring questions for me as a collector, describer, finder, and user of spatial data are: what criteria do I use to select data to preserve, and what are the minimum and ideal metadata fields needed to describe this data?

STEPHANIE SIMMS

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Stephanie Simms recently joined the California Digital Library as a Research Data Specialist where she will manage the DMPTool and other services to support UC researchers throughout the data lifecycle. Her own experiences with research data management during archaeological field projects in Mexico and Guatemala (Ph.D. 2014, Boston University) involved plenty of spatial data: creating maps, integrating historical maps and remotely sensed data in a GIS, modeling and spatial statistics, handling sensitive spatial data, etc. Concerns about how to manage and share these data led her to a position as a CLIR (Council on Library and Information Resources) Postdoctoral Fellow at UCLA where she primarily worked on an archaeological data publication initiative with the Digital Library and the Cotsen Institute of Archaeology Press.

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Perspective Statement

At UCLA I worked with various stakeholders to develop workflows for publishing open access archaeological data in tandem with traditional print monographs. For the pilot project we conducted interviews with researchers about their current data management practices, evaluated the usability of existing disciplinary repositories and publication platforms, identified metadata standards, and recommended policies for managing data in the Digital Library Collection system. A larger goal was to assess digital projects and data management in the context of library collections development, especially in a local sense (e.g., faculty research data and the UC Open Access policy). One of the most challenging aspects of the project was figuring out how to represent spatial-temporal data (i.e., place names and chronological periods), even for a single monograph, in a coherent manner. Historical gazetteers (e.g., Pelagios, PeriodO) are the key to linking these data sets while preserving their nuance and granularity. I look forward to exploring how the ADRL can coordinate with ongoing efforts to aggregate and link spatial data, especially from the humanities and social sciences that by their nature resist standardization.

DENISE STEPHENS

Library

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Denise Stephens joined University of California, Santa Barbara as the University Librarian in 2011. She is also currently serving as University's Interim Chief Information Officer. Stephens' particular areas of experience and research are in organizational and change leadership, program assessment, and digital services.

Stephens came to UCSB from the University of Kansas, where she served for many years as Vice Provost for Information Services and Chief Information Officer. Prior to that, she was Acting University Librarian at Syracuse University. She holds

a master's degree in library science from the University of Oklahoma and is an alumna of the Association of Research Libraries Leadership and Career Development Program.

University Librarian

As the University Librarian, she is leading revolutionary advances in information technology as well as the expansion and redesign of the Davidson Library. The expansion will provide critical physical spaces to support professional expertise and state of the art information resources to the new generation of scholars, technology, and the community.

Interim Chief Information Officer

As the Interim Chief Information Officer, Stephens is also leading the transformation of the Office of Information Systems and Technology (OIST) and Administrative Services enterprise IT programs into the new Enterprise Technology Services (ETS) organization. The mission is to help ensure the emergence and sustainability of a coordinated, broad-based, high-reliability organization delivering enterprise-wide solutions to our campus.

You are invited to learn more about this transformation of service programs and people comprising the emerging comprehensive, customer-focused IT services organization via the web portals <http://www.library.ucsb.edu/building> and <http://www.ets.ucsb.edu/>.

BERN SZUKALSKI

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Bern Szukalski is a 30-year veteran at Esri, and currently serves as chief technology advocate and product strategist. Szukalski focuses on ways to broaden access to geographic information, and helping users succeed with the ArcGIS Platform.

MARY WHELAN

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Mary Whelan has worked at the Arizona State University Libraries as the Geospatial Data Manager since 2008. Her primary responsibilities are to manage the ASU GIS data repository and to provide research support related to the discovery and use of geospatial data. Whelan's undergraduate and graduate training is in North American archaeology with an emphasis on paleoecology. She was an Anthropology professor at the University of Iowa for 15 years before changing careers and going into GIS. In her ASU Libraries position she works closely with the staff of two digital repositories, the ASU institutional repository (<http://repository.asu.edu/>) and an archaeology disciplinary repository called tDAR (the Digital Archaeological Record: <http://www.tdar.org/>).

Perspective Statement

Donna Haraway in her influential book *Primate Visions* focused on that highly developed human sense that has so powerfully shaped our species' development: sight. Look at a list of books in the university library and you understand it in a distant, categorical way, but look at a map of the places referenced in those books and you see patterns that weren't obvious, you think of questions that hadn't occurred to you before. Harvard's GeoHollis Beta project is an interesting example of this (<https://www.youtube.com/watch?v=ULkZE8TVP3I>).

One of my first jobs after I moved to Arizona was at ADOT, the Arizona Department of Transportation. The engineers there were very interested in a geo-catalog of past projects—their vision was of a map interface showing Arizona highways where a user could draw a box around an area and get search results that included reports on all of the projects ADOT had ever done along that stretch of highway.

After starting work at ASU I was approached by a Humanities professor who asked for help on a project she was working on with Hispanic communities in Phoenix. She wasn't interested in the City of Phoenix, for which I could have provided a shapefile. She was interested in "the Valley." This is the common colloquial name for the greater Phoenix metropolitan area. As such, everyone knows what it is (like culture) but can't define it very precisely, which makes it problematic to represent in a GIS. People would largely agree on the core cities included in the Valley (Phoenix, Scottsdale, Mesa), and would generally agree on what is too large an area to include (Does it include all of Maricopa County? Probably not) but the edges are fuzzy.

A few years ago I got the opportunity to work on an international project to integrate two domain repositories containing archaeological reports and data, one covering Great Britain (<http://archaeologydataservice.ac.uk/>, ADS) and the other mainly focused on North America

(<https://www.tdar.org/>, tDAR). TAG, or [the Transatlantic Archaeology Gateway](#), integrated search results from each repository to return a comprehensive list to users. However, metadata records in the different repositories were largely incompatible: what we in the States call the Woodland cultural period doesn't exist in Britain. Something they call Neolithic is roughly similar, but dates to a time thousands of years earlier. Our (imperfect) resolution was to ask user to specify Where (draw a search box on a map), When (use a slider bar to delimit years), and What (controlled vocabulary) they were looking for. We then "mapped" the metadata elements in the different repositories to the extent possible in order to facilitate the integration.

Experiences like these have shaped my vision of spatial discovery, and left me both hopeful and intrigued. There is clearly a growing demand for easy-to-use, web based services that incorporate georeferenced or geo-enabled data. The use cases above raise some of the intriguing challenges that meeting that demand would entail – metadata, standardized or interoperable systems, fuzzy spatial extents, taxonomic issues (controlled vocabularies, thesauri, ontologies), and the need for gazetteers that have a temporal dimension (name, older name, archaic name).