Criticism of Maps: Methodological Development for the Rediscovery of Silk Road Ruins and the Value of Sources

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http://dsr.nii.ac.jp/
Digital Silk Road Project

- **Digital Humanities:** Collaborative work between informatics + humanities people.
- Databases and resources are **publicly accessible** on the Web.

http://dsr.nii.ac.jp/
Toyo Bunko Rare Books

- Digitization of 203 books, 59358 pages.
- Collection of relevant academic references.
- Automatic OCR for full-text search.
- Manual input of captions and TOCs.

http://dsr.nii.ac.jp/toyobunko/
From Digitization to Databases

• Databases for research and study
  – Caves http://dsr.nii.ac.jp/china-caves/
  – Place-names http://dsr.nii.ac.jp/digital-maps/
  – Photographs http://dsr.nii.ac.jp/photographs/
  – Maps http://dsr.nii.ac.jp/geography/

• Databases for education and outreach
  – Participatory museum http://dsr.nii.ac.jp/senga/
  – Narratives and stories http://dsr.nii.ac.jp/narratives/

• Digitized books = Hub of databases.
[Q] Map is Fact? Data is Fact?
From Data to History

Data

Numerical data
Spatial data (map)
Visual data (photo)

Criticism

Inquiry

Historical Fact

Spatial / visual evidences for historical studies.

Digital Tools: Computational Algorithms and Databases
Data Criticism (Map Criticism)

Textual Criticism
- Well developed.
- Qualitative.
- Human reading and interpretation.
- Text-oriented.

Data Criticism
- Not so explored.
- Quantitative.
- Computational algorithm.
- Spatial and visual sources, or multimedia sources.

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Case Studies

1. Qianlong Map (Beijing)
   – Massive geometric correction.
   – Digital survey and discovery of mis-arrangement.

2. Stein Map (Silk Road)
   – Evaluation of error distributions.
   – Identification of “missing” ruins.

3. Grünwedel Map (Gaochang)
   – Interpretation of topological maps.
   – Rediscovery of the value of “untrusted” sources.
1. Qianlong Map (Beijing)
Massive Geometric Correction

Huge size = W 13 m x H 14 m

Many sheets = 203 sheets in total

Massive pixels = 29 billion pixels

• Control points + lines:
  We proposed a new geometric correction.
Discovery and Digital Survey

- **Discovery**: 5 sheets have mis-arrangements due to improper reconstruction in the past.
- **Digital Survey**: Place-names were checked to make a comprehensive gazetteer.
2. Stein Map (Silk Road)

- Stein’s map “Innermost Asia” was registered and displayed on Google Earth satellite images.
Two Methods of Map Registration

Geometric Correction
- All points are registered.
- Shapes are distorted.

Single-Point Registration
- Single point is registered (but no other points).
- Shapes are not distorted.
Mappinning

http://dsr.nii.ac.jp/digital-maps/mappinning/
Error Distribution in Tarim Basin

- Error is bigger along longitude than latitude (limitation of survey technology at the time).
- Error tends to be accumulative.
Comprehensive Guide on Errors

- The error consists of direction + distance.
- **Known points**: Errors can be computed.
- **Unknown points**: Errors can be estimated by interpolation in the neighborhood.
Identification of “Missing” Ruins

- Yārkhoto
- Bezeklik
- Kara-khōja
- Toyuk
- Sirkip
- Lukchun
- Chong-hassār, Kichik-hassār
- Oi-tam, ruined fort
- Bögan-tura
- Buluyuk (Shipang, Sassik-bulak, Kazma)
- Murtuk-ruins
- Yoghan-tura
- Chikkan-köl
- Bedaulat’s town, Bēsh-kāwuk, Kosh-gumbaz
- Yutōgh

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• Some ruins were reported by 20th expeditions, but are missing in recent survey reports.
Locating “Murtuk Ruins”

Based on error information of maps, our guess about the location of Murtuk Ruins is represented as  

Estimated error: west-southwest 5.6km
Wujiang-bulak (烏江不拉克)
Murtuk Ruins (Stein, 1915)

Stein’s map and satellite images for the same area. Each source reports different ruins due to different conceptualization.
Visual Sources as Evidence

伯西哈石窟 (烏江不拉克佇塔)

Murtuk Ruins (M. B. I)

烏江不拉克烽火台

Murtuk Ruins (Ruined Shrine M. C. I)
3. Grünwedel Map (Gaochang)

How to use the previously “untrusted” map?
Inconsistencies in Gaochang Maps

Aurel Stein

Albert Grünwedel
Topological Map

Where is $\nu$ and $\mu$?
We have multiple candidates...

Search for a road in north of $\gamma$ and $\omega$, and a road between the inner wall to the wall gate.

Hypothesize the location of $\nu$ and $\mu$ (to be verified later).

Maps designed for navigation purposes should preserve the topology, not to get lost.
Where is Tempel γ and Ruine ο?
Photographs as Evidence

- By synthesizing multiple sources as evidence, the credibility of the hypothesis is increased.
考査遺跡,
Tafel.10
Identification of Most Ruins

Connection between expedition results and recent surveys opens up new opportunities.
Error Distribution at Gaochang

- Composed of several regions with different error patterns.
- Hypotheses need to be verified by more evidences.
- “Topology” is the key for reasonable interpretation.

Red circles represent the grouping of TOC of the expedition report.
Our Contribution

1. We proposed a basic strategy for the criticism of spatial / visual sources, especially maps.
2. Data criticism and inquiry can increase the value of previously “untrusted” sources.
3. Data criticism requires digital tools for a comprehensive and quantitative survey.
4. Integration of visual and textual sources may lead to the discovery of new historical facts.
Advantage of Map Criticism

Textual criticism

Textual source A

Place name S

Textual source B

Place name T

Textual criticism

Place name U

Place name V

Map criticism

Geographic Relationship
On the map

Map Source C, D, E...
Map Criticism and Historical GIS

Historical GIS

Source

Criticism by Human

Digital Tools (GIS)

Analyze

Map Criticism

Source

Criticism by H&C

Digital Tools

Analyze
Computational algorithms and databases help criticism and inquiry.

Similar ideas can be applied to textual criticism?
Digital Silk Road Project

- Website
  - http://dsr.nii.ac.jp/
- Toyo Bunko Digital Archive
  - http://dsr.nii.ac.jp/toyobunko/
- Silk Road Maps
  - http://dsr.nii.ac.jp/geography/

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