Digital Silk Road: Toward Digital Survey of Dunhuang Mogao Caves

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http://dsr.nii.ac.jp/

2011 Dunhuang Forum: International Conference on Cultural Heritages and Digitization

Digital Silk Road



Digital 56k Road Project is a presearch project on criniting digital archives of cultural heritage through collaboration between informatics and humanities [Read Mare >>]

Latest News	
Silk Read in Photographs	
Khotan in Photography were added, and they were laiked with Database.	Stein Placename
	2011-02-33
The site is open to the public.	2023-06-84
Senga Silk Road	
5 Senga was updated and an introductory movie was also int	roduced.
	2010-18-26
Senga was updated to make a better link with Senga Browser.	
	2010-05-12
Senga Browser was released.	
	2250-03-81
The site is now open to the public (only in Japanese).	
	2007-08-23
DSR Imaginary Muteum	
Guideline for submitting is modified for people who are more	sted in Silk Road.
	2008-07-54
English version was added.	
	2208-06-04
The site is renewed, and we added "Silk Road Teur" and "Chron-	ological Map."
	2011.06.07
The site is renewed, and we added short cinemas and patiorama Barayan	images of the Hentage of
	2014-14-18
The site is open to the public.	

Proje	cta
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Duptal Books	Archow of Toyle Bunko Kare
Digni	Maps of Old Bejing
50 R	rial Maps
Citade	of Ban, Iran Keeping
Meno	ries and Gathering Information
for Pa	st-earthquake Reconstruction
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Datate	are for Buddhist Cave Temples
in Chi	
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DSR	himidi
Dera	Silk Read Kala

2004/07/29

- Started in 2001.
- Collaborative work between informatics and humanities.
- Digital humanities (data-centric) approaches to Silk Road studies.
- 10+ sub-projects.

http://dsr.nii.ac.jp/

Digital Humanities



 Massive data changes the way of humanities research.

Database supports digital survey of massive data.

 Digital survey reveals hidden relationships.

Digital Survey



Apply the digital survey approach to Dunhuang?

Digital Dunhuang?





• NII-Toyo Bunko Digital Archive of Rare Books

- Collaboration with Toyo Bunko

- Database of Buddhist Cave Temples in China
- Commentary on Pelliot Catalogue for Dunhuang
 - Collaboration with Dunhuang Academy and Lanzhou University

NII-Toyo Bunko Digital Archive of Rare Books

National Institute of Informatics - Digital Silk Road Project Digital Archive of Toyo Bunko Rare Books Digital Silk Rued - Toyol Bunka Archive Book List Image List Series List Volume List English Japanese | Page Search Title Page Full Test Search The digital archive (image database) of basic references on Silk Road, including 116 new books (33 authors 30,091 pages) through the digitization of whole books from cover to cover. (Part more 1 panel) Text Search | brage Search | May Search | List of Rocks | Project | Distanter | Centect | New Copyright (C) 2003-2010 National Institute of Informatics and The Toyo Bunko. All Rights Reserved.

- 116 books, 30000 pages of Silk Road academic books.
- Selection based on quality rather than quantity.
- OCR for full-text search (error not corrected).

http://dsr.nii.ac.jp/toyobunko/

Digitized Books

Dunhuang Mogao Caves

- M. A. Stein, Serindia
- P. Pelliot, Les Grottes de Touen-houang

Bezeklik, Kizil, ...

- A. Grünwedel, Alt Kutscha
- A. Grünwedel, Altbuddhistische Kultstätten in Chinesisch-Turkistan
- A. Le Coq, Chotscho
- A. Le Coq, Die Buddhistische Spätantike in Mittelasien

Database of Buddhist Cave Temples in China



- **Problem 1**: Many existing IDs are not integrated.
- Problem 2: Cave information is not linked with other references.
- Solution: Digital survey for the database of caves.

Digital Materials





Site plan by Stein



Plan of cave

Cave photo





Site plan by Pelliot

Digital materials from NII-Toyo Bunko Digital Archive

Antiquities founds in the Library Cave (Cave 17)

Existing IDs

- Stein Number
- Pelliot Number
- Zhang Daqian (張大千) Number
- Shi Yan (史岩) Number
- Current Number (given by Dunhuang Academy)
- **DSR ID** (given by us)

Unique ID for integration

One cave

has

many IDs

Linking IDs

Current Number	Pelliot Number	Stein Number	Zhang	Shi
320	139	CH. IV	125	281
321	139a		126	323
322	139b		127	324
323	140		128	325
324			128+	325-31
325			128+	325-32
326	141		129	326
327	142		130	327
328	143	CH. IX	131	328

Information on Each Cave



- Comparison of multiple IDs with a navigation bar.
- Links to and thumbnail images from digitized books.
- Captions from digitized books.
- Commentaries from digital reference.

Search from Maps



- Openlayers for manipulating the map, zooming in/out, panning, placemarks.
- Spatial relationship between caves.

Digital Survey and Corrections

- Cave IDs: Identified Stein IDs from photographs and maps.
- Book captions: Correct book captions from photographs and maps.
- Locations: Correct cave locations from maps and plans.

Digitization involves comprehensive digital survey for higher reliability

Multiple IDs for a Single Cave

- Caption shows
 "CAVE <u>CH.III. A</u>"
- Cave 334

- Caption shows
 "CAVE <u>CH. VI</u>"
- Cave $334 \rightarrow$ CH. III.



M. A. Stein, *Serindia*, vol. 2, fig. 209, Oxford: Clarendon Press, 1921.



M. A. Stein, *Serindia*, vol. 2, fig. 212, Oxford: Clarendon Press, 1921. 16

Multiple Caves for a Single ID

- Caption shows
 "CAVE <u>CH.III. A</u>"
- Cave 334

- Caption shows
 "CAVE <u>CH.III. A</u>"
- Cave $45 \rightarrow CH$. VI



M. A. Stein, *Serindia*, vol. 2, fig. 209, Oxford: Clarendon Press, 1921.



M. A. Stein, *Serindia*, vol. 2, fig. 208, Oxford: Clarendon Press, 1921. 17

Mismatched Relative Locations



Commentary on Pelliot Catalogue for Dunhuang



Paper-based reference on Pelliot Catalogue

序言

沙武田(敦煌研究院文献研究所研究员)

就更成石能而容。最早进行全面详细的考察。而属1000年社国人也希和(Peul Pellet 10年19月1日 带领的考察团的工作。1000年2月15日日共和考察团从新疆 进入数理。他们来到其高能以后。新先集中进行消散的编号。她的"我里和文平 记录工作。其中台域和主要分贵文平记录,护录大量的消散各头数记。附属师 兀 悟 (Lous Faillant) 和摄影明芬瓦特 (Charles Bustre) 分别负责测验局限 室的模工作。他们一直工作致5月21日,新超新了在最后误检达可迎接高外、一直 在从期间常的各元分费工作。

田林和其計編号至212号,其中其東京南自定度至211号,之区101.102号,中司 空缺号清整不祥,其計由編集高整分素,清整彩度、整高等現代1500%。先后发 素干1922-1924年在巴黎出版的《伯林和家僚石酸因录》大大本《Les Grottes de Tourn-houseg (Cartet de notes de Paul Pellist, inscriptions et pelotures sarale,1-72, Paris,1922-1024.)。找为個色图影,此市所要實的實態所提 料,在上地紀50年代中国政學开始以前。市研異高額局面設成以《中國石廠· 對理具高意》为代表》在中國大量出版之詞。成了世界已國中本具从單相更成完 主要可見多利用消度影響局量高級片量料,时世界記题/政慶石墨与佛教更常分 研究二生过量大的影响。相中已沒是對的全面性、原始性、以及服用的晶像代 的完成。是是中式重要的参考好。

最優壽一級的是,从由希知考察證如攝到今天已有百年的封闭。在这百年出中。 由于自然,而史以及人为的关系,得證已经支生了这样算样的变化。有的甚至实 生了模本性的笑化。在当时完好的彩燈雙簧,發了今天早已不得(代表像對這場



1000年毕业于西北大学文庫学校考 古市业。同年到属富智加维持完荣 生出大学校理学研究所、改造教理 学想士、博士学位。2000年4月至2008年 京学博士学校。2000年4月至2008年 9月送州大学历史学博士与科描的 这工作。2000年30月经过教育研究 整2008年30月日本国家克艺术大学 美术学等客员研究员、1里手...1

作者一览表	
RAN	
沙默田	
184	
新教史	

Format conversion

Integration of cave database and NII-Toyo Bunko Archive

Digital reference

Authors



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张景峰 (Zhang Jingfeng) 敦煌研究院考古研究所助理馆员



党燕妮 (Dang Yanni) 甘肃省图书馆副研究馆员



张善庆 (Zhang Shanqing) 兰州大学敦煌学研究所博士

Digital Reference

洞窟编号 (现行编号)) 伯希和图录的卷数和图片编号							《伯希和敦煌图录》图版说明 第6卷 图			
第3定	6-341 6-342 6-343							3/1			
第5定	6-334							341 张景峰(敦煌研究院考古研究所助理馆员)			
第6窟	6-329	6-330	6-331	6-332	6-333						
第7定	6-339							前壁左侧: 敦编第3窟,元代开凿。此画			
第9窟	6-335	6-336	6-338	6-339	6-340	6-359	6-360				
第12窟	6-339							上举抚胸, 左手下垂倒握净瓶, 作问下 倾倒状, 脚踩莲花, 局部画面已经模			
第16窟	6-354	6-363						湖。此画面表现的是观音菩萨以甘露布 施恶鬼的情景。			
第17定	6-368										
第25窟	5-297	5-298	5-299								
第27窟	5-286							相关的《伯希和敦煌图录》网页 Toyo Bunko			
第31窟	5-287	5-288	5-289	5-290	5-291	5-292	6-357	Digital Archive The Cave-Temples of Tun-Huang : vol.6 / Page 49			

 Original books and references are packaged into one Web page.

Current Status



Digital Book



Digital Reference

An Idea for the Future



Case Study: Bam Project



- Revive the Citadel of Bam, Iran almost collapsed by the earthquake in Dec. 2003.
- 3D model and ontology was built for Bam data.

http://dsr.nii.ac.jp/bam/ http://dsr.nii.ac.jp/Bam3DCG/

Bam Ontology



- Ontology represents our knowledge about Bam cultural heritage.
- RDF (Resource Description Framework) is the description language.

Bam 3D Model



- Software: 3ds max + AutoCAD.
- High quality for professional use.



Measurement-Based 3D Modeling



New data cannot be captured from now!

Laser scanning Image: Wikipedia



Image: Building Rome in a Day

Manual reconstruction from the integration of fragmented data and expert's knowledge.



CAD-Based 3D drawing (Wire frame model)

3D modeler



Visually-Acceptable 3D Modeling

Google Earth

Second Life



 See the "inside" of Bezeklik Caves with paintings on the wall.
 http://dsr.nii.ac.jp/3D/

Learning from Bam Project

- Structure: Accurate 3D models are required by professionals (geometry, color, discovery of hidden structures).
- Semantics: Ontology is useful for organizing our knowledge about caves (metadata, descriptions).
- Preservation: Documentation is precious for reconstruction after deterioration and disasters.

3D Models for Dunhuang

- **Geometry**: Laser scanning for measurement-based 3D models.
- Texture: Digital photographs for paintings and characters on the wall.
- **Color**: Multispectral sensors for accurate color measurement.
 - Measurement-based models: valuable for research and preservation.
 - Visually-acceptable models: useful for education and entertainment.

3D Semantic Database



- Digitization of each wall (north, ceiling, ...) leads to the 3D database of caves.
- Ontology-based 3D semantic database can deal with the complex structure of caves.

Semantic Modeling



• Paintings of sixteen-contemplation

Ontology-based Semantic Database



How to Make?

• **3D Model**: Laser scanning + computer graphics

-Technically mature, but costly..

 Ontology: Open source software + software development

- Reliable enough, but lack of experts..

• Data Policy: Share or hide?

- Worldwide platform or internal system?

Summary

- "Digital Silk Road" project was introduced from the viewpoint of Dunhuang Mogao Caves.
- An idea toward "Digital Dunhuang" was discussed in terms of database, 3D modeling and ontology.
- "Digital Dunhuang" is technically feasible, but lacks resources.
- Who will take the next step?

Websites

- Digital Silk Road
 - http://dsr.nii.ac.jp/
- NII-Toyo Bunko Digital Archive of Rare Books
 - http://dsr.nii.ac.jp/toyobunko/
- Database for Buddhist Cave Temples in China
 - http://dsr.nii.ac.jp/china-caves/
- Commentary on Pelliot Catalogue for Dunhuang
 - http://dsr.nii.ac.jp/reference/pelliot/

Collaborators

- Bam Project: Elham Andaroodi, Mohammad-Reza Matini, University of Tehran, ICHTO, Waseda University, ENSAPVS, EVCAU
- NII-Toyo Bunko Digital Archive: Yoshinori Shiba, Issei Tanaka (Toyo Bunko)
- Database of Buddhist Cave Temples: Takako Toyoma, Michiyo Mori
- Commentary on Pelliot: Sha Wutian, Dang Yanni, Zhang Jingfeng, Zhang Shanqing (Dunhuang Academy, Institute of Dunhuang Studies / Lanzhou University)
- Software Development: Tomohiro Ikezaki

Many thanks for the collaboration!