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INTEGRATED INFORMATION

International Conference on Integrated Information

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Preface: Proceedings of the International Conference on Integrated Information (IC-ININFO 2011)

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Aims and Scope of the Conference

The International Conference on Integrated Information 2011 took place in Kos Island, Greece, between September, 29 and October, 3, 2011. IC-ININFO is an international interdisciplinary conference covering research and development in the field of information management and integration.

The conference aims at creating a forum for further discussion for an Integrated Information Field incorporating a series of issues and/or related organizations that manage information in their everyday operations. Therefore, the call for papers is addressed to scholars and/ or professionals of the fields of Library and Archives Science (including digital libraries and electronic archives), Museum and Gallery Studies, Information Science, Documentation, Information Management, Records Management, Knowledge Management, Data management and Copyright experts the latter with an emphasis on Electronic Publications. Furthermore, papers focusing on issues of Cultural Heritage Management and Conservation Management are also be welcomed along with papers regarding the Management of Nonprofit Organizations such as libraries, archives and museums.

One of the primary objectives of the IC-ININFO will be the investigation of information-based managerial change in organizations. Driven by the fast-paced advances in the Information field, this change is characterized in terms of its impact on organizations that manage information in their everyday operations.

Grouping emerging technologies in the Information field together in a close examination of practices, problems and trends, IC-ININFO and its emphases on integration and management will present the state of the art in the field. Addressed jointly to the academic and practitioner, it will provide a forum for a number of perspectives based on either theoretical analyses or empirical case studies that will foster dialogue and exchange of ideas.

Topics of general Interest

Library Science, Archives Science, Museum and Gallery Studies, Information Science, Documentation, Digital Libraries, Electronic Archives, Information Management, Records / Document Management, Knowledge Management, Data Management, Copyright, Electronic Publications, Cultural Heritage Management, Conservation Management, Management of Nonprofit Organizations, History of Information, History of Collections, Health Information

Symposia

The Conference offered a number of sessions under its patronage, providing a concise overview of the most current issues and hands-on experience in information-related fields.

- Symposium on Integrated information: Theory, Policies, Tools
- 4th Symposium on Business and Management and Dynamic Simulation Models supporting management strategies

- Session on Open Access Rrepositories: Self-archiving, Metadata, Content policies, Usage
- Session on Evidence-Based Information in Clinical Practice
- Session on Business Management and Communication Strategies supporting Decision Making Process in Tourism Sector
- Session on Electronic Publishing: A Developing Landscape
- Session on Information and Knowledge Management
- Session on Information Content Preservation as Outcome of Conservation of Cultural Heritage: Ethics, Methodology and Tools
- Session on Advances Information for Strategic Management
- Session on Information History: Perspectives, Methods and Current Topics
- Session on Divergence and Convergence: Information Work in Digital Cultural Memory Institutions
- Session on Contemporary issues in Management: Organisational Behaviour, Information Technology, Education & Hospital leadership.

The wide range of aspects that the sessions covered, highlighted future trends in the Information Science.

Paper Peer Review

More than 300 papers had been submitted for consideration in IC-ININFO 2011. From them, 91 were selected for presentation, after peer review in a double blind review process. The accepted papers were presented at IC-ININFO 2011.

Thanks

We would like to thank all members that participated in any way in the IC-ININFO 2011 Conference and especially:

- The famous publishing house Emerald for its communication sponsorship.
- The co-organizing Universities and Institutes for their support and development of a high-quality Conference scientific level and profile.
- The members of the Scientific Committee that honored the Conference with their presence and provided a significant contribution to the review of papers as well as for their indications for the improvement of the Conference.
- All members of the Organizing Committee for their help, support and spirit participation before, during and after the Conference.
- The Session Organizers for their willing to organize sessions of high importance and for their editorial work, contributing in the development of valued services to the Conference.
- PhDc Marina Terzi for her excellent editorial work, contributing in the production of the Conference proceedings.

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KEYNOTE SPEAKER

Professor Amanda Spink

Professor Amanda Spink has published over 340 scholarly journal articles, refereed conference papers and book chapters, and 6 books. Many of her journal articles are published in the Journal of the American Society for Information Science and Technology, Information Processing and Management, and the Journal of Documentation. She is Editor of the Emerald journal Aslib Proceedings. Amanda's research has been published at many conferences including ASIST, IEEE ITCC, CAIS, Internet Computing, ACM SIGIR, and ISIC Conferences. Her recent books include Information Behavior: An Evolutionary Instinct and Web Search: Multidisciplinary Perspectives, both published by Springer. Amanda's research focuses on theoretical and empirical studies of information behavior, including the evolutionary and developmental foundations. The National Science Foundation, the American Library Association, Andrew R. Mellon Foundation, Amazon.com, Vivisimo. Com, Infospace.com, NEC, IBM, Excite.com, AlltheWeb.com, AltaVista.com, FAST, and Lockheed Martin have sponsored her research. In 2008 Professor Spink had the second highest H-index citation score in her field from 1998 to 2008 [Norris, M. (2008)]. Ranking Fellow Scholars and their H-Index: Preliminary Survey Results. Loughborough University, Dept of Information Science Report].

Information and Secrecy on the Silk Road. Methods of Encryption of Legal Documents in Inner Asia (3th-4th century)

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Abstract: *The aim of this paper is to provide an overview of studies concerning the linkage between the very complex system of the great Inner Asian Silk Road and the history of information. In an era where literacy was acquiring larger and larger importance beside the verbal information transmitting methods, the "filtering" (that is, privacy management) techniques became especially important, whose purpose was to keep the information inside a defined circle by the encryption or coding of written documents. Hence this paper cover not just general problems of transmitting information along the Silk Road, but also deals with the special methods of encryption or coding of Kharosthi documents. These legal documents can shed light on everyday life of the Silk Road during the 3th–4th centuries, and they help us understand processes of administration, diplomacy and information techniques of that era.*

Keywords: *Silk road, Methods of ecryption, Legal documents, Seals, Aurel Stein*

I. INTRODUCTION

The examination of the complex phenomenon of information has cut out a significant slice of the space of scientific disciplines covered by the larger fields of information technology, economics, etc. The examination of the history of information in itself has become such a broad research area that we can almost consider it as an independent discipline. Questions like the history of the flow of information, which examines/examined the speed, the intensity and the topology, etc., of information, dispose of literature sufficient to fill a whole library. The thorough investigation of the most important trade routes of world-history raises some really exciting questions of information topology. While until the last decades of the twentieth century these trade routes had been regarded primarily as the movers of the circulation of the economy, or the scenes of the spread of culture, religion, and artistic trends, today more and more are drawing our attention to a more complex role of the network of such routes. The spread of information and innovation would have been much slower and complicated without the network in all certainty. Thus, these commercial systems functioned not only as a cache and generator (not to a small extent contributing to the ever accelerating pace of the growth of the common human knowledge, which now is almost advancing at the speed of light), but due to certain counter-mechanisms they operated as an information filter, as well. The examination of these "filters" is an especially exciting, though almost undiscovered research area.

II. SILK ROAD AND INFORMATION

A certain piece of information, an innovation, an invention ensuring positional or strategic advantage to its owner meant such value (as it does today, too) that motivated its proprietor to make serious efforts to preserve it. Thus, two basic factors clashed on these routes: to use a modern simile, the first was the free and flexible handling of information in a basically open source coded commercial system, and the other was the efforts to preserve and keep information secret. To illustrate this thought with a specific example: the functioning of the large commercial system discussed in my presentation, the Silk Road, which connected China to Rome and then to Byzantium on one hand, served China's economic and political interests, on the other hand the secret of silk making becoming public was all the time considered as a serious loss to be avoided, so they tried to delay its happening as long as possible. Consequently, China tried to keep secret the way of silk manufacturing not only by legal, but also by administrative and military means. This worked so well that nothing was known about the nature of silk in the ancient Mediterranean before the arrival of the first cocoon in Byzantium. The people of the time had silk in their hands, they often took it apart into threads, but they could not exactly say what this great fabric was made of (Höllmann, 2004).

Thus, in this case we can speak about a kind of guided information filtering. At the same time there were filters in the system that did not inevitably worked due to state or "upper" will, what is more, in certain cases we can question intentionality in connection to them, nevertheless, these filters served the real or presumed economic, political, etc., interests of some states, social classes and communities well. The length of certain trade routes, the number of intermediaries or intermediary languages involved in the process of trade could be such factors in themselves. Each one of these factors could contribute to the slowing down, to the distortion, or God forbid, to the complete blocking of information. Because of the above factors it was clearly known already in the 19th century that, theoretically, the most valuable sources along the Silk Road are those which have a relatively small number of the intermediaries mentioned, thus the information goes through relatively few filters (Elisseeff, 2000). Exactly that is why Marco Polo's travelogues were regarded

among the most important medieval sources for a long time. The author had travelled all along the Silk Road to China, according to earlier theories, thus, his account is of first hand information, and the number of "filtering factors" is low in his book.

However, in his work, which has a new approach, a british China expert Frances Wood claims, opposing earlier theories, that Marco Polo's book is a typical example for the effects of the filtering factors mentioned. As it turned out, Marco Polo uses the Central Asian and Chinese proper nouns distorted, in Persian transcription, most probably he did not speak Chinese. Furthermore, there are several items in the book the authenticity of which can be doubted – and not because of the characteristics of the medieval genre. In addition, there should be a number of other things in the book if Marco Polo had really been to China. In Wood's final conclusion, Marco Polo had never been to China, and information reached him distorted and rarefied by many filters (Wood, 1995).

In an era where literacy was acquiring larger and larger importance beside the verbal information transmitting methods, the "filtering" (that is, privacy management) techniques became especially important, whose purpose was to keep the information inside a defined circle by the encryption or coding of written documents.

The wide range of encryption and coding is as old as information itself. The appearance of writing involved the appearance of sophisticated techniques of written encryption. Even in the cases of the earliest written records technologies obstructing the widespread of information were observed: closed envelopes, the use of seals, the coding of texts, or ciphers, all served the purpose of making information in the text available only for those whom it was destined to. Unfortunately, we know relatively little about these methods in the late antiquity due to the scarcity of archaeological material, consequently, findings providing information on the sophisticated methods of encryption from this period from the Central Asian section of the Silk Road are especially important.

III. METHODS OF ENCRYPTION OF LEGAL DOCUMENTS IN INNER ASIA

In his expedition to the Central Asian Silk Road the Hungarian–British archaeologist Aurel Stein discovered an ancient town in ruins in 1900, in the area of today's China, at the edge of the Taklamakan Desert (Mirsky, 1977). Among the ruins of Cadota, a settlement flourishing in the third and fourth centuries AD, he unearthed hundreds of written documents. These documents, written with the so-called Kharosthi writing and preserved in an excellent state in the sand of the desert, depict an incredibly exciting picture of the social, economic and cultural relations of the age (Atwood, 1991). They shed excellent light on the earlier unknown history of the Central Asian expansion of the Indian culture, and they also provide an insight into the everyday life of people once having lived there. The documents are especially important apart from their content, since their raw material, manufacturing, authentication, encryption technique make them unique documents on the chancellery practice of the age.

The majority of the documents were made of wood. (Few manuscripts written on leather were also found, but no paper or other materials were used to write on in Cadota.) The documents were created in an area where palm leaves, or birch bark could not be found, that is, there were no such raw materials which were widely used to write on in India and China at the time (Felföldi, 2005).

The "wooden papers", obviously made in the place by local joiners, are special regarding their shape, as well. Basically they can be divided into two main groups: elongated, wedge-shaped pieces, and rectangular ones. In the case of these documents the criterion of "content in the form" is really valid, since the different shapes were used for different purpose. Official messages, legal documents and the most important contracts were written on rectangular wooden tablets, while data referring to court cases, shorter messages, short orders and instructions were written on wedge-shaped tablets. The exact and accurate naming of the tablet types also appear in the documents (Burrow, 1940).

Figure 1. Rectangular double tablets

Thus, without exception, these tablets have important information on them. To hide and keep information secret, an exceptionally elaborate and sophisticated method was used by the literate of Cadota. The wedge-shaped and rectangular wooden tablets each had two, perfectly fitting pieces. In the case of the wedge-shaped tablets the lower piece and the precisely fitting covering piece were carved out of one single piece with the use of a saw. In the cases of the elongated, rectangular documents the lower and the upper pieces were not exactly the same. The lower tablets were a little longer, and their shorter sides had two prominent edges, which served as a frame, ensuring the perfect slide of the smaller covering tablet into the lower tablet. The majority of the text was on the lower tablet. If there was not enough space for the text on the lower tablet, it continued on the interior side of the upper tablet, but well-hidden from unauthorized eyes in any case.

The text hidden in this way was made even less accessible by the use of special cording, and seals.

In the cases of the wedge-shaped double tablets a hole was drilled in the pointed end of the tablet through the lower and the upper piece, and then, in the wider end a rectangular shaped indentation was carved. The wood was thicker here than in the pointed end, and the edge of the indentation stood out of the plane of the tablet perceptibly.

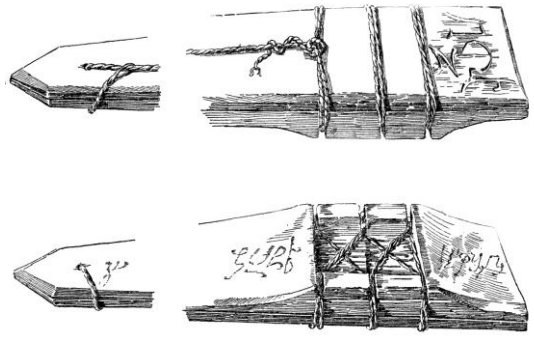

Figure 2. Wedge-shaped tablets

After preparing the document the cover tablet was placed onto the lower tablet, and a cord was pulled through the hole drilled in the more pointed end, and in the end, the cord was strained towards the indentation in the wider end of the tablet. The edge of the indentation was scarified, helping to keep the cord stable, which was driven through the indentation several times, straight and diagonally, as well. The cord fixed in this way was strained, tied, and the indentation above it was filled with clay. The official seal of the sender, or of the person requesting the documents, was printed here.

The rectangular wooden tablets were not drilled through, only the closing cord was wound vertically and diagonally multiple times above the carving above the indentation made for the seal of these "letters". Soft material was put on the cords, and seal was printed in it in this case, as well (Stein, 1907).

The seal prints found in Cadota could provide enough material for another, separate presentation, since they give an authentic evidence of the unique mixing of cultures along the Silk Road, of the intermingling of the Chinese, Indian, Persian, and ancient Greek and Roman civilizations. The seals of the documents that were found in the peripheries of China, written in Indian language and writing, although presenting more Central Asian character in their material, depict the Greek gods of Hellas of thousands of kilometres away, Eros or Pallas Athena, proving the cultural multi-colourness of the Silk Road in the third and fourth centuries.

Aurel Stein found several open, and seal-less documents on the site, but there were dozens of documents where the tablets, their cords, and their wonderful clay seals were intact. A large part of these double wooden tablets revealed their secrets only after being cut in the British Museum, over 1600 years after being closed and sealed (Stein, 1921).

Obviously, this sophisticated system did not take shape in Cadota which had only prospered for a few decades in the turn of the third and fourth centuries, but another, mature and previously tested chancellery system was adapted to the local conditions. Thus, it is an important question where the excellent and complex system of encryption originated from out of the above mentioned cultures (Chinese, Indian, Iranian, ancient Greek and Roman civilizations). Unfortunately, the majority of the geographical conditions of the above mentioned great civilizations are such that do not make possible the survival of numbers of documents made of similar organic material. (No similar written document has been found in any of the above mentioned great civilizations.) The majority of the records written on perishable material have not survived, or have survived in very limited numbers in the normal climate of both India and the Mediterranean. In spite of this, there are certain signs that make it more or less possible to localize the birthplace of the technology. In one of his later expeditions Aurel Stein found the predecessors of these strange letter papers and envelopes in hundreds of years older excavation layers, much closer to the China in the strict sense, hundreds of kilometres to the east of Cadota, next to Dunhuang. So it seems highly probable that this encrypting and authentication method appeared more to the east, a few hundred years earlier, and it spread westward to become a definitive element of the chancellery practice of Cadota during the third and fourth centuries.

Thus, in lack of evidence, we cannot exclude completely the possibility that the birthplace of the complex, sophisticated technology was India or another region, nevertheless, the probability of the method's arrival in the sand dunes of Taklamakan along the Silk Road from China is still higher.

And what secrets did these documents guard so carefully? Besides meticulously worded contracts on land purchase, or secret reports on the movements of Barbarians appearing at the frontiers, they contain information on all things that were important enough for a few people, or the local ruler, or his top rank officials to try to keep their content away from everyday readers as carefully as they, or their means could realize it.

IV. CONCLUSION

The image of another life has gained shape by today under the surface of life along the Silk Road (commerce, diplomacy, politics, etc.), where the acquisition and the hiding of information were in a fight of alternating success, sometimes deploying the devices of high politics, sometimes the simple devices of the chancellery of a small town. The stakes were obviously different, the means may have not.

REFERENCES

Atwood, C., "Life in Third-fourth Century Cadh'ota: A survey of information gathered from the Prakrit

documents found north of Minfeng (Niyä)." *Central Asiatic Journal*, **35**, 161–199 (1991).

Baumer, Ch., *Southern Silk Road. In the Footsteps of Sir Aurel Stein and Sven Hedin*, Bangkok (2003).

Burrow, T., *A Translation of the Kharo✹✷hi Documents from Chinese Turkestan*. London (1940).

Elisseeff, V., "Approaches Old and New to the Silk Roads." In: *The Silk Roads. Highways of Culture and Commerce*. Ed.: Elisseeff, V. Paris 1–26 (2000).

Felföldi, Sz.: "Fára, papírra, selyemre és bőrre írt kharo✹✷h✚ dokumentumok Belső-Ázsiából" In: *Abhivādana. Tanulmányok a hatvanéves Wojtilla Gyula tiszteletére*. Szerk.: Felföldi Sz., Szeged 131–144 (2005).

Höllmann, T.O., *Die Seidenstrasse*, München (2004).

Kharo✹✷h✚ Inscriptions. Discovered by Sir Aurel Stein in Chinese Turkestan. Part I. Text of Inscriptions discovered at the Niya Site 1901. Transcr. and ed. by Boyer, A.M.–Rapson, E.J.–Senart, E. Oxford (1920).

Kharo✹✷h✚ Inscriptions. Discovered by Sir Aurel Stein in Chinese Turkestan. Part II. Text of Inscriptions discovered at the Niya, Endere and Lou-lan Sites 1906–1907. Transcr. and ed. by Boyer, A.M.–Rapson, E.J.–Senart, E. Oxford (1927).

Kharo✹✷h✚ Inscriptions. Discovered by Sir Aurel Stein in Chinese Turkestan. Part III. Text of Inscriptions discovered at the Niya and Lou-lan Sites 1913–1914. Transcr. and ed. by Rapson, E.J.–Noble, P. S. Oxford (1929).

Mirsky, J., *Sir Aurel Stein. Archaeological Explorer*. Chicago–London (1977).

Padwa, M.–Sims-Williams, U., Kroraina: Settlements in the Desert. In: *The Silk Road. Trade, Travel, War and Faith*. Ed.: Whitfield, S.–Sims-Williams, U. Chicago 169–186 (2004).

Stein, M.A., *Ancient Khotan. Detailed report of Archaeological Explorations in Chinese Turkestan. Vols. I–II*. Oxford (1907).

Stein, A., *Serindia. Detailed Report of Explorations in Central Asia and Westernmost China. Vols. I–V*. Oxford (1921).

Wood, F., *Did Marco Polo go to China?* London (1995).