# Evolution of the Bibliographic Control Systems and Genesis of the Concept 'Documentation': Contribution of Paul Otlet and Henry la Fontaine in 19th C.

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**Abstract**

The paper covers a review of evidence existing for documentation systems followed in the pre Christian literary history and during the 19th C. A special attention was given to the evidence of a most comprehensive cataloguing system followed in the Alexandrian library 'the pinakes' which had a great impact to cataloguing, indexing and documentation tradition thereafter. Even though the concept 'documentation' was not introduced at that time during the 1st century to date, many attempts were made to capture the knowledge by scientists, priests, publishers and librarians especially after the printing technology was introduced in 16th C. A special attention was paid to the most versatile and systematic documentation system designed and carried out in 19thC by two visionaries, Paul Otlet and Henry la Fontaine who were creators of the concept 'documentation'. Evidence for this effort still exists in a card based archive in Belgium and its vision and design is now identified by computer scientists as the base structure of the World Wide Web and the base architecture of modern computer networks and search engines. The article provides a brief review of the structure and history of the bibliographic repertory of 18 million index cards.

***Keywords:*** Documentation systems, Documentation history, Indexing systems, Mundaneum, Paul Otlet, Henry la Fontaine

## Introduction

Capturing knowledge had been an issue for the mankind throughout the history and the same question emerge in the modern world in different angles of knowledge explosion especially with emerging technologies. During the centuries before Christ, libraries and colleges of knowledge sprang up in ancient civilizations contributing to the tradition of

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keeping libraries. Practice of keeping libraries had evolved as a profession and contributed immensely to the evolution of its science even though the first library science book was written in 116 BC. Objective of the controlling information and knowledge lies in the area of bibliographic control which is achieved through documentation systems and its instruments regardless the nature of information generated elsewhere. Evolved with the tradition of recording the knowledge in different forms documentation systems, over the time had taken roots to the systems followed by a category of professionals identified as librarians, archivists, viziers etc. whose legacy dating back to 3000 BC.

Historical evidence indicates that there were libraries that served the political, religious and social needs of the society of the time they belong. Library of King Ashurbanipal at Nineveh (c.625BC) which contained more than 30,000 clay tablets, Pergumum library in Asia minor during c.2 BC and the libraries of other civilizations emerged simultaneously in Sumeria, Babylonia, Assyria, China, Greece and in Indus valley (2600Bc -1700Bc) which had great contributions to the library management. The greatest contribution to the information management history comes from the library of Alexandria (288BC -32BC) and its daughter library, Serapeum, until their full destruction recorded in 400 AD and 391 AD respectively (Serageldin, 2013). Private library collections maintained by royals, elites and merchants of trade had also added considerable weight to the tradition of keeping and maintaining libraries. Evidence of such libraries was found in Ugarit in Syria on libraries that existed and arranged in an array of subject areas around 1200 BC (Oriental Institute, 2007). Evidence of organizing information also comes from the remains found in temple libraries in Greece around c.7$^{th}$ BC (Spoon, 1999). Custodians of these libraries had made considerable efforts to manage the materials received in many forms and types and followed simple to complex organization strategies in managing collections. Managing information had been a requirement of religious orders at that time or by the order of the royal court then. Information management concept evolved facing many changes and challenges with technological development in the ages it passed. Documentation strategies were however not developed in a scientific manner till the end of the 19$^{th}$ C.

This paper tries to summarize evolution of information management methods adopted by large libraries in the history upon evidences recorded and specifically records a mammoth effort launched in the 19th C by Paul Otlet and Henry la Fontaine to capture and organize the knowledge that started emerging from different corners of the world. The paper also summerises their contributions to the literary traditions of library science and the methods and criteria used by Paul Otlet and Henry la Fontaine for the purpose resembles the conceptual form of World Wide Web and computer based search engines of 21st century.

**Evolution from Pre-Christian Era**

With the historical evidences that reports the existence of great libraries in pre Christian era, it can be assumed that these collections were stored using some sort of organizing strategies. Hence it is worth to explore the evidences for the early mechanisms of information management. When tracing backwards in the history archeological evidence shows that the ancient Kemets (Egyptians) who were an African race geographically settled in Egypt, has roots to information gathering and management as far back as 2600 BC. According to the literature Kemets had developed an advanced system of collecting, organizing, describing, preserving and providing access to information and he also asserts that they had brought up a certain class of professionals to run the system (James, 1954, Posner, 1972, Zulu, 2012). The chief library builder of ancient Egypt and the most famous, was Rameses II (c. 1304-1237 B.C.), who had formed the first library motto, which read as "Medicine for the Soul". This was thousands years before the emergence of Greece as the pinnacle of western civilization and centre of knowledge in Europe (Zulu, 2012).

With the establishment of Memphis and Thebes Egyptian culture and religion developed with education system which had drawn scholars from around the world. However it was during Ramses II (c.1304-1237 B.C.), whose reign was marked with a flourished culture, religion, art, culture, special architecture, learning and scholarship and emerging of systematic temple -university libraries. The tradition evolved in African continent across the reigns of many kings who were supportive or non supportive for the learning and

libraries. The largest and systematic library in the ancient world was built by Ptolemy II around c.3rd BC in Alexandria where the first systematic catalogue *'the pinakes'* was designed by Callimachos (Witty, 1990), a special account on which is given in the next section of this paper.

Methodology used to document and control or manage information too dates back to the ancient Kemetic concept of the seven liberal arts (grammer, rhetoric, logic, geometry, arithmetic, astronomy, and music), the general mystery system of the four elements (fire, water, earth, air) and four qualities, duality of opposites (hot-cold, wet-dry etc.) (Zulu,2012). It is interesting to note that modern classifications systems have divisions in similar bases with much more analysis to the subject accommodating newly emerging areas and concepts.

In Egypt papyrus rolls placed in clay jars or metal cylinders labeled with a few key words describing their content and parchment scrolls divided by author, title, or major subject placed in bins or on shelves" (Gates, 1983). Ernest Posner, in his book 'Archives in the Ancient World'(1972), illustrates on keeping records in ancient Egypt. According to him record keeping thus institutionalized in the office of the 'Vizier', the chief administrator and chief official of the government, who catalogued and inventoried every citizen and all living and non-living things in Egypt. The most well known vizier as revealed from ancient tomb inscriptions was Rekhmire (lived in 15th C BC). He was a librarian, a judge and recorded as the first professional library administrator. Rekhmire was the highest ranking official under the pharaohs Tuthmosis III and Amenophis IIduring a period when Egypt's empire stretched to its farthest extent and was at the peak of her prosperity. Among the explanation of duties of Rekhmire found within his tomb is the evidence for the administrative and library management duties he had carried out (www.digitalegypt.ucl.ac.uk, 2013). Herbert Small (1982), in his account on the Library of Congress too gives a description of Rekhmire and reports that an image of Rekhmire is painted on the ceiling of Library of Congress as an honour for the first reputed and powerful library administrator.

Somewhere around 500 BC to 1200 AD, another civilization known as Maya emerged with high intellectual contribution to the learning history in Middle America. Mayan lexical text known as Mayan hieroglyphics, a script neatly written in square shape pictorials, different from Egyptian hieroglyphics dates back around 250 BC, but the script is thought to have developed at an earlier date. Recent archeological finds indicate that the Mayan civilization started much earlier: around 3,000 BC (Coe, 2002).

Developed around 2600 BCE, Mohendajaro-Harappa was one of the largest settlements of the ancient Indus Valley Civilization, and one of the world's earliest major urban settlements, contemporaneous with the civilizations of ancient Egypt, Mesopotamia, Carthage and Crete. A count of the number of signs reveals a lot about the type of recording system that had been used by Indus valley people. Alphabetic systems rarely have more than 40 symbols. Syllabic systems like Linear B or Cherokee typically have 40 to 100 or so symbols. The third ranges from logophonetic to logographic, running upwards of hundreds of signs (like 500 signs in Hieroglyphic Luwian, and 5000 symbols in modern Chinese). It appears that the maximum number of Indus script symbols is 400, although there are 200 basic signs (i.e. signs that are not combined from others). This means that the Indus script is probably logophonetic, in that it has both signs used for their meanings, and signs used for their phonetic values (Elmer, 1970).

The clay tablets etched in cuneiform script discovered in Sumeria, some of the tablets dating back to 2600 BC. Evidence of these scripts marks the end of prehistorical era and the start of written history. The written archives in clay tablets dating back to 2600 BC found in Sumer mark the end of prehistory. There is also evidence of libraries at Nippur (Peters, 1897) in Mesapotemia (now Nuffar in Iraq) about 1900 BC and at Nineveh in Assyria (now Mosul in Iraq) about 700 BC showing a library classification system categorising epics, omen texts, astrology, etc. (Elmer,1970).

Aristotle in his college (Lyceum) used a class system which was used by many colleges later. Private or personal libraries made up of written books (as opposed to the state or

institutional records kept in archives) appeared in classical Rome and Greece in the 5th century BC. Evidence for huge libraries in Greece was found with description inscribed in stones and pillars regarding the collections prevailed in those libraries. Private literature collections maintained by royals, elites and merchants of trade also have added considerable weight to the information management tradition. Evidence of first listing of materials was found in the "book hall" of the Horus temple at Edfu in Egypt, which lists 37 titles and dates from the time of Ptolemaios VIII and Euergetes II (177-116 B.C.) which was incised on to the stone wall of the temple (Gates, 1983).

Library of King Ashurbanipal at Nineveh, which contained more than 30,000 clay tablets (c. 625 BC), and there were other royal and academic libraries of Sumeria, which had been using systematic arrangement of books on clay. The Library of Ashurbanipal at Nineveh, provides modern scholars with an amazing wealth of Mesopotamian literary, religious and administrative work. Among the findings were the Enuma Elish, also known as *the Epic of Creation,* which depicts a traditional Babylonian view of creation, the Epic of Gilgamesh, a large selection of "omen texts" including *Enuma Anu Enlil* which "contained omens dealing with the moon, its visibility, eclipses, and conjunction with planets and fixed stars, the sun, its corona, spots, and eclipses, the weather, namely lightning, thunder, and clouds, and the planets and their visibility, appearance, and stations", and astronomic/astrological texts, as well as standard lists used by scribes and scholars such as word lists, bilingual vocabularies, lists of signs and synonyms, and lists of medical diagnoses (Anderson, 2012).

In 26 BCE, at the command of emperor Han Chengdi, Liu Xiang spent much of the rest of the some 20 years of his life engaged in his massive bibliographic work on organizing the imperial library. This work was assisted by his son, Liu Xin, who finally completed the task, after his father's death. Liu Xiang established the first library classification system during the Han Dynasty, and the first book notation system. At this time the library catalogue was written on scrolls of fine silk and stored in silk bags. Liu compiled the first catalogue of the imperial library, the *Bielu*, or *Abstracts* and was the first known editor of the *Shan Hai Jing*

(finished by his son). Liu was a prodigious collector (or writer) of stories and other works, which he compiled into the *Zhan Guo Ce*, the *Xinxu* , ( "New Prefaces"), the *Shuoyuan* ("Garden of Stories"), the *Lienü Zhuan* "Biographies of Exemplary Women", and probably the *Liexian Zhuan* (a Daoist hagiography)(Wikipedia, accessed in 2013)

There are other evidences too that could be brought forward from the history relating to the presence of bibliographic guides to the information stores. For example Marcus Terentius Varro BC – 27 BC) (Britannica, 1995) was a Roman scholar and writer. According to the literary evidence Julius Caesar had entrusted Marcus Terentius Varro, an outstanding scholar and a Roman public librarian to design a public library in Rome. For the purpose Varro wrote a treatise on technical organization of libraries; 'De Bibliothesis' a 3 volume book, around 25 BC (Britannica, 1995). This may be the first recorded evidence of the book written on library organization. His *Nine Books of Disciplines* became a model for later encyclopedists, and librarians in Europe. The *Nine Books of Disciplines* organise the knowledge into grammar, rhetoric, logic, arithmetic, geometry, astronomy, musical theory, medicine, and architecture. Using Varro's list, subsequent writers defined the seven classical "liberal arts of the medieval schools" (Lindberg, 2007).

Printers Elder Aldus (Aldus Matinius) (Encyclopedia Britannica,accessed 2013) used five class system while Robert Estienne (Armstrong, 1999) used a 14 class system. But these were not used by librarians may be due to the limited subject coverage satisfactory only for printers. Another textbook on library science was published 1808 by Martin Schrettinger a monastic librarian which gives technical organization of materials and concepts. The term "library science" was first used by Schrettinger and brought out his work entitled *Towards a Complete Textbook of Library Science*. (Goethe Institute, 2012)

Charles Ammi Cutter's catalogue, 'the catalog' was revised and published in five volumes known as the Athenæum Catalogue. Cutter was the librarian at the Boston Athenaeum for twenty-five years. The magnum opus of Cutter's bibliographic pilgrimage came into operation in 1880 when he introduced the Athenaeum and eventually the library world to

an avant-garde and divergent system of cataloging he termed as Cutter Expansive Classification. This system incorporated seven levels of classification with the most basic libraries operating at the first level and the grandest, most distinguished institutions utilizing the seventh level, and it was Cutter's aspiration to orchestrate a classification system for every type of library. The classification system utilized an alpha-numeric methodology used to abbreviate authors' names and generate unique call numbers known as ("Cutter numbers" or "Cutter codes") and these are still in use in today libraries (Cutter, 1931).

In 1873 Melvil Dewey had compiled the Dewey Decimal Classification (DDC) system and which became the world's most widely used library classification system a mile stone in the documentation history. The DDC reached its 23rd edition. At the time the DDC was introduced, shelf browsing was not considered of importance. The use of DDC increased the advantages of relative positioning on shelves and encouraged the librarians to open the shelves for public browsing. Based on DDC Otlet and la Fontaine compiled UDC with a different approach. In 20$^{th}$C Ranganathan had compiled Colon Classification which is a faceted system.

However it is important to note that the divisions and analysis made by Callimachos for his catalogue (pinakes) had been the base for many developments in bibliographic tools ( Spoon,1999, Zulu,2012) and a brief description of 'pinakes' is worth to be accounted.

***'Pinakes'* of Alexandria**

Ptolemic and other ancient libraries too had similar treatment to documentation for the materials gathered. The great library of Alexandria was built by Ptolemy II around 288 BC, with a systematic plan to acquire materials to the library which flourished as 'book trade' in Rhode Island had become a robust activity then. Around 296 BC, Callimachus, a reputed member of the editorial team of the Alexandrian library, was entrusted by Ptolemy II to organize the collections of more than 700,000 in the library. Callimachus was an intellectual and belongs to high society in Alexandria and was assigned the task to do a

bibliographic survey to document the literary works held in Alexandrian library. His famous "*Pinakes"* (has original meaning of 'tablets' or 'tables'), a systematic listing of genres, authors, and works written in 120 books (Bagnal, Accessed 2000) now survives in only few fragments numbered as 825 pieces; a numerical sequence given by Pfieffer (Witty, 1958). Literature on Pinakes were compiled upon these evidences and upon references made to Pinakes by different scholars in their work at that time. A detail description of Pinakes in English is rare except the works of few researchers. The fragments of the works of Callimachus was first collected and edited by the famous English classical scholar Richard Bentley and were included in the Graevius edition of the 'works of Callimachos' in 1697 (Witty, 1958).

Pinakes a catalog of books and scrolls of Alexandrian library was the first evidence found for a methodologically compiled library catalog but only a few fragments of it have survived the fire that destroyed the great library in 48 B.C. The pinakes carried the meaning of tablets which were hung and placed above the various library cases signifying the classes of literature contained in the scrolls therein. Later the word was used to refer to a list of authors and works or for a catalog (Irwin, 1956). The remnant gives an approximation for the whole cataloguing tool that was in use. This catalog was a set of indexes which included bibliographic information of categorized collections. A medieval Greek lexicon Suidas (Alder, 1928) is the source for the complete title of the pinakes.

Suidas too mentions two other works of Callimachos beginning with the word 'pinakes'. These two other works that were referred as *pinakes* and were probably somewhat similar in format to the *Pinakes* (of which they "may or may not be subsections"), but were concerned with individual topics (Alder, 1928). These are listed as A Chronological Pinax and Description of Didaskaloi and Pinax of the Vocabulary and Treatises of Democritus. According to Witty these were lesser works; one being a pinakes of the dramatic poets in chronological order, the other a pinakes of glosses and compositions of Democritus (Witty, 1958) and not parts of great pinakes. The great Pinakes according to Suidas reads

as "Tables of those who were outstanding in every phase of culture and their writings – in 120 books".

By consulting the Pinakes, a library patron could find out if the library contained a work by a particular author, how it was categorized, and where it might be found. It is important to note that Callimachus did not seem to have any models for his pinakes, and invented this system on his own ( Witty, 1958) According to Spoon (1999) his system contained 3 major divisions; poetry, prose and varia. Poetry category had 6 main divisions; epic, elegy, iambic, melodrama tragedy and comedy: Prose had 5 divisions; history, rhetoric, philosophy, medicine and law: Varia include fishing, cake baking and other works on miscellany. Witty (1958) too records the subject areas covered in Pinakes according to the evidence he found in a sample of 825 remnants and records as; history, laws, oratory, philosophy, miscellany, medicine, lyric poetry, and tragedy.

The scrolls were kept in divisions of racks by category. The library contained papyrus or parchment scrolls, plates, tablets etc., which were grouped together by subject matter and stored in bins. Each bin carried a label with painted tablets hung above the stored papyri or parchments. *Pinakes* was named after these tablets and had available in the form of a set of scrolls of index lists. The bins gave bibliographical information for every scroll. A typical entry started with the title. It also provided the author's name, birthplace, his father's name, any teachers he trained under, and his educational background. It contained a brief biography of the author and a list of the author's publications. The entry had the first line of the work, a summary of its contents, the name of the author, and information about where the scroll came from and who or where it was confiscated from. When an author was not known a catalogue entry was written using a 'symbolic author'(Spoon, 1999). The symbolic author in many cases, the most famous figure in the subject area; eg: an anonymous medical work is organized under the name 'Hippocrates'. When there were many authors it was mentioned in the catalogue to avoid confusion.

Acquisition of books in ancient times was acquired by force, confiscated from its owners hence its origin was considered important to mark in the catalogue (Witty, 1958).

The *Pinakes* proved indispensable to librarians for centuries. It became a model to use all over the Mediterranean. Its influence can be traced to medieval times, even to the Arabic counterpart of the tenth century: Ibn al-Nadim's *Al-Fihrist* ("Index") (Wellisch, 1986). When al-Nadim began to collect material for his work, the universe of knowledge (which is what he meant by "the sciences") as seen through Muslim eyes was generally divided into three parts: the first-known as "the sciences of Islam"--consisted of the Qur'an, *Hadith* ("Tradition"), *Fiqh* (religious law), philology, and history; the second-"the pre-Islamic sciences"-were those that existed before the coming of the Prophet and developed further afterward-mainly poetry and oratory; and the third consisted of the sciences not previously known to Arabs but transmitted to them by way of translation from the Greek and other languages-i.e., medicine, mathematics, geometry, astronomy, alchemy, and the philosophical writings of Aristotle and the Neo- classification schemes devised individually by three great Muslim polymaths, al-Kindi (d. AD 873), al-Farabi (d. AD 951), and al-Khwarizmi (d. AD 997) for their encyclopedic works. Al-Nadim could therefore build on existing classificatory traditions, especially on that of the contemporary of his youth, al-Farabi, who divided his *Ihsa al-'Ulum* (Enumeration of the sciences) into eight main classes beginning with Philology (including grammar, writing, and poetry). Yet al-Nadim's classification scheme, while preserving the classical order of the "sciences of Islam," broke new ground. He divided the universe of knowledge into ten main classes, to each of which he devoted a *maqalah* or chapter.latonists. This traditional tripartite division of the universe of knowledge formed the basis of the library classification scheme.

Variations on Alexandrian classification system was used in libraries until the late 1800s when Melvil Dewey developed the Dewey Decimal Classification in 1876, which is still in wide use around the world. There are other evidences too that can be brought forward from the early history relating to the presence of bibliographic guides to the information stores, not developed comprehensively as *Pinakes* though.

**Documentation Methods Revolutionized in 19th C**

The challenge of preserving, classifying, visualizing and disseminating knowledge is a question as old as the production of knowledge itself. In a space of less than twenty years digital technologies have revolutionized the social behaviour and penetrated every area of daily lives with noticeable impacts. This new age of knowledge distribution started out and took roots in the efforts made by Paul Otlet and Henry la Fontaine who were able to outline a clear vision (Renaissance 2.0, 2012). They were visionaries who tried to circulate knowledge in a dynamic way and radically transformed the facts into a universal web of knowledge while building relationships among information, people and institutions. So that it is worth to note that how the documentation process was settled on a clear platform of bibliographic control to treat Paul Otlet as the father of 'documentation'.

Paul Otlet's dream of universal access to knowledge now has taken shape in information flow of the Internet. Moreover his project Universal Bibliographie Repertoire was referred by scholar Alex Wright as an "analog search engine" or 'paper google' to introduce the initiative taken by Otlet in setting up a fee-based service to answer questions by mail and by sending the requesters, copies of the relevant index cards for each query (Wright,2008). The millions of index cards now maintained in Mons as an information archive of Belgium, which now carry symbolic term 'Mundaneum' which was used by Paul Otlet long ago to introduce the information capturing, knowledge dissemination/sharing and encyclopedic model he designed and established initially in Brussels.

**Brief Personal History of Otlet (1868-1944)**

Paul Marie Ghislain Otlet was born in Brussels, Belgium on 23 August 1868, as the eldest child of Édouard Otlet and Maria. The family belonged to the wealthy bourgeois class of Belgium Following the tradition of the high class society then, young Otlet was home tutored. When he was a child, Otlet had a very few friends, and he regularly played with his younger brother Maurice. Within this limited social and family setup he soon

developed a habit of reading books and ventured to explore new knowledge and methods of organizing the same.

At the age of 11, Paul went to school for the first time, in Paris, where he stayed for three years and later Paul studied at the prestigious Collège Saint-Michel in Brussels for high school certificate. Otlet was educated at the Catholic University of Leuven and at the Université Libre de Brussels, where he earned a law degree in 1890. He was then articled with famed lawyer Edmond Picard, his father's friend. Here he met his lifelong friend Henry la Fontaine who had been the intellectual strength for the bibliographic adventure they launched together.

Recognized as father of modern documentation, Paul Otlet was a passionate innovator in architecture, urbanism, documentation, bibliography and museology. His interest to gather and document knowledge led him to discover the power of the Bibliography. This documentation tool he envisaged as the focus tool in providing information to the society.

**Bibliographical Adventure of Paul Otlet and la Fontaine**

Edmond Pickard was a famous literary figure in Brussels then and founded an enormous compendium of 'Belgian Jurisprudence' (*Pandectes belges*) in 1818 and edited the same until his death. Otlet became one of the members of the multidisciplinary team mobilized to publish *Pandectes Belges* and Otlet became aware of the importance of bibliography and identified it as predominant and central in controlling information; the domain he later tried to elevate into a science with his publications (Rayward, 2010).

There were similar efforts in bibliographical attempts in other countries during the period in various areas of sciences and social sciences. Those works were presented at International Congress of Statistics in 1856 and Antwerp International Conference on the Book, in 1890. The Society Mathamatique de France had created a *Repertoire Bibliographique des Sciences Mathematiques* in 1885 and *Royal Society of England had*

*issued Catalogue of Scientific Papers* in 1867. In 1895 they convened an international conference on bibliography where their works were presented to the intellectual world.

**International Institute of Bibliography and the Mundaneum**

Paul Otlet's most lasting legacy was the 'International Institute and office of Bibliography' which he created in 1895 to compile a bibliography on all times and places of the world. He was immensely supported by Henry la Fontaine his professional colleague. Through this effort Otlet envisioned an ultimate form of new kind of encyclopedia constituting all forms and sources of knowledge with a redefined concept of museum. The approach was positively taken by state agencies and he inaugurates a new kind of museum in Brussels, the centre was named as 'Palace de Mondial' in 1920. The museum was supported by a library which had eventually developed into a 'center for universal documentation' which was organized according to the Universal Decimal Classification created by Otlet and Fontaine in 1897.

In 1895, Otlet and Henri La Fontaine established the *Repertoire Bibliographique Universel (RBU, later identified as 'Mundaneum' after the Otlet's own interpretation for world knowledge))*, an ambitious attempt at developing a master bibliography of the world's accumulated knowledge. Otlet recognized from the beginning that the success of the whole undertaking would depend largely on the usefulness of its conceptual software, the classification system. He created the Universal Decimal Classification (UDC) and introduced the standard in Europe. Otlet wrote numerous essays on how to collect and organize the world's knowledge, culminating in two books, the *Traité de documentation (1934)* and *Monde: Essai d'universalisme* (1935).

The RBU was in its time was the most important work of IIB. By 1934 approximately more than16 million index cards had been collected and classified in the RBU. The RBU was organized basically with two objectives;

- What works have been written by an author?

- What is written on a particular subject?

These two objectives important as the RBU was universal in its scope and information retrieval was planned to address without restrictions of time, place or language.

The index contained a card format of 12.5 x 7.5 initially and shifted to American standard card of 5 x 3 inches. The bibliographical rules followed in making cards were to include the author, publisher, date of publication, notes about the item, subjects etc. The rules also standardized the punctuations, abbreviations and order of elements when constructing an entry.

The subject arrangement in the drawers was according to the UDC, with single and combined numbers. Coloured division cards, protruding tab marks were also used in card drawers for easy access. A metal rod was passed at the bottom of card drawers to hold cards in the drawers. A wood block with movable clasp was set at the end of each set of cards to ensure the uprightness of the cards. The clasp still works right when pressed to release block from its rail. The card cabinets were in an approachable height with wheels to ensure mobility. A pullout tray was also provided at chest level of the user, on which the card drawers could be placed when consulting the cards.

**The Mundaneum**

Otlet and la Fontaine designed and opened 'The Mundaneum' (in English the 'world space'), a public museum on intellectual world in the early 20th century. It was a dazzling success story. Otlet and his colleague Henri La Fontaine, who later won a Nobel Peace Prize, had been working on the project since 1895. The Mundaneum, which opened its doors in 1920 in a grand building in the heart of Brussels, was a mixture of public museum and meeting place for scholars, with an enormous catalogue of information, as well as an archive.

The Bibliographic Repertoire, RBU (A gigantic Catalogue/Index) was the main part consisted of 'the Mundaneum' which in French depicting the idea of 'global knowledge'. The institution operated a gigantic catalogue of world knowledge in the 1920s. Mundaneum, testifies to the utopianism of two men, Otlet and Fontaine, who were the descendents of the enlightenment and 19th C positivism and committed pacifists. They embarked on a bibliographic adventure that would create international networks designed to promote the exchange of knowledge (Dubray, 2010). It was expected to collect all the knowledge of the world on neatly organized 3"x5" index cards, an archive of world knowledge indexed interconnected. He envisioned collecting all of the books ever published and interlinking them using an archival system he developed himself (Athenius Kercher Soc., 2007).

Once housed in some grandeur in a wing of the Palais du Cinquantenaire in Brussels, what remained of the collections, publications and archives of this enterprise today are only 16 million cards. After years of government neglect, the repertoire was bundled into a section of an old anatomy building, situated on the edge of the Parc L'opold, that belonged to the Free University of Brussels. This re-location occurred just as the Germans, having ignited the Second World War, overwhelmed Brussels. Restored to some but incomplete order during and after the War, distributed in two large workrooms, in corridors, under stairs, and in attic rooms and a glass-roofed dissecting theatre at the top of the building, this residue gradually fell prey to the dust and damp darkness of the building in its lower regions, and to weather and pigeons admitted through broken panes of glass in the roof in the upper rooms. The most valued idealism of the two creators of Mundaneum was that the global dispersal of knowledge could promote world peace. To achieve this target, they worked in close collaboration with research institutions in other countries.

The author of this article tried to identify the system used in the RBU by investigating the remaining 12 million cards at the Mundaneum in April 2013. The task was extremely

difficult due to the short time limit available for the researcher hence an original study conducted by Boyd Rayward (Rayward, 2010) was consulted to understand the arrangement.

RBU was not a single repertory or a dictionary catalogue as introduced by American libraries in 19th C. Otlet used a coding system to indicate the access points and it had a divided arrangement. Author file name was identified by 'N' and the subject file by 'A' which were the principal files. The periodical file by 'NR', the book file by 'NT'.

A special file indicated by 'K' includes administrative work of IIB, which is now the essential source to understand the activities conducted and communication that was established with the other countries by Otlet and Fontaine. Every communication was listed and noted with dates in the cards; letters received information about the management of the IIB staff, publications, inventory of collections etc. It consists rare listings of learned associations existed at that time, affiliated societies and above all their specific catalogues. To date, though we are in the peak of electronic information communication in an office is not indexed in this systematic order. This kind of repository is not seen anywhere in the world which enlists not only the bibliographic information but the personal, institutional and subject relations.

According to Gillen (2012), the archivist, jumble of numbers written on an index card, the user may be able to decipher dozens of pieces of information about the book to which the card refers. Many modern researchers agree that with this archival system, developed around the turn of the last century, Otlet essentially invented hypertext, the network of links that help us navigate around the Internet today. "You could call Otlet one of the original minds behind the Internet," as Gillen accounts at an interview (Gillen, 2012).

Otlet first developed the idea of a global knowledge "network" in 1934. At a time when radio and television were still in their infancy, he tried to develop multimedia concepts to improve opportunities for cooperation among researchers. Otlet wrestled with the

question of how to make knowledge accessible across great distances. He used a combination of index cards, telephones and other equipment to approximate what is possible today with any computer. His network far a card based World Wide Web with its hypertext structure. Otlet didn't just want to connect various pieces of data with one another, he also wanted the links themselves to carry meaning. Many experts agree that Otlet's idea demonstrates many parallels to the concept of a "semantic network," which aims to make it possible for computers to utilize the actual meaning of data, allowing them to interpret information and process it automatically.

Without the aid of electronic data processing, he built up a network of knowledge in card, yet Otlet's name and his work are largely forgotten. Americans Vannevar Bush, Ted Nelson and Douglas Engelbart are considered the minds behind hypertext and the Internet, while the remains of the Mundaneum collection was not given publicity or proper place in the documentation history.

The archive contained not only books, but posters, postcards around 200,000 news papers as well as samples of everything from airplanes to telephones. Otlet worked with organizing knowledge structures that could be considered as the earliest precedent of the World Wide Web. He spent his entire life trying to conceive search engines that could establish hyper-connections between all existing information. Otlet dreamt of the creation of an infinite network of information that could contain and interconnect the whole body of human knowledge. This was the first artificial conception of a hyperlink model of infogathering – infosharing. He envisioned a system of information access similar to the semantic web, materialized by computer scientists only decades after his demise.

He laid out the concept of an academic conference that could be broadcast by telephone, and wondered, "Why not send images, too? It could be called 'radio telephotography' Otlet also saw gramophones as a way to archive and reproduce spoken information ".

**A Paperless Way of Spreading Information**

The RBU had within a very short period of time become the centre of scholarly communication. Inquiries came to RBU s by letter or telegram, as many as 1,500 of them a year, and the answers were handled manually, a process that sometimes took weeks. The project was something like a paper Google, but developed decades before the Internet and without the benefit of computers and world's first search engine is made of wood and paper at Mundaneum. Specifically, it consists of rows of dark brown cabinets about as tall as a person, filled with boxes of index cards. According to the records Sixteen million index cards/ notes (Spiegel Online International (2011) were compiled and stored in the repertoire where Otlet wanted to map out the world's knowledge and preserve it in his wooden cabinets.

Alongside his passion for collecting, Otlet worked on new ideas for the paperless dissemination of knowledge. He saw books as nothing more than "containers for ideas," ones which could be replaced by more practical media, for example graphics and diagrams, of which he himself produced countless examples. These saved space because they could be recorded on microfilm, and had the added benefit of being internationally comprehensible. Otlet also hoped to use audio and film to make it possible to transport information faster, further and more easily.

Radio, at the time a new medium, was especially fascinating for Otlet because of its ability to transmit information wirelessly across long distances and to reach an unlimited number of receivers. For him, it was one step toward fulfilling the dream he formulated in 1934 for a "universal network that would allow the unrestricted dissemination of knowledge."

Anyone sitting at home "in an armchair," Otlet suggested, would be able to access the current state of global knowledge. Developments anywhere in the world could be recorded as soon as they happened, "in this way becoming a flexible image of the world, its mind, its true duplicate." Otlet described this as a "mechanical, collective brain" (Spiegel Online International, 2011). He was talking about a ‘telegraphicbook’ by combining telephone and a display screen (Lindberb, 2007). In his Treaties on

Documentation, Otlet referenced what would become the computer when he wrote: 'Here the workspace is no longer cluttered with any books. “In their place, a screen and a telephone within reach… From there the page to be read in order to know the answer to the question asked by telephone is made to appear on the screen” (Otlet, 1934). He went on to suggesting that dividing a computer screen could show multiple books at once, a possible reference to opening a few browser windows or tabs at once.

Otlet first developed the idea of a global knowledge "network" in 1934. At that time the radio and television technology were in primary stages. He tried to develop multimedia concepts to improve opportunities for cooperation among researchers. Otlet continuously wrestled with the issue of making knowledge accessible across borders. He used a combination of index cards, telephones, telegraphic machines and other equipment to approximate what is possible today with any computer.

**Writings on Bibliography and Documentation**

Otlet’s publications on the concept of creation of knowledge, capturing universal knowledge, disseminating strategies, diverting from bookish knowledge, museology, encyclopedic elements, bibliographic materials, building a World City etc. are numerous and mostly written in French. His magnum opus was the *Traité de Documentation,* 1934, and the Universal Decimal Classification (UDC) a descriptive manual compiled on classification of knowledge materials.

***The Traité de Documentation,* 1934**

Otlet had collected all of his ideas on bibliography and documentation in his 400-page book "Traité de documentation." in 1934 (reprinted in 1989). Otlet’s magnum opus *TheTraite* encompases a lifetime's thinking of Otlet about the problems of creating new, and improving existing, systems for organizing knowledge. The *Traité* is perhaps the first

systematic, modern discussion of general problems of organising information. Otlet biographer Boyd Rayward describes the *Traité* as, "perhaps the first systematic, modern discussion of general problems of organising information." (Boyd, 1991). "Documentation" is a term invented by Otlet to designate what today we teach under the concept 'bibliographic control' where the documentation systems are treated as the main tool of achieving BC. However the *Trait*é is the first information science textbook addressing modern library & documentation science issues.

The *Traité* begins with a long and exhausting general exposition about communication and information examined historically and from the point of view of various social and other sciences. It then proposed that new kinds of mechanical, integrated information handling systems should be invented that would transform the work environments and practices of scholars. Like Vannevar Bush, Otlet's speculations were prompted by a concern to deal with the ever expanding growth of literature and the realisation that a technological innovation was at hand to help. What fired his imagination was the realization of the bibliographical uses to which standard 3"x5" card and later loose sheets or leaves of standard sizes could be put. Here was a simple technology to be exploited by those who had the imagination to see the potential implicit in it. Cards permitted the "analytical" recording of single, separate pieces of information, be they bibliographical or substantive, and so effectively the creation of what in Hypertext are nodes or chunks of text. Larger chunks of information could be recorded on separate sheets. Otlet called this the "Monographic Principle" (Otlet, 1918).

The use of the term, monographic, was well chosen for, from the Greek, etymologically it signifies a single or individual piece or unit of writing. It is possible that Otlet's use of the term derives from his involvement in Die Brücke or the Bridge, a society for the study of the organization of knowledge set up in Munich in 1911 with the famous German chemist, Wilhelm Ostwald, in the Chair. Otlet was named Honorary President. The reciprocities in the relationship between Otlet and the IIB and Ostwald and die Brücke are in need of

much further investigation. For Otlet, if cards and sheets were standardized especially as to size and weight, the collaborative, continuous expansibility of databases that were created in these media according to the monographic principle became possible. In theory it was easy to excerpt items in the databases or to duplicate them in whole or in part simply by copying the cards or sheets comprising them.

After evaluating the classification systems then in use, such as Dewey Decimal and the British Museum system, Otlet concluded that they all shared a fatal flaw: they were designed to guide readers as far as the individual book but no further. Otlet wanted to go a step further. He wanted to penetrate the boundaries of the books themselves, to unearth the "substance, sources and conclusions" inside.

**Universal Decimal Classification (UDC)**

Otlet had already developed *Classification Decimale*, in 1897 for IIB bibliographies and the experience led him to adopt DDC of Dewey with permission to build up UDC. Taking the Dewey Decimal system as his starting point, Otlet began developing what came to be known as the Universal Decimal Classification, a widely used faceted classification system (Wright, 2003). Facets of the UDC system indicate as follows:

- Facts: Empirical observations or assertions.
- Interpretation: Analysis or conclusions, derived from "facts."
- Statistics: Measured, quantifiable data.
- Sources: Citations or references.

Today, the UDC comprises over 62,000 individual classifications, translated into over 30 languages (one reason for its popularity outside the U.S.). The UDC has 10 main classes with a series of auxiliary tables allowing for additional facets. These tables provide notations for place, language, physical characteristics, and for marking relationships between topics using a set of "connector" signs such as "+," "/" and ":".

UDC's most innovative and influential feature is its ability to express not just simple subjects but relations between subjects. In UDC, the universe of information (all recorded knowledge) is treated as a coherent system, built of related parts, in contrast to a specialized classification, in which related subjects are treated as subsidiary even though in their own right they may be of major importance. Otlet and his colleagues were also responsible for the development of what we would call a highly flexible database management system for databases created form cards and sheets, this was the Universal Decimal Classification (Rayward,1994).

**Summary**

The record available on evolution of history of writing indicates that human beings were trying to record the knowledge and capturing knowledge emerged elsewhere. With the advent of printing technology and revolution in knowledge domains paved the way to an age of renaissance in 19$^{th}$ C. Knowledge capturing had become a main question at the hands of intellectuals and scholars when Paul Otlet and la Fontaine toiled to capture, organize and disseminate knowledge. Both of them were visionaries driving their vision and experiments towards achieving world peace through information and knowledge networking. The duo had founded *Institut International de Bibliographie* in 1895 which later became the International Federation for Documentation and Information, the FID. They were also visionaries especially the noble peace prize winner la Fontaine, were behind forming of League of Nations in early 20$^{th}$ C, the forerunner of UNESCO.

Decades before the Vennaver Bush made his searching machine and Ted Nelson's Xanadu project ultimately to coin the word ' Hypertext', or iPad, the Kindle or even the computer screen, Otlet was devising a plan to combine television with the phone to send and spread information from published works. His card based index is now treated as a card based Google by modern scientists. To recognise this mammoth effort the Google Belgium was the main sponsor of exhibition opened of Mundaneum 2013, in Mons Belgium, "the Rennaissance 2.0".

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