Interrogating Spatial Analogies Relating to Knowledge Organization: Paul Otlet and Others

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Abstract

The author provides an examination of how ideas about place and space have been used in thinking about the organization of knowledge. The spatial analogies of Paul Otlet (1868–1944) in relation to his overall vision are traditional and conventional. Notions of space, place, position, location, and movement are frequent in the work of other leading innovators (Martin Schrettinger, Melvil Dewey, Wilhelm Ostwald, Emanuel Goldberg, and Suzanne Briet) concerning specific practical aspects of knowledge organization. Otlet's spatial imagery is more original and more ingenious when applied to technical problems compared to his overall vision.

Introduction

In the organization of knowledge, one challenge is how best to think about and represent place and space, but here we are concerned with the reverse relationship—how ideas about place and space are used to think about and represent the organization of knowledge, with special reference to spatial analogies used by Paul Otlet (1868–1944). We consider this topic in five stages: first, we summarize the nature of analogy; second, we examine spatial aspects of selected examples of Otlet's symbolism; third, we review spatial aspects in the work of some other innovators in the organization of knowledge; fourth, we look at other examples of Otlet's use of spatial imagery; and, finally, we draw conclusions.

Analogy

Analogy is a structural, exploratory, or argumentative figure based on selective similarity. If we say of a soldier that "he was a lion in battle," we do not mean that, like a lion, he walked on four limbs, wore no clothes, and

would eat the flesh of dead warriors. Instead we are assumed to mean that he fought fiercely as, by human tradition, a lion would.

Analogies are cultural, situated, conventional, and purposive. Analogy is a rhetorical device with which symbols are used to increase the effectiveness of communication. The symbols used descriptively can be natural, representational, or arbitrary, as with Dewey Decimal Classification numbers.

The selective similarity and cultural situatedness of analogies are at once a strength and a weakness. They are a strength because they can bring vividness, emphasis, and stimulation. But used in the wrong situation or contrary to established convention, analogies will tend to fail or, worse, result in unintended meanings. Further, although culture is shared within a community, interpretation is ultimately personal. For these reasons, analogies tend to be highly standardized, and making effective use of analogies in unconventional ways is an unusual and valuable skill.

Analogies, like vocabulary, decay with time. The initial vividness diminishes. Images become stale and stereotyped. Cultural changes may make them obsolete, even meaningless.

Comparing actual space with notional space is metaphorical. (Here we are using *analogy* in a broad general sense, and *metaphor* is one of the specialized forms of analogy.) A well-known example of comparing actual space with notional space is memory theater, in which one associates objects or concepts with physical details of a familiar street or building for *inventio*, one of the five traditional parts of rhetoric. Inventio is finding from memory the most persuasive reasons and examples when composing an argument. It is a form of mental indexing and retrieval.

SELECTED SPATIAL ANALOGIES USED BY PAUL OTLET

The characteristics of spatial imagery can be illustrated by examples used by Paul Otlet (1868–1944), the Belgian pioneer of documentation. The publications in which he originally used them are not widely available, but fortunately, many of his published and unpublished drawings have been reproduced in recent publications (Levie, 2006; Courtiau, 1987; van den Heuvel, 2004, 2008; Chabard, 2008; Ducheyne, 2009; Van Acker, 2011). Here we discuss some examples.

Triple Spheres: Universe, World, and Inner Self

Otlet made frequent use of a highly spatial image of three concentric spheres, which he used with a variety of different meanings. In one relatively simple use, concisely showing extremes of physical scale, he explains that it represents the universe, the world, and the inner self as three concentric physical globes (see fig. 1).This physical, spatial analogy illustrates selective similarity in the relative physical sizes of the three units but disregard for other fundamental differences. Refer-

Figure 1. Otlet's triple-spheres logo (Levie, 2006, p. 89).

ring to one's psychological world as "inner" and to one's "innermost thoughts" is a long-established convention. The inner self is psychological and not, or at least not primarily, physical. The earth, as presented in Otlet's book *Monde* (1935) is a geocultural entity. One might consider the universe as essentially physical. With Newtonian physics, there was no longer any place for heaven or for the soul, but in this image the universe appears as an all-encompassing totality that includes the totality of the universe, the geocultural world, and the psychological inner self. It is a spatial image of elements that are only partly spatial (see also Ducheyne, 2009).

Index Scientiae: *A Fruitful Tree with a Key and Books*
Another favorite image of Otlet combines a fruitful tree, a key, books, and the Latin legend "*index scientiae*" (index to knowledge). Figure 2 combines the tree of knowledge (*scientia*) and the key as an *index* to that knowledge. An index is crucial because some organizing principle is essential to overcome the chaos of unorganized collections. Without the index, one can neither find anything nor have any sense of the whole. In this image, the spatial element is less dominant than in the triple spheres, but space and movement are present in multiple ways: A fruit tree *on top of* a pile of books denotes how knowledge *arises* from prior knowledge (the books *below*, with the nutrients doubtless sucked *up through* the roots) and yields new discoveries and understandings (the fruit) at the *ends* of *elevated* branches.

The tree with its roots, trunk, branches, twigs, flowers, and fruit was a well-established medieval metaphor for knowledge systems and popularized by Ramon Lull's *Arbor scientiae* (Tree of Knowledge), written around 1300.

Figure 2. *Index scientiae*. A fruitful tree with a key and books (Levie, 2006, p. 70).

A tree is characterized by *growth* over time. The nutrients absorbed by the roots *rise* through the trunk resulting in beneficial fruit *high up* in the tree.

A tree occupies space, but its importance is in showing relationships, how elements are related in time and causality. Familiar examples are family trees and tree diagrams. Whether or not he intended to indicate so in this image, Otlet believed that all kinds of knowledge are, or ought to be, related. The Universal Decimal Classification served that purpose.

In addition to the hierarchical relationship of trunk and branches, the tree image illustrates a central phenomenon: the presentation of culture as if it were natural (Burke, 2000, pp. 86–89). This image also illustrates the situational nature of analogies: when associated with knowledge, the fruit of a tree is beneficial. In other situations, the fruit of a tree may be forbidden and dangerous, as Adam and Eve learned. A book, too, must occupy some space, but it is also the *locus* of knowledge, the symbolic *place* where knowledge is found and where one can learn.

A variant form of this image cropped at the bottom and not showing the books was used as a logo on the title page of Otlet's *Traité de Documentation* (1934) and frequently in publications of the International Institute for Bibliography founded by Otlet and Henri La Fontaine (reproduced in Levie, 2006, p. 102).

A key ordinarily provides access to a space (a room or a box), and by analogy an index provides *access* to a *volume* of literature. Here, again, the image is spatial and associated with the tree, with its spatial features of growth and progress. The meaning is clear because the image of a key is very conventional and also explained by the legend in Latin, *index scientiae*. Without these culturally specific conventions, the juxtaposition of a tree and a key and books on the ground would be absurd.
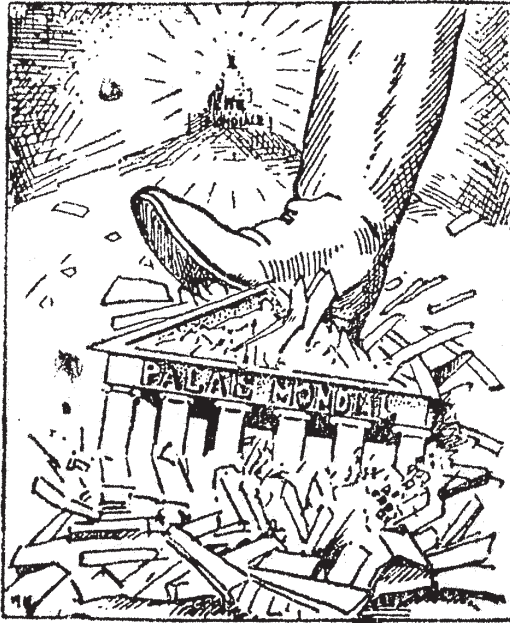
Figure 3. Boot, building, and city (Levie, 2006, p. 292).

Boot, Building, and City

In 1934, the Belgian government decided to expand the royal museums housed in the Palais du Cinquantenaire in Brussels, displacing Otlet's use of space in it. Otlet's encyclopedic *Traité de Documentation* was in press at the time, and the distraught Otlet was able to add a passionate protest as an annex at the end of his book with a forceful image showing not the educational repurposing of space but the destruction of a monumental building (see fig. 3). The image is clearly a reference to the Palais du Cinquantenaire, although it bears no architectural resemblance to it (*Complexe*, 2009; Gresleri, 1987, p. 57). Instead, a highly emblematic example of monumental classic civic institutional architecture, labeled "Palais mondial," is being demolished by a large boot crushing it *down*. In stark contrast, *high up* in the background, *elevated on top of* a hill, *superior to* and opposing the *direction* of the boot, is the radiant world city, signified as sacred by being domed like a cathedral. Of course, what was really under attack was not the Palais du Cinquantenaire but Otlet's grand institutional vision.

The holy city is a very traditional Christian image, vividly described in the apocalyptic final pages of the *New Testament* in the grand climax of the Revelation of St. John the Divine, a classic source of consolation for virtuous but suffering true believers:

> And I saw a new heaven and a new earth . . . And I John saw the holy
> city, new Jerusalem, coming down from God out of heaven, . . . And I
> heard a great voice out of heaven saying, Behold, the tabernacle of God
> is with men and he will dwell with them, and they shall be his people,
> . . . And God shall wipe away all tears from their eyes; and there shall
> be no more death, neither sorrow nor crying, neither shall there be
> any more pain: . . . He that overcometh shall inherit all things . . . But
> the fearful and the unbelieving, and the abominable, and murderers,
> and whoremongers, and sorcerers, and all liars, shall have their part in
> the lake which burneth with fire and brimstone: which is the second
> death. (Rv 21:1–8)

Otlet's image invokes a very strong contrast between the evil destruction
of the present day and the most powerful traditional symbol of the per-
fect future for true believers who will eventually triumph *over* evil.

The boot illustrates another characteristic of analogies: diminished ef-
fectiveness over time. The meaning is clear and brutal today, but it no
longer carries the special forcefulness that a military jackboot with metal
studs had in the 1930s when it was a direct and obvious reference to the
ruthless brutality of the new fascist regimes of Hitler and Mussolini.

Combinations
Otlet freely combined symbols to indicate dynamic movement. The *index
scientiae* used three different symbols (books, tree, and key) to indicate a
flow of learning. The boot building and heavenly city are combined to
show a tale of destruction and rebirth. The triple-spheres image was freely
incorporated into other drawings, such as the Mundaneum depicted as a
sailing ship carrying its precious cargo of knowledge (books and the triple
spheres) across a perilous sea to the dawn of new, happier era (Chabard,
2008, p. 109; Levie, 2006, p. 278; Rayward, 1975, p. 352).

Architectural Designs for Otlet
Otlet's evocation of the radiant connection of earth with heaven trumpets
his symbolic message fortissimo. That symbolism was continued in two
striking architectural designs prepared for his grandiose plans for a new
world center of knowledge.

The design offered by Hendrik Andersen and Ernest Hébrard, named
the Tower of Progress, emphasized the loftiness of Otlet's ideal through
sheer *elevation* in a design. In shape and size, it resembled an Eiffel Tower
clad in masonry (Gresleri & Matteoni, 1982, pp. 33–35; Levie, 2006, p. 124).
The Eiffel tower, completed some twenty years earlier, was the world's
highest building at 324 meters, and a century later it remains one of the
great modern iconic symbols. It is hard not to notice an unintended irony.
The design by Andersen and Hébrard closely matches Otlet's plans in be-
ing visionary, symbolic, elevated, and recklessly impractical. It would have
been difficult to construct, inconvenient to use, wildly uneconomical, and

difficult to adapt to changing circumstances. This design, so starkly different from the modernist international architectural style then emerging, is architectural sculpture.

If the Andersen-Hébrard design echoes the Eiffel Tower, Le Corbusier's design of 1929 for the Cité Mondiale à Genève was a ziggurat, an extreme of archaic design dating to the third millennium BC (Chabard, 2008, pp. 122–123; Gresleri & Matteoni, 1982, pp. 165–189; Courtiau 1987, p. 65; Gresleri, 1987, pp. 73–77; Levie, 2006, pp. 244–245). A ziggurat was a massive pyramid. Le Corbusier's design had a hollow center to provide a high-ceilinged exhibition area and a spiral path up around it to the top. This symbolism is suitable for Otlet's sacred vision in that ziggurats were temples and the spiral path is reminiscent of Dante's Mountain of Purgatory, but Le Corbusier's design can also be seen as symbolizing Otlet's vision in unintended, ironic ways. Quite apart from using an archaic design to implement a futuristic vision, in Le Corbusier's plan the highest floor would be for exhibiting prehistoric periods and the floors below would be assigned to progressively later civilizations as they developed, *down* through time to the ground floor, which was assigned to the present. Since one could not expand farther downward, Le Corbusier's design, in addition to being inefficient and resistant to change, lacked an expansive future!

Otlet's spatial imagery as described here gives no indication that Otlet's adult life coincided with a brilliant period of innovation on the arts, technology, social change, and science that induced an emphasis on design and efficiency. Form should follow function. Technology can conquer distance. Descartes' separation of mind and body is undermined. There was a cult of dynamic progress, Darwinism, and machinery that is not reflected in the examples considered so far (Buckland, 2008).

Spatial Ideas of Other Innovators

These images, strikingly traditional and conventional, serve to open up issues of space. The triple spheres position three different kinds of experience. A tree occupies space, but its symbolic significance lies in showing relationships of hierarchy, causality, and time. A book is a symbolic locus of knowledge. A city, although it is physical and occupies space, is primarily a cultural construct. Place, position, proximity, locus, and movement constitute a variety of different relationships far beyond physical space and volume. With this extended range, we may expect to find that spatial analogies are widely used in imagery relating to the organization of knowledge.

Otlet has been the focus of much attention, so much so that he would be understood better if more attention were paid to other significant thinkers with related interests, thereby allowing Otlet to be seen in the wider context of his field. So, next, we turn to some spatial ideas of other thoughtful leaders.

Martin Schrettinger (1772–1851) was a Bavarian monk who sought radical improvement in library service. He coined the phrase "library science" and, in 1808, published a textbook on this subject, *Versuch einer vollständigen Lehrbuchs der Bibliothek-Wissenschaft.* Schrettinger opposed attempts by his predecessors to arrange their collections according to Nature (or the Mind of God). Following Kant, he argued that we could not know the mind of God and, even if we believed that we did, we could never know whether we understood it correctly. Instead, in a spirit that anticipated Melvil Dewey, Schrettinger argued that library service needed simple pragmatic spatial arrangements complemented by catalogs to minimize dependence on a librarian's personal knowledge of resources (Garrett, 2004).

Melvil Dewey (1851–1931) was dedicated to efficiency and was, as a result, very interested in questions of space. He promoted the important move from fixed location (assigning volumes to particular positions on specific shelves) to relative location (shelving books according to their position in a classification scheme), thereby ensuring that all books on the same topic were shelved together and maintaining the preferred collocation of related topics however the collection or the physical shelving might change. He also championed the use of decimal notation for library classification because decimal notation is infinitely hospitable to expansion at any point. A space can always be created for an additional topic however knowledge might expand. Also, his use of standard auxiliary tables to augment his basically hierarchical classification moved library classification toward a multidimensional design, a process significantly furthered by Otlet and LaFontaine in the Universal Decimal Classification and, later, by S. R. Ranganathan, B. C. Vickery, and others, resulting in the current orthodoxy of faceted classification.

Wilhelm Ostwald (1853–1932), Nobel laureate in chemistry, was very interested in the organization of science and documentation. He was inspired by Otlet to establish his own, similar documentation institute in Munich, Germany, and he used a striking spatial analogy. He noted that workers in agricultural, industrial, military, and governmental occupations were generally organized on a geographical basis: a farm, a factory, or a territory. Intellectual workers, however, such as scientists and inventors (in those days before Big Science and large research and development laboratories), tended to work in isolation, like islands in an archipelago. The resulting lack of communication and community hindered progress, so what was needed were bridges linking the islands (the isolated individual intellectual workers) to each other to facilitate the circulation of ideas. Accordingly, Ostwald named his institute Die Brücke (The Bridge) and adopted the image of a bridge with a rising sun bringing the dawn of a new era of more efficient scholarship (e.g., Bührer & Saager, 1911, front cover).

Much attention was devoted at The Bridge to spatial efficiency through standards and careful design. Shelving documents of standard sizes on shelving of optimal dimensions could allow remarkable improvements in the effective use of space (Bührer, 1912). Ostwald developed a "World Format" (*Weltformat*) system of paper sizes, which, with small revisions, become the current international standard for paper sizes (ISO 216, A4, etc.).

Ostwald and his colleagues at The Bridge, Karl W. Bührer and Adolf Saager, developed the monographic principle whereby texts could be reduced to basic conceptual units ("monos") that could then be related to each other in various ways to express or even, possibly, create new concepts. A record of all known basic concepts and relationships could constitute a "world brain," and the flexibility of card files would allow the world brain (an encyclopedia on cards) to be continuously updated. The analogy they invoked was Gutenberg's moveable, reusable type: the letter "e" might help compose *Ghent* this week, *Otlet* next week, and *bridge* the following week (Ostwald, 1912). Better yet, since concepts exist in multiple semantic and syntactical relationships, Ostwald believed that a combinatoric method whereby all possibilities were explored would allow the best combination to be identified through systematic examination of all possibilities (Hapke, 2004). This was a positional, rather than a spatial, approach, but positional arrangements are locational and therefore spatial.

Emanuel Goldberg (1881–1970), a former student of Ostwald, addressed spatial issues in a very direct way through the extreme miniaturization of documents. In 1925, Goldberg demonstrated microdots with texts still legible through a microscope at a scale so small that the complete texts of fifty entire Bibles could be contained in one square inch. Although microdots were used for clandestine messages, the reduction was too small for most practical purposes. However, the problem of discovering relevant microfilmed documents led Goldberg to develop a type of electronic search engine of a kind that was later popularized by Vannevar Bush's microfilm rapid selector and was the basis for Bush's mythical Memex (Buckland, 2006, chaps. 14 & 19).

Because documents could be contained very compactly on microfilm, the space problems of libraries could be mitigated. Further, because microfilms could be copied and distributed, they could remove the need to travel to libraries. For these two reasons, microfilm was recognized as conquering distance in much the same way as radio, aviation, and, now, the Internet (Buckland, 2006, chap. 10).

Suzanne Briet (1894–1989), librarian, documentalist, and feminist, was, in a way, Otlet's heir as theorist of documentation. One of the ideas she advanced was that documents acquire their meaning from how they are positioned in discourse. A wild antelope on the plains of Africa acquires a new and different status if captured, taken to a zoo, placed in a labeled cage, assigned a scientific name that positions it within a taxonomic system,

and, generally, placed in scientific context in articles, encyclopedias, and textbooks (Briet, 1951, pp. 7–8; 2006, pp. 10–11).

Briet also used a nice spatial analogy when she described the dynamic relationship of the researcher and the librarian collaborating in the search for relevant documents. The documentalist's work, she wrote, is like that of "the hunter's dog, out in front—guided, guiding" [comme le chien du chasseur—tout à fait en avant, guidé, guidant] (Briet, 1954, p. 43).

Robert Fairthorne (1904–2000), a man of exceptional clarity of thought and of expression concerning information science, deserves mention for his recognition of the essentially spatial character of indexing and retrieval. He wrote: "First all retrieval systems demand marks of some kind; entries on reference cards or lists or on the documents themselves. . . . An object can be marked by changing it intrinsically in some recognizable way—as by painting it, punching a hole, or introducing it to a skunk. This I call 'inscribing'. Or it can be changed relative to its environment by putting it upside down, on one side, in an inscribed pigeon hole, and so forth. This is called 'ordering' the item. Better terms for less formal contexts are 'marking' and 'parking'" (Fairthorne, 1956, p. 65; 1961, pp. 84–85.)

Otlet's Spatial Ideas About Information Systems

We started with some examples of Otlet's spatial analogies that we found to be traditional, conventional, even banal. Rather than being original or subtle in making an argument, they are forceful and loudly declarative, as Otlet's writing tended to be. We now turn to Otlet's descriptive use of spatial ideas in the design of information and information systems.

The expansive character of the decimal notation championed by Dewey is shown elegantly by Otlet in radiating, subdividing segments in figure 4.

The multidimensionality of knowledge that came to be reflected in faceted classification is difficult to represent graphically on the printed page. Otlet used the image of an unfolding box in figure 5 to show five facets as *dimensions*: subject, place, time, form, and language.

More striking is Otlet's graph showing how a document could be represented in six-dimensional space by floating one freely rotating three-dimensional graph within another and the explanation: One can represent these six categories of data with a three-dimensional cube (1, 2, 3) that moves on three major axes (4, 5, 6) (reproduced in van den Heuvel, 2008, p. 148; detail in Figure 6). If we understand this graph correctly, the inner rotating three-dimensional graph could have additional rotating three-dimensional graphs nested within it to increase the dimensionality to nine and higher, but only one point at a time can be marked when more than three dimensions are used.

Otlet was very interested in the use of technology to cope with distance. He pioneered the use of microfilm and wrote eloquently of telecommu-
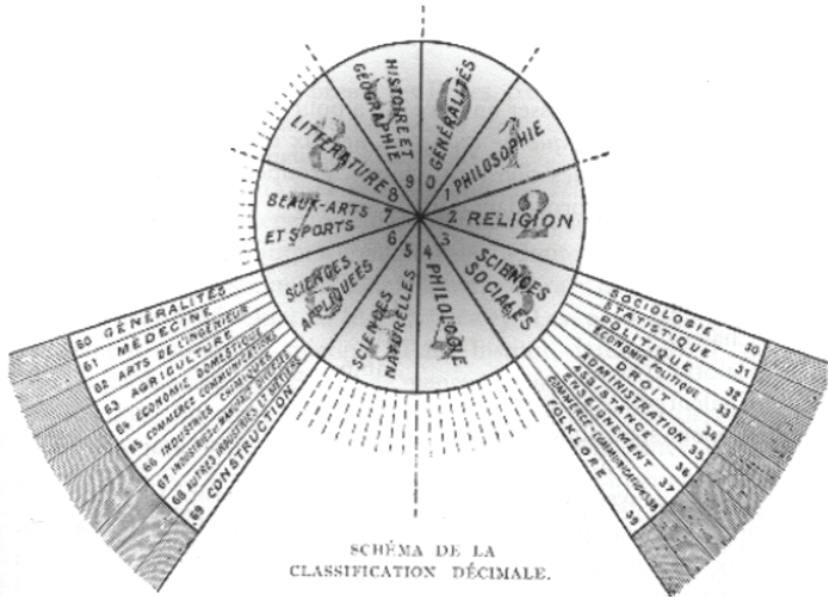
Figure 4. The expansive properties of decimal classification (Levie, 2006, p. 57).
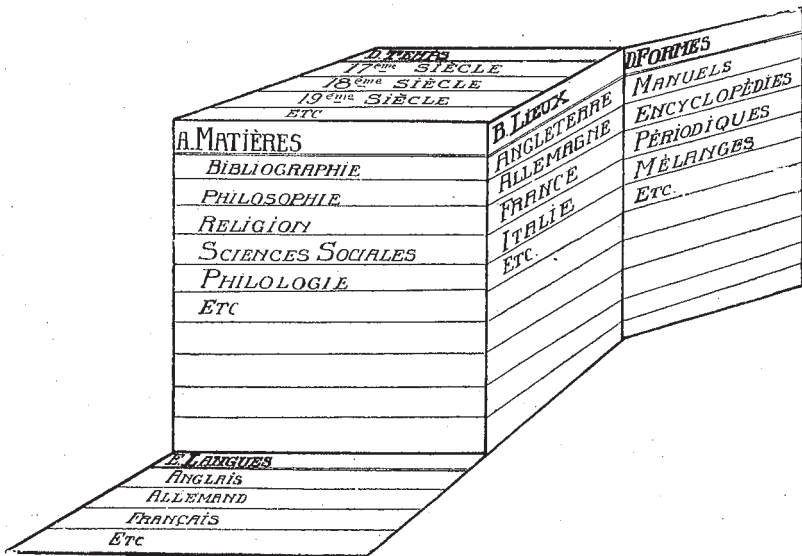

Figure 5. Otlet's image of an unfolding box to show five dimensions (Otlet, 1934, p. 378).
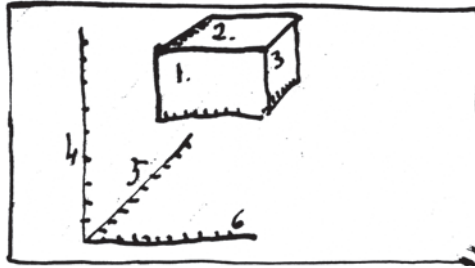
Figure 6. Otlet's six-dimension graph (van den Heuvel, 2008, p. 148).

nications, and in 1925 he must have been among the very first to envision reading distant texts on a desktop television screen. His organizational response to distance is the hierarchical network shown in figure 7. Otlet's international visions always have a world center!

Unlike Ostwald, Otlet, despite his innovative use of microfiche and microform and his interest in standards, does not seem to have been much concerned with the efficient use of space. At least, his reckless collecting and relentless quest for the creation of a world center and new world libraries in Geneva or elsewhere suggest not. Where his graphic imagery becomes more interesting is in his sustained efforts to evolve new forms of "the Book" that would lack the multiple constraints and rigidity of the printed codex. Among his most charming images is one of concepts being physically poured from a large codex book into the more flexible format of a card file.

When we compare the Otlet's thoughtful use of spatial imagery in these examples with the relative banality of those with which we started, we can see that they are different in kind as well as in quality. The examples initially considered are rhetorical statements about the world and his aspirations to improve it. The final set of examples are descriptive and prescriptive design statements about documentation, about processes of organizing knowledge.

Conclusion

What we also find, once we look, is that it is difficult to represent relationships without spatial references, at least positioning, whether using diagrams, flowcharts, scales, or natural language. Of a friendship, for example, one might say, "We were once close, but he became more distant." Studies in cognitive linguistics are revealing just how fundamentally we think in spatial terms.

It is clear from these varied examples that discussion of documentation commonly includes spatial analogies and that spatial issues run far deeper
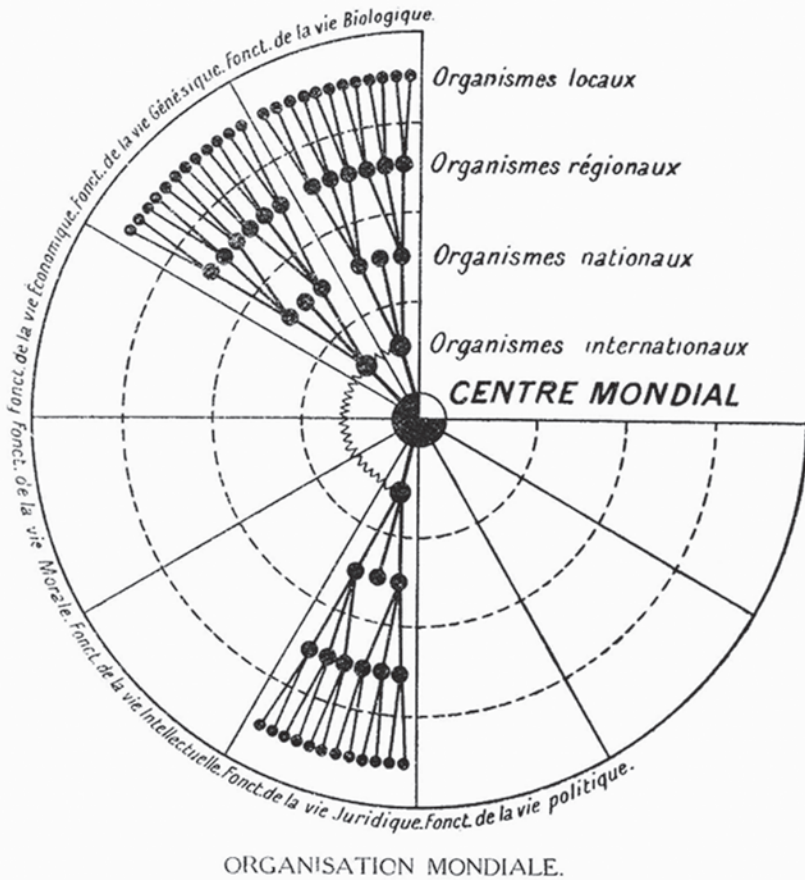
Figure 7. Otlet's design for a world network (Otlet, 1934, p. 420).

than mere analogies. *The organization of information is profoundly spatial.* Perhaps it could not have been otherwise. Documents occupy space, and space constraints affect what is economically (hence politically) feasible. Distance deeply affects the use of documents as well as communication between intellectuals. Texts and other objects are considered to be documents *because* they are considered meaningful, but what meaning they are perceived to have depends on how they are *positioned* within their context.

The spatial theme could be explored more widely. For example, much of modern information retrieval is based on the vector space model and retrieval *is* a matter of positioning, of partitioning documents into those retrieved and others not retrieved, or into more gradually ranked subsets (Buckland & Plaunt, 1994).

The examples we have noted are sufficient to conclude that to a significant extent librarianship, documentation, and information science are profoundly engaged in struggles with space, location, and arrangement, and nowadays this engagement is moving into cyber*space.*

ACKNOWLEDGMENTS

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