**Mentefacts as a missing level in theory of information science**

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**Abstract**

*Purpose:* The current debate between two theoretical approaches in library and information science and knowledge organization, the cognitive one and the sociological one, is addressed in view of their possible integration in a more general model.   
*Approach:* Personal knowledge of individual users, as focused in the cognitive approach, and social production and use of knowledge, as focused in the sociological approach, are reconnected to the theory of levels of reality, particularly in the versions of Nicolai Hartmann and Karl R. Popper ("three worlds"). The notions of artefact and mentefact, as proposed in anthropological literature and applied in some knowledge organization systems, are also examined as further contributions to the generalized framework. Some criticisms to these models are reviewed and discussed.   
*Findings:* Both the cognitive approach and the sociological approach, if taken in isolation, prove to be cases of philosophical monism as they emphasize a single level over the others. On the other hand, each of them can be considered as a component of a pluralist ontology and epistemology, where individual minds and social communities are but two successive levels in knowledge production and use, and are followed by a further level of "objectivated spirit"; this can in turn be analyzed into artefacts and mentefacts. While all these levels are relevant to information science, mentefacts and their properties are its most peculiar objects of study, which make it distinct from such other disciplines as psychology and sociology.   
*Value:* This analysis shows how existing approaches can benefit from additional notions contributed by levels theory, to develop more complete and accurate models of information and knowledge phenomena.

**1: Introduction: competing paradigms in LIS and KO**

This paper discusses some aspects of currently dominating theoretical approaches to library and information science (LIS) and knowledge organization (KO).

We will consider LIS and KO together as they are clearly related fields, although the exact nature of their relationship can be debated. *Knowledge* may be commonly understood as a substantial corpus of *information* that is structured in some systematic ways. KO in a strict sense is usually interpreted as "mostly affiliated with library and information science" (Hjørland, 2016, section 1), in that many of its principles and techniques have developed in the professional context of library and documentation services. However, in a broader sense, KO also concerns the intellectual structure of knowledge in encyclopedic treatments, in teaching, in organization departments, in philosophy of science and in culture in general; LIS, on the other hand, focuses on information services and includes such practical aspects as management of services and staff, library architecture, technologies for processing and storing information, that are not central to KO. Therefore it seems to be preferable to see LIS and KO as intersecting fields.

The theory of LIS and KO involves both ontological and epistemological aspects. Ontological aspects concern the place of the objects studied in LIS and KO within general knowledge frameworks, that is, what these objects exactly are and which relationships they have with other kinds of entities, such as materials or people. For example, one can claim that the objects of LIS and KO are intellectual contents, or works, or documents, then discuss where these entities should be listed in a general system of knowledge.

LIS-KO epistemology discusses which are the best approaches to perform research and gain understanding in these domains. This depends on methodological choices (e.g. user studies, bibliometric approaches, abstract approaches) as well as on the ontological conceptions themselves. For example, Floridi (2002) considers "information" to be a fundamental entity ontically involved in any material, living, psychic or social phenomenon, and LIS as "applied philosophy of information"; consequently, authors accepting his view, like Bawden and Robinson (2018), can understand LIS as a widely encompassing domain, which should be addressed by general principles covering several sciences, rather than just by laws with an application limited to the technical procedures and praxis of information services. That is, if everything is information, then information science can in some way be relevant for studying everything. In this paper the ontological status of the objects of KO and LIS will be discussed, which will also have epistemological consequences.

In recent decades, two major paradigms have been competing in LIS and KO theory: the cognitive approach and the sociological approach (Hjørland, 2002). The cognitive approach emphasizes the personal experience of individual knowledge users, and has been applied especially in computer science and in studies of information users: "The cognitive view in information science [...] was based on the view that the study of how humans search and index/classify information is based on universal rules inherent in the human mind (and connected to human neurobiology). In other words, the principles of information science can be uncovered by the study of the human mental system, considered to be universal (as opposed to a culturally and socially shaped mind)" (Hjørland, 2017, section 3.4).

The sociological approach, instead, considers knowledge as an expression of discourse communities in specific social contexts, and accordingly proposes domain analysis as a basic method in LIS and KO. In this view, knowledge is basically produced by social interactions among individuals through intersubjective processes (Berger and Luckmann, 1966). "A sociological approach means that the focus is on knowledge/information/document production, mediation and utilization, understood through social and cultural perspectives. This perspective includes the analysis of the roles of all actors, institutions, systems, media and documents. It also means that explanations for empirically observed phenomena are sought in social conditions rather than in universal cognitive processes" (Hjørland, 2017, section 3.6).

For example, Bawden (2016) reported from the COLIS 2016 conference in Uppsala that "[t]he debate between the cognitive and domain analytic approaches in information science rumbles on #colis9", where the two perspectives were represented by Jeppe Nicolaisen and Birger Hjørland respectively.

The central thesis of this paper is that, despite having been characterized as alternative, cognitive and sociological approaches can be viewed as complementary and are in need of being completed with a third component. This third additional perspective involves a greater consideration of certain kinds of entities that have been described by different thinkers variously as "objectivated spirit", "World 3" or "artefacts and mentefacts".

In order to develop such an analysis, the first step consists in reconnecting both individual minds, as considered in the cognitive approach, and social communities, as considered in the sociological one, to the framework of the theory of levels of reality.

**2: The methodological contribution of levels theory**

The theory of levels of reality (Poli, 2001) provides an important intellectual tool to better analyze the relationships holding between different principles of explanation. This theory identifies a series of different levels in reality, each resting on lower levels but also showing novel emergent properties that are not owned by the lower levels. Among the main levels that are commonly acknowledged by most authors are matter, life, mind, and society; these can be further analyzed into successive layers, e.g. life includes the layers of cells, organisms, and populations.

Dependence relationships between levels generate an order of them. Its simplest representation is that of a linear sequence (life depends on matter, mind depends on life, etc.), although more complex networks are also explored (in Poli's model minds and societies coevolve, hence are reciprocally dependent; however this may be related to definitions: if "minds" are allowed to include awareness in animals, they clearly precede the development of civil "societies" based on human languages).

While the cognitive approach emphasizes the role of mind in the production, organization and retrieval of information, the sociological one emphasizes the role of society. Clearly, however, both mind and society are involved in these processes and interact through inter-level relationships. The most oustanding philosopher of levels, Baltic German ontologist Nicolai Hartmann (1882-1950), observed that generalizing what has been understood for one level and taking it as the only relevant principle for understanding the whole of reality is a philosophical fault, that can be described as "monism"; this fault is commonly found in many philosophical and theoretical systems, because it suits the human need for unity in knowledge (Hartmann, 1953, ch. 6). On the other hand, full understanding of such complex phenomena as information and knowledge needs a more complete, pluralistic approach.

Hartmann identifies four major levels ("strata") in reality: the material, the organic, the psychic and the spiritual. Information, knowledge and their organization belong to the spiritual level. Hartmann's term *spirit* (*Geist*) comes from the German philosophical tradition and should be understood in a broad sense, involving not just spirituality or religious phenomena but anything related to human culture.

The stratum of spirit is further analyzed by Hartmann into three layers: "[t]he category of the spirit is divided into personal, objective and objectivated spirit. Personal spirit is the spirit of the individual; objective spirit is the living spirit of communities; and objectivated spirit characterizes the products of spirit" (Poli, 2016). These three layers of spirit offer a suitable model for analyzing the phenomenon of knowledge. Indeed, personal spirit, also reminding of Polanyi's (1958) "personal knowledge", has to do with the knowledge of individual information users that is focused in the cognitive approach; objective spirit has to do with the social sharing of knowledge as focused in the sociological approach; and objectivated spirit has to do with the structure of knowledge in itself, as a product of humans subsisting after separation from its original producers.

Unlike those of personal spirit and objective spirit, the layer of objectivated spirit has not been considered by mainstream approaches in information science widely enough. This may be due to implicit reference to ontologies not acknowledging any more layer over the social one, as it will be seen in section 5. However, the framework of levels theory suggests that the layer of objectivated spirit should also be considered, in order to build a more complete theory of LIS and KO. Indeed, the same logic that recommends to avoid monisms and to develop models accounting for all levels of reality suggests that the layer of the products of intellectual activity of minds and communities, including such entities as stories, symphonies or theories, should not be omitted in analysis. While knowledge and its organization do presuppose individual minds and discourse communities, their most characteristic properties lay at this higher level of intellectual products. No doubt, biographical, sociological or historicist approaches can contribute to understand the context in which certain concepts have been connected to others by certain communities to produce knowledge, as is done in domain analysis. However, says Hartmann(1936, ch. 1), such emphasis on the historical origin of a theory does not fulfill the task of those who want to address genuine philosophical problems completely, as the conclusions of a theory may go beyond, or even contradict, the original form in which it arised. This makes the form of knowledge after separation from its original producers another necessary component in modelling information phenomena.

"Objectivated spirit"is a philosophical expression that might be misinterpreted by those not familiar with Hartmann's ontological theory. Indeed, *objectivate* is sometimes defined as a synonym for *objectify* and the latter term can carry quite pejorative connotations in English. However, similar ideas that have been discussed by other authors under different terms may be of help to grasp our point.

Among them are Karl Popper's notions of "objective knowledge" and of "World 3" (Popper, 1972; 1978; 1992), which also refers to the products of thought as entities autonomous from the material and mental levels that have produced them. The three "worlds" postulated in this model are broadly listed by Popper as those of matter, of consciousness and of culture (Popper and Eccles, 1977, part 1). Popper's epistemology is especially concerned with the nature of knowledge and its development through theories. To him, theories belong to World 3 and as such have an autonomous status, similar to objectivated spirit, so that once a theory has been formulated, its full properties can be discovered and considered even independently from the particular conception of its original creator. For example, a theoretical physicist may postulate the existence of certain particles that behave according to some mathematical laws; then, on the basis of these laws, another physicist can predict that the particles will behave in a given way, and yet another team of scientists can perform an experiment trying to detect such predicted behaviour, in order to corroborate or falsify the theory: the experiment was not imagined by the original proposer, but has emerged later as a consequence of the theory itself.

Although not all epistemologists accept Popper's three-worlds model, an important reflection on its potential relevance to information science was contributed by Brookes (1980) in the first paper in a series on the foundations of the discipline. In his view, "what information science needs at its roots [...] is an *objective* rather than a *subjective* theory of knowledge" (Brookes, 1980, 127, emphasis original). A Popperian view of knowledge has also been adopted by Swanson (1980), while Serrai (1981; 1983) has discussed its application to cataloguing theory.

Neill (1982) basically supported Brookes' and Swanson's suggestion that World 3 is relevant to information science, and noticed that "[t]he great library classification schemes ‒ Dewey, Colon, Bliss ‒ are classifications of knowledge *as it is found in world 3*". Thus, levels theories such as Hartmann's and Popper's are relevant to LIS-KO in two ways: to assess the status of information and knowledge as objects of study, and to order all objects of study in knowledge organization systems (KOS). The latter application has indeed been implemented in general classification schemes by the Classification Research Group, Dahlberg, Gnoli and others (Kleineberg, 2017, section 3; Gnoli, 2017).

Additional bibliography of authors referring to Popper's model is provided by Bawden (2002), who supports it by discussing its application to actual examples in health information. He describes Brookes' papers as "seminal writings generally regarded as a foundation of the 'cognitive' approach to information science" (Bawden, 2002, 53) and this author as "generally accepted as the originator of the highly influential 'cognitive approach' to information science, and to information retrieval in particular (Ingwersen and Järvelin [2005])" (Bawden, 2008, 416). Cognitivism, however, is mainly a psychological theory focusing on the way individual knowledge is acquired and works, inspired by such authors as Piaget, Miller, Chomsky or Fodor: this would make cognitivism more suitable to be associated with World 2 of subjective knowledge than with World 3 of objectivated knowledge. Talja and colleagues also find that "[t]he cognitive viewpoint in IS, as initially formulated by Brookes, Belkin and colleagues and Ingwersen, does not represent cognitivism [...] The cognitive viewpoint in IS differs from cognitivism by laying major emphasis on the way in which knowledge is actively built up by the cognising subject, that is, by the individual mind to serve the organisation of internal and external reality" (Talja *et al.*, 2005, 81, references omitted, cited in Hjørland, 2017).

This confusion may be another symptom of the common failure to acknowledge the additional level of objectivated spirit (World 3) and to separate it from that of personal spirit (World 2). Authors criticizing the cognitive approach then should make clear whether their polemical target is the primacy of personal spirit or that of objectivated spirit.

**3: Mentefacts as objectivated spirit**

Another interesting notion discussed in KO is that of *mentefact*. Barbara Kyle introduced this term, as a parallel to *artefacts*, in the context of her research on general classification,to group classes of phenomena not very different from those covered by Hartmann's objectivated spirit or Popper's World 3 (CRG, 1964; Kyle, 1965; see section 4).

The history of this term, in its American spelling *mentifacts*, is quite long and apparently forgotten, as the current *Wikipedia* (2018) entry erroneously credits Julian Huxley for coining it. As a matter of fact, it was already introduced some decades before Huxley in E. E. Eubank's *The concepts of sociology ‒* a text that Kyle herself could have seen given her special interest in the classification of social sciences, although she does not refer to it. Eubank (1932, 214, emphasis original) lists the "major divisions of the factors controlling society" like this:

I. *Bodily factors* [...]

II. *Geographic factors* [...]

III. *Societary factors:* Controls originating in the world of men.

1. Through direct interaction with human beings

2. Through the influence of human products:

a. Group *ways* (folkways and mores)

b. Group *feelings* (attitudes, sentiments, and beliefs)

c. Group *creations*

(1) Artifacts (material creations)

(2) Mentifacts (mental creations)"

He then illustrates the concept of mentifacts in subsequent parts of his treatise:

"Only living men act, feel and think; and when they pass from the scene their earthly acting, feeling, and thinking, *per se*, pass with them. A third major of culture remains, however, which does not pass with its makers. This is that body of elements external to man's physical self which we designate as his creations. They are achievements of his hand and brain which, when once created, stand forth as existents in and of themselves. Because of this separability from their source they are societary products in a way that differs from behavior and feelings (which are also products, of course). They are, so to speak, "constructions" of the group, results of their activity which exist quite apart from the actors or actions whence they originated. Changing the figure, we may think of them as crystallizations of man's mental and physical energies, in much the same way that capital is regarded by the economist as "cristallyzed labor." We may in fact regard them as cultural capital, equipment to be used in the production of further culture.   
These crystallizations occur in two forms, one of which is material in nature, the other non-material. The first we call *artifacts*, the term covering all physical objects made by man, or man-made modifications of any materials of nature. […]   
The second we may speak of by contrast as *mentifacts* [footnote: "I am indebted to Mrs. Eubank for this term"]. These include all non-material mental creations which are sufficiently "crystallized" to be subject to description and analysis, but which are factually separable from their creators. Language as a body of mental concepts (as distinguished from its artifactual form on the written or printed page) comes under this head. The great body of knowledge which the race has accumulated through the centuries belongs here also, as do the systems of thought, the great codes of morals, the great mythologies and philosophies of the world. The fact that these things are all preserved to us in some artifactual form must not prevent us from recognizing that they have an intrinsic psychic reality that is wholly non-material, and which exists for us quite independent of any mechanical device which embodies them. Neither must we confuse them, because they are mental, with the thoughts, feelings, and sentiments previously discussed. *Mentifacts*, like artifacts, must be thought of as purely impersonal creations, entities in themselves; whereas feelings and beliefs are states or conditions or activities of mind or thought inseparable from the person holding them." (Eubank, 1932, 356-357, emphasis original)

As it can be seen, Eubank credits his wife for coining the term *mentifact*. He had two wives during his life: Eva Maude Stephens, married in 1910 but died in 1923, and Jessie Logan Burrall, married in 1928 (*Prabook* n.d.); as the first edition of the book was issued in 1928, the one credited in it is probably the latter (see Robinson, 1920 for biographic information).

In the perspective of Hartmann's and Popper's ontical levels, it is especially relevant that Eubank acknowledges mentifacts as "purely impersonal creations, entities in themselves". Indeed, this agrees with the view that they deserve to be considered as a separate level in the analysis of human knowledge.

Eubank is credited at David Bidney's first mention of mentifacts in his theoretical book on anthropology (Bidney, 1953, 27). Here mentifacts are mentioned among the "cultural capital" or "cultural products" (33) of human culture, then listed more extensively in terms similar to Eubank's ones:

"In addition to material artifacts and "agrofacts" there are conceptual symbols or "mentifacts", comprising language, traditions, literature, and moral, aesthetic, and religious ideals, as well as the various intellectual instruments of scientific research which are valid and objective for the mind which conceives them and reflects upon them as mental phenomena. There are also the social norms and organizations, which we may term "socifacts"..." (Bidney, 1953, 130).

Just two years later, Bidney is cited in turn by biologist and philosopher Julian Huxley, who discusses the idea widely:

"There is not even agreement on the definition of culture, that central anthropological concept: some anthropologists maintain that culture is an abstraction, others that it is the sum of human activities, or the patterns of human behavior within a given society, still others that it includes all "artifacts, socifacts and mentifacts," to use Bidney's convenient terms for the different types of products of a culture or human society" (Huxley, 1955, 9).

Huxley keeps the distinction between mentifacts and other kinds of cultural products. Interestingly, he describes them below as self-reproducing units, which suggests some analogy with genes or characters as the self-reproducing units of living beings. Years later, Richard Dawkins (1976) will also propose the notion of *memes* as cultural reproducing units analogous to genes. The existence of reproducible information units may trigger processes of selection and evolution at various levels of organization (cf. Gnoli and Ridi 2014), which can offer another research perspective for LIS, e.g. by "bibliometrical" evaluation of rates of information reproduction.

"In the most general terms, a culture consists of the self-reproducing or reproducible products of the mental activities of a group of human individuals living in a society. These can be broadly divided into artifacts‒material objects created for carrying out material functions; socifacts‒institutions and organizations for providing the framework of a social or political unit and for maintaining social relations between its members; and mentifacts‒mental constructions which provide the psychological framework of a culture and carry out intellectual, aesthetic, spiritual, ethical or other psychological functions.   
The categories inevitably overlap, since all cultural activities have a mental component, all artifacts have been shaped by mind, all mentifacts have a material basis or vehicle, and all cultures are embodied in societies. Thus a piece of pottery may be both a useful artifact and a beautiful mentifact; socifacts like codes of law and morals incorporate much of spiritual and ethical mentifacts; and we all know how the intellectual mentifacts we call scientific theories and laws become transposed into technological artifacts. Nevertheless, the distinction is a useful one." (Huxley, 1955, 16-17)

This "overlap" is in agreement with Hartmann's theory of levels, where a level does not consist in any specific set of things, but is a metaphysical entity that may pervade a particular thing together with other levels. Thus a piece of pottery is at the same time a manifestation of the material level, as it consists of some material particles, and of the spiritual level, as it has a particular form and decoration which are the result of its maker's knowledge; the latter includes both the layer of its social function (objective spirit, socifact) and that of its cultural technology (objectivated spirit, artefact). Similarly, a book obviously is a manifestation of both matter and culture (artefact and mentefact).

In some mentefacts, the ontical levels of their personal and social origin are imprinted more deeply than in others. The intellectual product known as the *Kunst der Fuge* can be enjoyed today without the presence of its producer J.S. Bach, and one can enjoy realizations of it that Bach may have never imagined (Glenn Gould's versions, for one), as is typical of World 3 entities. However, the fact that its final fugue takes its subject as the name *BACH* (=*B* flat*-A-C-B*) is indissociable from the fact that these four letters were available to the German tonal vocabulary of the 17th century: one could not create such a musical pun in the English or French tonal vocabularies, which do designate certain tones as *A* and *C* but do not designate the tone B as *H* and the tone B flat as *B*. Here, then, a trace of both the mind and the linguistic community that produced the *Kunst* is embedded within the structure of the work itself.

Artworks are included, together with theories and other intellectual and symbolic constructions, in Huxley's treatment of mentefacts:

"Other methods of communication are provided by symbols, and still others by the various arts, notably poetry and drama (including the cinema), painting and sculpture, and in special ways by architecture and music. But with these we reach the last category of cultural components‒those with primarily mental or psychological functions, as against primarily material or primarily social functions. For while language is the medium of communication, the arts provide mentifacts‒organized constructions of significance to be communicated from one human mind to others. [...] Mentifacts thus serve as the psychological framework of culture, the mental organs of man in society. They express awareness or experience in various organized ways‒aesthetic and symbolic as well as intellectual‒and communicate and transmit these organizations of experience to others. There appears to be no accepted term to denote these "awareness organs" collectively. As I have ventured to suggest elsewhere, their function may be called *noëtic*, and collectively they would then constitute the noösystem.

In addition to symbols and works of art, the noëtic components of a culture include rituals and formal celebrations, beliefs and superstitions, mythology and theology, tradition and history, philosophy and science. They include the totality of accumulated and available factual knowledge as well as *the organized formulations of knowledge* provided by mathematics and logic, scientific theories, and philosophical ideas; and finally the assumptions and attitudes that characterize a culture, including the vitally important epistemological premises on which its thinking is conducted". (Huxley, 1955, 17-18, emphasis added)

It is interesting to remark that Huxley uses the phrase "organization of knowledge" several times in this paper. In its conclusion, he remarks "the immensely increased importance [in cultural evolution as opposed to biological one] of mind and mentifacts, notably the accumulation and better organization of knowledge" (Huxley, 1955, 24).

The distinction between artefacts and mentefacts approximately corresponds to that between *tangible* and *intangible cultural heritage* of a place, as adopted in UNESCO conservation programs and other anthropological projects. The notion of mentefact has indeed had a continuing influence in anthropological theory until recent authors:

"Mentifact (sometimes called a "psychofact") is a term coined by Julian Huxley [...]. This concept has been useful to anthropologists in refining the definition of culture. For instance, Edward Tylor, the first academic anthropologist, included both artifacts and such abstract concepts as kinship systems as elements of culture. Anthropologist Robert Aunger explains that such an inclusive definition ends up encouraging poor anthropological practice because "it becomes difficult to distinguish what exactly is not part of culture" [Aunger, 2002]. Aunger goes on to explain that after the cognitive revolution in the social sciences in the 1960s, there is "considerable agreement" among anthropologists that a mentifactual analysis, one that assumes that culture consists of "things in the head" (i.e. mentifacts) is the most appropriate way to define the concept of culture." (*Wikipedia*, 2018; also cf. Fantini and Fantini, 1995).

While attribution to Huxley of the coin of the term is wrong, his influence in adopting and spreading the term is relevant. It may be recalled here that Huxley was a biologist contributing important parts of the modern theoretical synthesis about organic evolution, while he also had broader interests covering anthropology and philosophical humanism. He introduced such notions as *grade* (Huxley, 1959) and *advance* which have a broader relevance to a generalized theory of evolution also covering culture, such as that currently developing as the "extended evolutionary synthesis" (Laland *et al.*, 2015), as well as to the phylogenetic approach to knowledge organization (Gnoli, 2006).

As it can be seen, the distinction between socifacts, artefacts and mentefacts, considered as an array of increasingly evolved grades, can easily be compared to Hartmann's three levels of spirit. Although evolutionary relationships themselves have not been considered by Hartmann, Lorenz (1977) has observed how his ontology fits evolutionary thinking very well. These categories can also be reconnected to the lower levels of being in Hartmann's and Popper's models, in the way shown in Table 1.

*Table 1: Comparison of levels according to different authors*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *levels* | *Bidney; Huxley* | *Hartmann* | | *Popper* |
| culture | mentifacts | objectivated spirit | spiritual stratum | World 3 |
| artifacts |
| socifacts | objective spirit | World 2 |
| mind |  | personal spirit |
| psychic stratum | |
| life |  | organic stratum | | World 1 |
| matter |  | material stratum | |
| form |  | ideal being | |  |

The table makes clear how the anthropologists' distinction of levels is finer than the philosophers' one, in that the products of human intellect are further distinguished into artefacts (material heritage) and mentefacts (immaterial heritage).

Compared to this model, Brookes's (1980, 128) claim that "the practical work of library and information scientists can now be said to collect and organise for use the records of World 3" appears to be exceedingly broad, as LIS is more concerned with mentefacts than with artefacts as such (e.g. with book bindings or paper types). Artefacts like Chinese plates may be relevant to LIS only in that they are sample objects kept in museums and catalogued, or are dealt with in books kept in libraries. What is studied by LIS is especially *knowledge* about Chinese plates, while the discipline focusing on Chinese plates themselves is ceramic art. Confusion between the two has indeed been characterized as the "Chinese plate syndrome" (CRG, 1978).

As previously observed, distinguishing mentefacts from artefacts may be relevant for LIS and KO in two ways: (1) by identifying a relevant class of phenomena to be listed in KOSs, (2) by making the theory of LIS and KO itself more clear. The next section addresses point 1, while the final sections address point 2.

**4: Mentefacts in KO literature**

As mentioned in section 2, levels theory has been applied in knowledge organization to identify main classes in such general classifications as Dahlberg's Information Coding Classification and Gnoli et al.'s Integrative Levels Classification. Both these KOSs are influenced by Hartmann's version of the theory, which includes "spiritual" levels, and they list classes of technical and intellectual products accordingly. On the other hand, while working at a new general classification which should list phenomena instead of disciplines, the Classification Research Group (CRG) referred to Joseph Needham and James Feibleman's versions of the theory, and only applied it to classes of natural phenomena, from subatomic particles to man (Kleineberg, 2017). These views are not incompatible anyway, as they all seek to describe reality as a graduated series of ontical strata. To organize the remaining domains of human sciences, the CRG appealed to the notions of artefacts and mentefacts, which can be functionally equivalent to spiritual levels, as it has been shown above.

The term *mentefacts* can be found already in some working papers by CRG members Barbara Kyle (1963) and Eric Coates (1963), later republished in a collective volume (CRG, 1969, 14; 21-22). However, as a reference for the notion, the Group indicated Kyle's review of the proceedings of a Classification Research conference held in Elsinore (curiously not listed in the journal back issues table of contents online, hence not easy to retrieve). Here, in her informal and personal style, Kyle claimed:

"While in this egotistic vein I perhaps may be allowed to say a word about the term 'mentefact' since I invented it at a CRG meeting. (See CRG Bulletin, no. 8, *J. Doc.*, vol. 20, no. 3, p. 157, 163 [CRG, 1964].) We already had the word artefact used by anthropologists for a man-made article; a subdivision of artefacts, for those which appealed to, or were aimed at, our aesthetic apprehension, was 'work of art'. But there was no useful term for man-made 'abstract entities' which were not 'manufactured' though they might be symbolized or described within an artefact (books, etc.). 'Mentefact' was intended for naming the category of abstract entities such as digit, numeral, equation, maths; letter, alphabet, grammar, syntax, language; value judgment, ethical system, philosophy, etc. 'Mentefacts', like artefacts, with aesthetic qualities, may also be 'works of art'‒e.g. poems and other works of literature and music. Whether an 'elegant equation' is or is not a work of art I will leave to those mathematicians who have aesthetic sensibilities." (Kyle, 1965, 302)

The CRG Bulletin cited in this review indeed reported:

"*Annexe to Minute* 509

*Integrative levels* (Natural phenomena)

1. *Evolutionary* [...]

2. *Fabricated by man* (Artefacts) [...]

3. *Mentally invented by man* (Mentefacts)

Mathematics higher level than digits, linguistic than alphabets.

This line proceeds from unit-ideas to systems of thought or disciplines and art.

4. *Aggregate levels* [...]" (CRG, 1964)

Thus, Kyle seems to have introduced the term *mentefacts* independently from the recently-appeared texts by Bidney and Huxley, though maybe as a reminiscence of a previous reading of some anthropological source. Her examples of mentefacts focus on such phenomena as equations, linguistic sentences or value judgments, in view of their listing in a general classification, while Huxley more broadly considered "the totality of accumulated and available factual knowledge as well as the organized formulations of knowledge provided by mathematics and logic, scientific theories, and philosophical ideas", which is more directly related to knowledge and its organization as a whole.

Kyle's short description also suggests that, within each main class, phenomena can be organized again in an increasing order of integrative levels. Thus, mentefacts include such elementary knowledge units as digits and alphabets then proceed towards increasingly complex constructions. In the case of KO, conceived as belonging to mentefacts, concepts and their relations may then be taken as the lowest-level units, while whole systems of knowledge such as a general KOS may lie at the highest level.

Later in the same bulletin mentefacts are listed, both in text and in a table, among the integrative levels of phenomena that should form the main classes of the new drafted classification. The table is reproduced in the CRG collective volume (CRG, 1969), where mentefacts are mentioned again by coauthors Helen Tomlinson (especially p. 36 and 75, also p. 30-31, 40, 43, 54, 57) and Derek Austin (113, 123; cfr. Austin, 1969, 79), although Tomlinson seems to have interpreted the term in a way different from Kyle's original one. Indeed, in the next CRG Bulletin a discussion is reported concerning the precise interpretation of mentefacts:

"*Minute 743, on word forms*. A long discussion on the meaning of 'Mentefact'; it was felt that we had strayed from the original use and were confusing it with 'abstraction' or even 'property'" (CRG, 1968, 277).

"*Minute 892, on artefacts*. Purpose might prove to be a general principle for grouping artefacts and mentefacts, once we had established a basic sequence of naturally occurring entities" (CRG, 1968, 285).

Mentefacts are also correlated with "Symbolic" concepts in J.P. Guildford's typology of concepts in the intellect (CRG, 1968, 275) and with "Abstracts" in a table of unit concepts that had been proposed by CRG member J.E.L. Farradane (276). Unfortunately, the same bulletin has opened with the following note:

"It was with deep regret that the Group heard of the death of Barbara Kyle in April 1966. Throughout a long illness she maintaned an interest in the work of the Group, attending meeting whenever possible and contributing greatly to its discussion. Her lively mind can be assessed from the following lines, sent to the Group from hospital in February 1965, and duly minuted:

Minute 702. The following message was received from Barbara Kyle:

'He sought it with links, he sought it with roles,   
He pursued it with terms tied and free,   
But he failed to retrieve it, with all his controls,   
For the concept he thought

Would never be sought

Was the one that was asked for by me'." (CRG, 1968, 273)

Although the notion of mentefacts has been cited again by later CRG authors, Kyle's death may have slowed further exploration of it in classification literature. Also, the potential connection between anthropology and KO seems to have been lost, of which a clue may be the coexistence of the two different spellings, *mentefacts* and *mentifacts*. This alternative reflects that between *artefacts*, more used in Britain, and *artifacts*, more used in the U.S.A. The British form *mentefact* has indeed prevailed in KO literature of English origin, while the American one *mentifact* has prevailed in anthropological literature. This is especially unfortunate for our digital era, as it determines a separation in information retrieval between the two domains using the notion. Connecting these domains, and both of them with such philosophical ideas as objectivated spirit and World 3, appears to be a promising operation in view of a broader theory of LIS and KO.

**5: "Do we really need" mentefacts?**

To reconnect with our initial overview, it is our thesis that the notion of objectivated spirit, and that of mentefact in particular, are useful to make the theoretical bases of information science more clear, with respect to the current dialectics between the cognitive and the sociological paradigms. As we have seen, the general picture is more complex: minds (of information users) and social relationships (in knowledge production and use) are but two levels among others. In particular, artefacts and mentefacts are further levels laying on the top of them. These additional levels should be taken into account in order to build a more complete, pluralistic theoretical framework for LIS and KO.

Just like exclusive emphasis on one particular level leads to forms of monism (section 2), fail to acknowledge one or more levels imply various forms of reductionism. For example, Thatcherian reductionism famously claimed that "there is no such thing as society", thus reducing all political and economical analysis to individual (or familiar) preferences. As it is evident from our table above, Popper also omits the level of society in his list of the three "worlds": indeed, his philosophy tends to emphasize the role of the individual thinker and her intellectual products. This kind of reductionism can also be found in some applications of the cognitive approach, where they assume that society is irrelevant to the analysis of knowledge processes. Hjørland has often criticized this view, advocating for a sociological turn in the epistemology of LIS and KO (e.g. Hjørland, 2017).

But just in the same way, a sociological reductionism can assume that no level exists of objectivated spirit or World 3, thus reducing the analysis of information, knowledge and their organization to a sociological problem only. Indeed, not all authors in information science have been ready to hypostasize World 3 as a relevant ontical level. Shortly after the formulation of Popper's three-levels model, Bloor (1974) argued that his abstract idea of objective knowledge should be "demytologized" and "demistified". To this Grove has replied that, while human thought clearly is a social product, "the *results* of human thought, the *contents* of human thought, the *ideas* that thought express, once produced (and especially when recorded publicly in some recoverable form) exist independently of the minds that produced them; and independently of the particular social and cultural conditions under which they were produced" (Grove, 1980, 174, emphasis original).

Some information scientists have been skeptical that the cultural level is substantially different from that of social phenomena, and relevant to LIS theory as a consequence. Rudd (1983) thus wondered "do we really need World III?". He observed that Popper's objective knowledge lies at the social level (as Hartmann's objective spirit indeed does), but this is lacking in Popper's model (as it has just been noticed); furthermore, World 2 and World 3 would sometimes be mixed in Popper's writings. He advocated for "a much more dynamic concept of information which says that it is meaningless to speak of information divorced from people (both creators and users)" (Rudd, 1983, 101), as otherwise "an information science on these terms is surely trying to fashion a discipline from the tip of the iceberg" (104). More recently, Capurro and Hjørland (2003) have also found that "we simply do not need Popper's World 3 in order to explain informational processes", as it would just consist of "signs in the Peircean sense". However, Bawden and Robinson (2016, 36) comment that "Capurro, with other commentators, may have underestimated the value of Popper's ontology as a natural conceptual framework for LIS".

One can agree with Rudd that the social level, and consequently the sociological approach, are also needed for building a complete model of information science. Levels theory (someway evocated by Rudd's iceberg metaphor) indicates that the cultural level indeed lies on the top of the social level, which in turn lies on the mental level, so that all these levels and the interactions between them should be taken into account. On the other hand, the existence and relative autonomy of the top level can be corroborated by various examples.

One argument to show that we do need mentefacts in our models is that some phenomena can only be accounted in terms of them. Consider, for example, fictional characters, such as Pinocchio or James Bond. They do not belong to World 1, as they do not consist of real organic or wooden bodies; nor to World 2, as they do not experience any real subjectivity. They only exist inasmuch as creations of the human spirit in World 3. Also, they are continuing to exist today well after the death of their creators, Carlo Collodi and Ian Fleming; from the pages of their original books, they have been able to move to cinema, cartoons and gadgets, by taking in turn the consistence of wooden, plastic and digital objects or the living faces of Sean Connery, Roger Moore, Andrea Balestri etc. What can they be but mentefacts?

Another basic criterion to check whether a class of entities is really needed in an ontological model is to question whether it has any causal power. Do mentefacts have any causal power on other classes of phenomena? Clearly, thinking systems and other cultural products have been very influential on the history of humankind. Theories, both successful and wrong, have determined the destiny of many people through their application. Aerodynamic theory involving mathematical calculations is needed to design airplanes, by which people now move much faster and air is significantly more polluted. Applications of Alexander Fleming's theory about the observed effects of penicillin on some bacteria have saved millions people. Individuals believing that their god ask to sacrifice themselves to kill "unfaithful" people may act against their self-preservation organic inclinations as a result of a fundamentalist theory. Even artworks may inspire people and lead them to action.

To focus on a specific example, we may consider the theory that Earth is roughly spherical, which gradually replaced the alternative theory of a flat Earth during Late Antiquity and the Middle Ages. This theory was a necessary premise to persuade European explorers to organize ship voyages westwards to promote new trade routes. As an effect of this theory and various theoretical estimates of geographical distances, Christopher Colombus planned to reach Japan from Portugal by navigating westwards and actually sailed with three ships; the estimates were inaccurate, so that he could have not reached Japan with those resources, but he found America in-between. Magellan and Elcano's expedition (1519-1522) then achieved the circumnavigation of Earth, thus demonstrating the theory of sphericity. What is relevant to our argument is that a theory, belonging to the level of mentefacts, has had causal power on behaviour at the levels of material ships and living sailors. This is a case of downward causation (Campbell, 1974) from the higher level of mentefacts to the lower levels of matter and life. Without acknowledging the level of mentefacts, certain historical phenomena could not be understood.   
 In the special case of theories by which knowledge is organized in KOSs, which are also parts of mentefact, Lambe (2015) showed how different categorizations in e.g. police archives may even lead to survival or death of a person. Similarly, classifying endangered animals in a separate class or not may lead or not to adequate conservation acts, hence determine whether the whole group survives: as recently shown by Gippoliti (2016), although endangered Apennine populations of brown bears have a unique skull morphology, European conservation policies are based on a taxonomy that does not distinguish them from other varieties of brown bears, thus failing to preserve them appropriately by specific laws.

As mentefacts are needed to account for the existence of some phenomena, and may have causal powers over the lower levels of reality, they deserve to be a separate main class in general systems, and not to be overlooked by theory of information science. Quite on the contrary, they are the component that contains the most peculiar properties making information science different from sociology or psychology. While societies and minds are indeed relevant as the ontical substrate of knowledge, as they are needed for knowledge to be produced, information science should not be reduced to sociology or to psychology. It should develop as an autonomous field just as mentefacts have an existence autonomous from its original producers.

**6: A pluralistic theory of LIS and KO**

What our enquiry suggests, in the end, is integration of existing theories of information science, focusing on either individual cognition or social construction of knowledge, into a broader, pluralistic framework taking all the relevant levels of reality into account. These include the psychic level, the social level and the cultural level. The cultural level, that is the level of objectivated spirit, World 3 etc., can be further analyzed into artefacts and mentefacts.

An important part of this framework consists in the inter-level relationships: the psychic, the social and the cultural are not independent but tied in this very order, so that e.g. there cannot be culture without minds (while the opposite is true, e.g. in the case of animal minds), nor interactions between mind and culture that are not mediated by society.

It seems that, in the recent debate between the cognitive and the sociological approach, some argumentations have conflated the former with some characters of mentefacts: this may be the reason why, as it has been seen, Talja *et al.* (2005, 81) have found that "[t]he cognitive viewpoint in IS differs from cognitivism by laying major emphasis on the way in which knowledge is actively built up". Thus Hjørland (2017) can describe the cognitivist perspective in LIS as focusing on "the human mental system, considered to be universal (as opposed to a culturally and socially shaped mind)". In these reconstructions, the cognitive approach would assume a universal mind that produces universal, supposedly objective, knowledge and there would be no need to distinguish any further level; the main difference between the competing approaches would then reside in universalism as opposed to warrant of local perspectives. However, levels theory shows that personal spirit is not the same as objectivated spirit. Indeed, objectivated knowledge may itself be either local or universal (e.g. a myth in a particular culture vs. an international scientific theory), just as social knowledge may be either local or universal (e.g. regional marriage customs vs. globally viral claims in Facebook).

Subjective knowledge arises in occasional circumstances and ends with the death of the knowing person; but in the meantime it may have interacted with the personal knowledge of others via social relationships and produced a broader objectivated system, that the original thinker could have never envisaged. The concept of oxygen has been produced in the mind of individual researchers and in the social context of chemical laboratories of the 18th century, but also has an independent value of its own in current chemical knowledge. In order to have survived criticisms, it has had to pass the selection of theory testing: in this way, some mentefacts like "phlogiston" have been abandoned while others including "oxygen" have been given increased importance. While the premises of arguments are social, hence historically transient, their conclusions are not (Bhaskar, 1998, section 1.2).

Objectivated knowledge is usually acknowledged by realist epistemologies, although this does not mean that social knowledge or personal knowledge are less real (a realist view of social knowledge is defended by Hjørland, 2005, as "pragmatic realism"). Concepts, the units of objectivated knowledge, clearly are not the same as the conceptualized phenomena themselves, but are representations of phenomena as accurate and reliable as the present state of knowledge allows. The set of real phenomena presently conceptualized as "oxygen" is not the same as the conceptualization itself. When, in the past, these phenomena were partially covered by the concept of "phlogiston", the phenomena were the same as today, despite the concept was a different one.

In this sense, mentefacts including concepts also are constructions of individual minds and societies; as such they are subjected to criticism, revision and evolution, as in Popper's falsificationist conception of World 3. They should not be conceived as in a positivist, naive realism, but by the *critical realism* commonly acknowledged in contemporary epistemology as a sound foundation of science (e.g. Sellars, 1916). Similar perspectives have also been labelled as "hypothetical realism" (Lorenz, 1977) or "transcendental realism" (Bhaskar, 1997; 1998; cf. Dobson, 2002, for application to LIS).

In the development of objectivated knowledge, LIS and KO themselves have an important role, already acknowledged by various thinkers in the past as exemplified by the preceding quotes from J. Huxley. That is, LIS and KO should not simply account for existing systems of information and knowledge, by reproducing them faithfully for practical purposes only; rather, the organization of objectivated knowledge is itself part of its development. As shown by the cases of downward causation by mentefactual categories on people and animals presented above, LIS and KO can have a proactive role to creatively reassemble concepts into new, fruitful structures. One way to perform this is breaking the boundaries of traditional disciplines to encourage discovery of interdisciplinary connections between available corpora of knowledge (Szostak *et al.*, 2016).

Objectivated KOSs should be able to organize knowledge on a general, interdisciplinary basis not tied to any special person, community or domain, although collectively produced by several of them: in the words of Thomas Nagel, "a view from nowhere" that represents the view of nobody in particular, as opposed to individual subjective views. Indeed, one purpose of knowledge organization should be finding ways "to combine the perspective of a particular person inside the world with an objective view of the same world, the person and his viewpoint included" (Nagel, 1986) and to represent them adequately in KOSs. While it is not always easy to separate these dimensions, some technical solutions to express them separately by analytico-synthetic systems have been proposed in the León Manifesto (see Gnoli, 2016). LIS and KO should thus provide the currently best available systematic views of mentefacts, which are never final or ultimate but can always be falsified and corrected.

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**References**

Aunger, Robert (2002), The Electric Meme: A New Theory of How We Think, The Free Press, New York.

Austin, Derek (1969), "Prospects for a new general classification", *Journal of Librarianship*, Vol. 1 No. 3, pp. 149-169.

Bawden, David (2002), "The three worlds of health information", *Journal of Information Science*, Vol. 28 No. 1, pp. 51-62.

Bawden, David (2008), "Smoother pebbles and the shoulders of giants: the developing foundations of information science", *Journal of Information Science*, Vol.34 No. 4, pp. 415-426.

Bawden, David (2016), tweet, 28 June 2016, *Twitter*, available at: https://twitter.com/david\_bawden/status/747699954009931776 (accessed 29 March 2018).

Bawden, David and Robinson, Lyn (2016), "Super-science, fundamental dimension, way of being: library and information science in an age of messages", in Kelly, M. and Bielbly J. (Eds.), *Information Cultures in the Digital Age: A Festschrift in Honor of Rafael Capurro*, Springer, Wiesbaden, pp. 33-43.

Bawden, David and Robinson, Lyn (2018), "Curating the infosphere: Luciano Floridi's philosophy of information as the foundation for library and information science", *Journal of Documentation*, Vol. 74 No. 1, pp. 2-17.

Berger, Peter L. and Luckmann, Thomas (1966), *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. Doubleday, New York.

Bhaskar, Roy (1997), *A Realist Theory of Science*,2nd ed., Verso, London.

Bhaskar, Roy (1998), *The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences*, 3rd ed., Routledge, London.

Bidney, David (1953), *Theoretical Anthropology*, Columbia University, New York.

Bloor, D. (1974), "Popper's mystification of objective knowledge", *Science Studies*, Vol. 4, pp. 65-76.

Brookes, Bertram C. (1980), "The foundations of information science. Part 1: Philosophical aspects", *Journal of Information Science*, Vol. 2, pp. 125-133.

Campbell, Donald T. (1974), "Downward causation in hierarchically organised biological systems", in Ayala, Francisco José and Dobzhansky, Theodosius (Eds.), *Studies in the Philosophy of Biology: Reduction and Related Problems*, Macmillan, London/Basingstoke, pp. 179-186.

Capurro, Rafael and Hjørland, Birger (2003), "The concept of information", *Annual Review of Information Science and Technology*, Vol. 37, pp. 343-411.

Coates, Eric J. (1963), "CRG proposals for a new general classification", in CRG, 1969, pp. 19-22.

CRG: Classification Research Group (1964), "Bulletin n. 8", *Journal of Documentation*, Vol. 20 No. 3, pp. 146-169.

CRG: Classification Research Group (1968), "Bulletin n. 9", *Journal of Documentation*, Vol. 24 No. 4, pp. 273-298.

CRG: Classification Research Group (1969), *Classification and Information Control: Papers Representing the Work of the Classification Research Group During 1960-1968*, Library Association, London.

CRG: Classification Research Group (1978), "CRG Bulletin 11", *Journal of Documentation*, Vol. 34 No. 1, p. 23.

Dawkins, Richard (1976), *The Selfish Gene*, Oxford University Press, Oxford, 4th ed. 2016.

Dobson, Philip J. (2002), "Critical realism and information systems research: why bother with philosophy?", *Information Research*, Vol. 7 No. 2, available at: http://www.informationr.net/ir/7-2/paper124.html (accessed 2 May 2018).

Eubank, Earle Edward (1932), *The Concepts of Sociology: A Treatise Presenting a Suggested Organization of Sociological Theory in Terms of Its Major Concepts*, Heath, Boston/New York (first ed.: Western Educational Service, 1928).

Fantini, Alvino E. and Fantini, Beatriz C. (1995), "Artifacts, sociofacts, mentifacts: a sociocultural framework", in Fantini, A.E. and Fantini, B.C. (Eds.), *New Ways in Teaching Culture*, TESOL, Alexandria, VA, pp. 57-59, also available at: https://www.learner.org/workshops/tfl/resources/s5\_artifacts.pdf (accessed 29 March 2018)

Floridi, Luciano (2002), "On defining library and information science as applied philosophy of information", *Social Epistemology*, Vol. 16 No. 1, pp. 37-49.

Gippoliti, Spartaco (2016), "Questioning current practice in brown bear, *Ursus arctos*, conservation in Europe that undervalues taxonomy", *Animal Biodiversity and Conservation*, Vol. 39 No. 2, pp. 199-205.

Gnoli, Claudio (2006), "Phylogenetic classification", *Knowledge Organization*, Vol. 33 No. 3, pp. 138-152.

Gnoli, Claudio (2016), "Classifying phenomena. Part 1: Dimensions", *Knowledge Organization*, Vol. 43 No. 6, pp. 403-415.

Gnoli, Claudio (2017), "Classifying phenomena. Part 2: Levels", *Knowledge Organization*, Vol. 44 No. 1, pp. 37-54.

Gnoli, Claudio and Ridi, Riccardo (2014), "Unified Theory of Information, hypertextuality and levels of reality", *Journal of Documentation*, Vol. 70 No. 3, pp. 443-460.

Grove, J. W. (1980), "Popper 'demystified': the curious ideas of Bloor (and some others) about World 3", *Philosophy of the Social Sciences*, Vol.10, pp. 173-180.

Hartmann, Nicolai (1936), *Der Philosophische Gedanke und seine Geschichte*, De Gruyter, Berlin.

Hartmann, Nicolai (1953), *New Ways of Ontology*, Regnery, Chicago, also available at: https://archive.org/details/newwaysofontolog00hart (accessed 29 March 2018), orig. German ed.: *Neue Wege der Ontologie*, Kohlhammer, Stuttgart, 1949.

Hjørland, Birger (2002), "Epistemology and the socio-cognitive perspective in information science", *Journal of the Association for Information Science and Technology*, Vol. 53 No. 4, pp. 257-270.

Hjørland, Birger (2005), "Domain analysis: a socio-cognitive orientation for information science research", *Bulletin of the American Society for Information Science and Technology*, Vol. 30 No. 3, pp. 17-21.

Hjørland, Birger (2016), "Knowledge organization (KO)", *Knowledge Organization*,Vol. 43, no. 6, pp. 475-84, also in Hjørland, Birger (Ed.), *ISKO Encyclopedia of Knowledge Organization*, available at: http://www.isko.org/cyclo/knowledge\_organization (accessed 29 March 2018).

Hjørland, Birger (2017), "Library and information science", in Hjørland, Birger (Ed.), *ISKO Encyclopedia of Knowledge Organization*, available at: http://www.isko.org/cyclo/lis (accessed 29 March 2018).

Huxley, Julian S. (1955). "Guest editorial: Evolution, cultural and biological", *Yearbook of Anthropology*, Vol. 1955, pp. 2–25, also available at: http://www.jstor.org/stable/3031134 (accessed 29 March 2018).

Huxley, Julian S. (1959). "Clades and grades", in Cain, A.J. (Ed.), *Function and Taxonomic Importance*, Systematics Association, London.

Ingwersen, Peter and Järvelin, Kalervo (2005), *The Turn: Integration of Information Seeking and Retrieval in Context*, Springer,Dordrecht*.*

Kleineberg, Michael (2017), "Integrative levels", *Knowledge Organization*, Vol. 44 No. 5, pp. 349-379, also in Hjørland, Birger (Ed.), *ISKO Encyclopedia of Knowledge Organization*, available at: http://www.isko.org/cyclo/integrative\_levels (accessed 29 March 2018).

Kyle, Barbara R. F. (1963), "Lessons learned from experience in drafting the Kyle Classification", in CRG, 1969, pp. 11-16.

Kyle, Barbara R. F. (1965), Review of Atherton, Pauline (Ed.), *Classification research: Elsinore, Denmark, 14-18 September 1964: Proceedings of the Second International Study Conference*, Munksgaard, Copenhagen, 1965, *Journal of Documentation*, Vol. 21 No. 4, pp. 301-303.

Laland, Kevin N., Uller, Tobias, Feldman, Marcus W., Sterelny, Kim, Müller, Gerd B., Moczek, Armin, Jablonka, Eva and Odling-Smee, John (2015), "The extended evolutionary synthesis: its structure, assumptions and predictions", *Proceedings of the Royal Society. B: Biological Sciences*, Vol. 282 No. 1813, pp. 1-14.

Lambe, Patrick (2015), "From cataloguers to designers: Paul Otlet, social impact and a more proactive role for knowledge organization professionals", *Knowledge Organization* Vol. 42 No. 6, pp. 445-455.

Lorenz, Konrad Z. (1977), *Behind the Mirror: A Search for a Natural History of Human Knowledge*, Harcourt Brace Jovanovich, New York/London, original German ed. Piper, München, 1973.

Nagel, Thomas (1986), *The View from Nowhere*, Oxford University Press, New York/Oxford.

Neill, S.D. (1982). "Brookes, Popper, and objective knowledge", *Journal of Information Science*, Vol. 4, pp. 33-39.

Polanyi, Michael. (1958). *Personal Knowledge*, Routledge and Kegan Paul, London.

Poli, Roberto (2001). "The basic problem of the theory of levels of reality", *Axiomathes*, Vol. 12 No. 3-4, pp. 261-283.

Poli, Roberto (2016). "Nicolai Hartmann", substantive rev., in: *Stanford Encyclopedia of Philosophy*, available at: https://plato.stanford.edu/entries/nicolai-hartmann/ (accessed 29 March 2018).

Popper, Karl R. (1972), *Objective Knowledge: An Evolutionary Approach*, Clarendon Press, Oxford (rev. ed. 1979).

Popper, Karl R. (1978), *Three Worlds: The Tanner Lecture on Human Values, delivered at the University of Michigan, April 7, 1978*, available at: https://tannerlectures.utah.edu/\_documents/a-to-z/p/popper80.pdf (accessed 29 March 2018).

Popper, Karl R. (1992), *Unended Quest: An Intellectual Autobiography*, rev. ed., Routledge, London.

Popper, Karl R. and Eccles, John C. (1977), *The Self and its Brain: An Argument for Interactionism*, Springer, Berlin etc.

*Prabook.* (n.d.), "Earle Edward Logan", in: *World Biographical Encyclopedia*, available at: https://prabook.com/web/earle\_edward.eubank/729873 (accessed 6 February 2018).

Rudd, David (1983), "Do we really need World III? Information science with or without Popper", *Journal of Information Science*, Vol.7, pp. 99-105.

Robinson, Alice Gram (1920), "Jessie Burrall: girl's girl", *Good Housekeeping*, Vol.71, December issue.

Sellars, Roy Wood (1916), *Critical Realism: A Study of the Nature and Conditions of Knowledge*. Rand-McNally, Chicago.

Serrai, Alfredo (1981), "Dai 'Mondi' di Popper alla soggettività della informazione, ovvero come l'ontologia può giovare alla catalogazione", in: *Temi di attualità bibliotecaria*, Bulzoni, Roma, pp. 77-98.

Serrai, Alfredo (1983), "Popper's worlds", *Journal of Information Science*, Vol. 5 No. 5, p. 203.

Swanson, Don R. (1980), "Libraries and the growth of knowledge", *Library Quarterly*, Vol.50 No. 1, pp. 112-134.

Swanson, Don R. (1986), "Undiscovered public knowledge", *Library Quarterly*, Vol. 56 No. 2, pp. 103-118.

Swanson, Don R. (1990), "Medical knowledge as a potential source of new knowledge", *Bulletin of the Medical Libraries Association*, Vol. 78 No. 1, pp. 29-37.

Szostak, Rick, Gnoli, Claudio and López-Huertas, María (2016). *Interdisciplinary knowledge organization*, Springer, Cham.

Talja, Sanna, Tuominen, Kimmo and Savolainen, Reijo (2005), "'Isms' in information science: constructivism, collectivism and constructionism", *Journal of Documentation*, Vol. 61 No. 1, pp. 79-101.

*Wikipedia* (2018), "Mentifact", available at: https://en.wikipedia.org/wiki/Mentifact (accessed 29 March 2018).