Is an all-purpose classification possible?

Insights from Farradane's approach to knowledge organization

Claudio Gnoli

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Abstract

The field of knowledge organization was originally developed from library and information science, although it is of more general philosophical interest. Today its influential school of domain analysis is based on pragmatist views, according to which any classification reflects particular perspectives and purposes. This implies that there are many alternative ways to identify real, natural kinds and to group them, none of which would be superior to the others. The same concepts, e.g. rice and bamboo, are indeed grouped in different ways according to disciplinary contexts, e.g. biology or agriculture or economics. On the other hand, a principle of "unique definition" was identified in the 1960s by Jason Farradane and other members of the Classification Research Group to draft a general bibliographic classification based on phenomena (as opposed to disciplines): according to such principle, a concept can be defined at a specific level of organization then combined with concepts at other levels without losing its constant notation. Some classifications inspired by that research are currently under development. Classification structures are illustrated with some actual examples. It is shown how certain technical solutions developed for bibliographic organization of knowledge, including unique definition, may also offer contributions to address epistemological issues, suggesting a way towards the development of classifications that can serve as reference to reconnect different purposes.

Keywords

Jason Farradane; knowledge organization systems; levels of reality; natural kinds; pragmatism; unique definition

1. Introduction: knowledge organization as a field of study

Humans have always looked for classification principles in order to organize their knowledge about many subjects. Depending on application contexts, their results may be referred to by various terms, including *classification schemes, thesauri, taxonomies* and *ontologies*; a more general term encompassing all of them is *knowledge organization system* (KOS) (Mazzocchi, 2018).

The aims of KOSs may be both theoretical and practical. Theoretical KOSs list entities as they are identified by scientific research, for example kinds of plants as identified by botanists or different languages as identified by linguists. Applied classifications are used to organize knowledge resources, such as books on library shelves and catalogues, contents in websites and online stores, or topics in textbooks and education curricula. They then organize documents about phenomena, e.g. about plants or about languages, as opposed to the phenomena themselves, which implies additional dimensions. Bliss (1929; 1933) acknowledged that different applications may require slightly different classifications, but also found that applied schemes, including classifications for education and for bibliographic organization, have their foundations in philosophical and scientific ones and should basically follow the same order of “gradation in speciality”.

While classifications are most often studied within the limits of each application field – systematic biology, typological linguistics, library science, etc. – their common principles also deserve to be investigated as such in more general ways. This possibility has been explored in recent decades within the field called *knowledge organization* (KO) by the same words Bliss choose for his book titles. The field was established in a formal way on impulse of some researchers led by Ingetraut Dahlberg, a previous member of the German Gesellschaft für Klassifikation, by founding in 1989 the International Society for Knowledge Organization (Szostak & Ohly, 2020).

While especially developed from library and information science (LIS), the field of knowledge organization also has important connections with philosophy, education, linguistics and computer science. Indeed, its founder looked for general, “universal” principles for ordering knowledge, building on such philosophers as Aristotle and Nicolai Hartmann; she developed a theory of concepts and a general scheme of research fields (Dahlberg, 1978; 1979).

This approach implies the existence of some general criteria for classification that are accepted internationally by all users, much in the way the sciences are, despite differences in cultural perspectives or in application purposes. It implies an objectivist view of classification. The discussion has been revived recently by Machado et al. (2023), who conclude by advocating for a “moderate realistic foundation” of knowledge organization systems, that “embodies the scientific method and the fallibilist attitude of scientific realism and, while using ontological perspectivism, accommodates multiple perspectives without falling into an ‘anything goes’ attitude”.

In this paper we will address the debate between objectivism and multi-perspectivism by considering some contributions from the KO field. This dichotomy should be kept distinct from the other dichotomies that we also mention in our discussion:

- theoretical classifications vs. applied classifications;
- scientific classifications of objects vs. bibliographic classifications of documents about such objects;
- classifications of phenomena vs. classifications of disciplines that study those phenomena;
- general classifications of all knowledge vs. special classifications of individual domains.

We will show how our target dichotomy is related to these further dichotomies in certain ways, as for example phenomenon-based classifications look more suitable to support objectivism, although disciplinary ones do not rule it out.

The currently prevailing approaches in KO emphasize the fact that any classification is biased by its intended purposes and by the more or less explicit assumptions of those who have developed it. For example, Mai (2010, 627) proposes “to establish pluralism as the basis for bibliographic classification theory and practice”. Research in the KO field tends to focus on identifying such differences, also in a critical attitude, as any classification imposes to its users the perspective of its creators, for example by adopting hierarchies and terminologies that reveal Western, Christian, chauvinist etc. viewpoints (Olson, 2002).

Indeed, the KO field has been widely influenced by the notion that any concept is “theory-laden”, as stated by Hanson (1958) and made popular by Kuhn’s (1962) epistemology. As concepts are the basic units of KOSs, there could be no neutral system, no atheoretical classification (Hjørland, 2016).

In particular, Birger Hjørland’s approach of domain analysis recommends that all classifications – or more generally all KOSs – are described in terms of the cultural perspective and purposes of the communities that have developed them:

> The domain analytic approach to classification and KO can be summarized in this way:
>
> - Go to a given domain,
> - Look at how it is classified according to contemporary knowledge (including different views)
> - Discuss the basis, the epistemological assumptions and which interests are served by proposed classifications
> - Suggest a motivated classification
>
> (Hjørland, 2017)

While domain analysis is currently popular, KO literature tends to subscribe to its approach in quite abstract ways, without providing actual examples of “a motivated classification” as recommended in Hjørland’s last point. As a good example of domain analysis, Hjørland often cites a paper by his Danish countryman Anders Ørom (2003). In that extensive work, Ørom discusses the different ways the visual arts have been subdivided in different classification systems, and shows that they depend on adopting in each case a different characteristics to divide the arts: by represented theme, or by style, or by social context of production, etc. This indeed reflects alternative approaches and theories of the arts, that may please different researchers. It is then a good example of domain analysis as a critical tool in the study of existing systems – the second and third points in Hjørland’s summarization –, although it does not explain how domain analysis could be applied in the development of new systems that are satisfactory for relevant communities of researchers.

2. Pragmatism and natural kinds

Domain analysis is an application of the pragmatist paradigm in philosophy, as initiated by Charles Sanders Peirce, William James and John Dewey, according to which human knowledge cannot be separated from the purposes of human activities. Hjørland (e.g. 2021; 2024) professes himself to be a pragmatic realist and is sympathetic with Dupré’s (1993) promiscuous realism. According to promiscuous realism, we can indeed find real borders between things, but have many alternative ways to do it depending on our interests and purposes, and none of them is more correct than the others. Similar views can be found in other philosophers of science and metaphysicians (Brzović, n.d.), including Kitcher’s (1984) pluralistic realism: in their views, categories and schemes developed in scientific research are necessarily subject to some specific perspective, even when they are well structured and successful. Even our best science, that is, would produce partial, biased classifications.

Such ideas seem to support a negative answer to the question whether classes identified in science can aspire to form a single reference scheme, that is to correspond to “the” actual joints in reality as found by Plato’s ideal butcher (Plato, 1952, 265e; Khalidi, 2013; Umphrey, 2016; Barberousse et al., 2020), rather than being limited to some specific purpose. While there would be many alternative ways to identify natural kinds, it would be impossible to satisfy the most demanding of the four principles implicit in the notion of natural kinds as reviewed by Hacking (1991, 111):

> *Uniqueness*. There is a unique best taxonomy in terms of natural kinds, that represents nature as it is, and reflects the network of causal laws. We do not have nor could we have a final taxonomy of anything, but any objective classification is right or wrong according as it captures part of the structure of the one true taxonomy of the universe.

Hacking immediately declares he does not believe in uniqueness. And Bryant (2000, 112, italics original), concluding her study on the metaphysics and epistemology of classification, writes:

> Of course classification concerns metaphysics–it is the job of science to uncover the regularities and patterns which exist in *reality*. Rather, the objectivist’s mistake is to assume that there exists a unique set of regularities and so classes into which the natural world can be divided. *Even at the scientific level*, there exist different patterns and regularities which criss-cross the natural world–and different regularities can result in different divisions of that world.

Interestingly, a midway solution between objectivism and skepticism appeals to the same term *domain* that is popular in the knowledge organization field, taken in the sense of an area of knowledge that has its own particular way of partitioning reality. It is the position of Magnus (2012, 8, italics original): “To put it loosely, the account of natural kinds which I defend maintains that a category of things or phenomena is a *natural kind* for a domain if it is indispensable for successful science of that domain". In Magnus' view, similarly to Dupré, human categories do have some foundations in reality, but there are many different partitions of reality according to the purposes of classification, none of which has a privileged status. This position would still prevent the identification of any classification of real phenomena of general acceptance, beyond all domain-specific ones: classifications could only be valid within their particular domain and its particular theories (cf. Cuypers & Reydon, 2023).

A different view is that of Wilkins and Ebach, according to which observations of reality and their organization into classes are prior to theories, as before them there would be nothing yet to theorize about: "we argue that observations can lead to classification in the absence of a theory of a given domain. Once there are classifications in such theory-free fields, then explanations can be developed" (Wilkins & Ebach 2014, 2). This looks like a more empiricist understanding of the scientific process, as it assigns to observation and unconstrained classification a key role in the determination of theories. Others could give the Kantian reply that observations themselves are unconsciously classified according to some theory built in our perceptual apparatus: the meanings of "theory" may actually involve various stages in knowledge and in evolution. Unconscious categories may in turn have been selected to work in our real world, hence be non-arbitrary (Lorenz, 1977).

Going back to knowledge organization, the warnings of pragmatists about the relative value of any classification appear to be at odd with the aspirations to some common reference system. Even in a world of critical researchers aware of epistemological issues, reference systems are desirable to provide frameworks of available knowledge that satisfy our need for unity and consistence, as well as standard tools for exploring published sources and identifying conceptual relationships across different fields.

3. Disciplinarity

One factor of fragmentation in the actual organization of knowledge is the existence of disciplines that are cultivated and developed separately. While many disciplines focus on specific classes of phenomena – pure chemistry is the study of chemical substances, botany is the study of plants, etc. – there is no biunivocal correspondence: industrial chemistry and agriculture also study those phenomena in different ways, and such disciplines as philosophy, history or literature rather are general methodological approaches that may study anything from their specific perspective (Langridge, 1976; Mills & Broughton, 1977, § 5.53).

As each discipline organizes its objects of study according to its perspective and purposes, classifying knowledge by discipline may produce a set of incommensurable systems. While the Periodic Table of elements is often cited as an example of a satisfying scientific system, it is based on properties of elements that are mainly of interest to chemists, such as atomic numbers; prioritizing other properties that are of greater interest to physicists, such as quantum numers, produces alternative, even more elegant organizations like the Stowe Table, also described as “the Physicist’s Periodic Table” (Channon, 2011).

The separation of scientific disciplines is largely reflected in bibliographic systems. Bibliographic classifications have been developed in detail especially since the second half of the 19th century by such authors as Melvil Dewey, Charles Ammi Cutter, Paul Otlet, Ernest C. Richardson or James Duff Brown. Most of them have been structured as lists of traditional disciplines, including philosophy, mathematics, physics, biology, psychology, economics, the arts and so on. Within each discipline, its characteristics branches and topics are listed as subclasses – for example, physics is divided into mechanics, thermodynamics, electromagnetism etc., while only in deeper subdivisions are the studied phenomena listed, such as protons or heat. Disciplinary branches can optionally be specified by various common or special auxiliaries, sometimes called *facets*, such as “history”, “American”, “theory” or “handbook”. Classes, subclasses and facets are represented by a symbolic notation according to syntax rules. This allows to produce a classmark that is assigned to each document, such as a book or a scientific article.

This approach implies that each discipline is a separate realm with its own characteristics of subdivision, an approach someway agreeing with the assumption that the optimal classification depends on the domain on hand. While physicists may find it useful to divide their topics in one way, engineers may prefer a different ordering, and each community will hopefully be served by a different section of a general classification – or by a special classification only covering their specific domain with an independent structure, such as the Physics and Astronomy Classification Scheme (Smith, 2020) or the Mathematics Subject Classification (Sperber & Ion, 2011). But even a general classification of disciplines itself ends by consisting in a set of different classifications.

A remarkable consequence of this practice is that a given concept, for example “heat”, will probably be listed several times in different classes – heat in physics, heat in engineering, etc. – each time in a different position and role depending on the disciplinary context. And there will be no unique place or notation for the concept of heat as such (apart from the alphabetical index of classes, as introduced by Melvil Dewey, that provides cross references to the occurrences of a term in different parts of the scheme, but still forces searchers to follow each different path rather than providing them with a unified class).

An important technical advancement was introduced by S.R. Ranganathan with facet analysis, which was applied in his Colon Classification (CC), in the second edition of Bliss Bibliographic Classification (BC2) and in other modern systems. Facet analysis allows to express the subject of a document by combining its different facets. A physics book on measurement methods in thermodynamics in 20th-century laboratories, rather than just falling under the thermodynamics subclass, may be indexed as “physics, heat, measurement, 20th century”. For the purposes of consistency in the arrangement of topics, including their sorting in digital dynamically-produced lists, the citation order of such facets follows a standard order of *categories*, prioritizing types over parts, processes, place and time: “measurement” follows “heat” because measurement is a process, and “20th century” comes last because it is a time specification (Mills, 2004). Such standard citation order of categories holds in all disciplinary classes, that is within physics as well as within engineering or the arts, and thus provides an element of structural consistency across the whole classification.

This, however, does not mean that the same concept always appears in the same place across disciplines, as it may fill different categorial roles: e.g. heat can occur as the object of study (the type) in physics but as a source of power to produce something else (the process) in engineering. As a result, the same concept still has different places and notations depending on its disciplinary context.

Supporters of pragmatism will emphasize that it does indeed make sense that the same concept is seen differently in each case. Different sciences look at the same phenomena differently, and will classify them accordingly. For example, as acknowledged since John Stuart Mill’s (1843, § IV, vii, 2) original discussion of kinds, pure sciences need to classify phenomena in a different way than applied sciences. “Even if we stick to animals, vegetables and minerals we have kinds such as guard dogs, weeds and tombstones. This are not natural kinds” (Hacking, 1991, 116) or, as an adherent to promiscuous realism could prefer to say, they are natural kinds alternative to dog breeds, plant families and rock types.

To take an example following this popular argumentation, in Colon Classification plants are listed according to taxonomical kinship in the class of botany, so that both rice and bamboo appear among poaceae, a subdivision of monocotyledons (*I7*); but the same plant species are instead listed in agriculture according to their use, where what matters is their relevance to human purposes rather than their phylogenetic origin: rice is thus in “food” (*J381*) while bamboo is in “fabric” (*J748*) (Ranganathan, 1960, § 2.64-65). It would thus look a solution consistent with the pragmatic view that a concept like “rice” does not have any unique place, as its optimal place depends on the disciplinary context.

4. The needs of interdisciplinarity

This picture, however, does not tell the whole story. Even within agriculture, there may be researchers who study the same plants according to different perspectives and for different purposes, and not all of them will be happy with the place they have been given by the authors of the classification: for example, bamboo is not used just as a fabric, but also as food (in buds) or as a building material; rice starch is also used in cosmetics. Distinguishing disciplines is not exactly the same as distinguishing purposes, so that disciplinarity is not the only problem in our quest for consistency and unity in classification.

Furthermore, some researchers may need to study a plant in interdisciplinary ways, for example to assess how the climate of the countries where rice is cultivated affects its abundance and trade: they will then be interested in both its biological properties, such as optimal habitat, and its economic role as an agricultural commodity, which may be expressed by different facets in different classes.

Increasing interdisciplinarity is a well known fact in the science of recent decades (Klein, 1996). Based on this, Szostak et al. (2016) urge KO scholars to develop KOSs that can serve the needs of interdisciplinarity better. Such a trend stands in opposition, or at least in some complementarity, to the approach of domain analysis, as KOSs designed to reflect the specific needs of one domain result in a hindrance to interdisciplinary research. What is needed is a system where the same concept can be identified and retrieved independently from any particular discipline and can be combined with any other concept: “bamboo” may indeed be related to “poaceae” or to “fabric”, or to “building”, or to “pandas”, or to “Philippine mytology”.

The needs of interdisciplinary KO have been stated in the León Manifesto, published after an ISKO conference held in León, Spain. The manifesto consists of five points:

- the current trend towards an increasing interdisciplinarity of knowledge calls for essentially new knowledge organization systems (KOS), based on a substantive revision of the principles underlying the traditional discipline-based KOS;
- this innovation is not only desirable, but also feasible, and should be implemented by actually developing some new KOS;
- instead of disciplines, the basic units of the new KOS should be phenomena of the real world as it is represented in human knowledge;
- the new KOS should allow users to shift from one perspective or viewpoint to another, thus reflecting the multidimensional nature of complex thought. In particular, it should allow them to search independently for particular phenomena, for particular theories about phenomena (and about relations between phenomena), and for particular methods of investigation;
- the connections between phenomena, those between phenomena and the theories studying them, and those between phenomena and the methods to investigate them, can be expressed and managed by analytico-synthetic techniques already developed in faceted classification. (*León Manifesto*, 2007)

There are not many examples of such general phenomenon-based classifications, as they are recently called (Gnoli et al., 2024). The main projects that are currently being developed are the Integrative Levels Classification (ILC) and the Basic Concepts Classification (BCC), which are both inspired by the principles of the León Manifesto and mainly differ in the degree of concept synthesis expressed in their notations. ILC is inspired by an earlier project granted by NATO and developed by several members of the

English Classification Research Group (CRG), although never completed (Classification Research Group, 1969).

We are not going into more technical details of bibliographic classifications in this article; but what is especially relevant to our argumentation is that these phenomenon-based classifications list such concepts as “heat” or “bamboo” independently on any particular discipline. That is, they have no class of physics or of botany, but simply a class of energy and one of plants.

This unconventional approach implied some new questions, including that of the placement of concepts that may occur in various relationships with other phenomena: indeed, “bamboo” as a plant or as a fabric now appeared to be the same thing, as it had no specific role in any disciplinary perspective, making its placement in the scheme a crucial decision. Such questions were faced by CRG members in their regular meetings and are recorded in a series of CRG Bulletins published in *Journal of Documentation*. Despite their technical appearance, such minutes and bulletins contain many ideas that are deeply meaningful for classification theory, and deserve to be studied and discussed in more detail than has been done yet. Among them is the very problem of the place where a concept that may occur in different contexts should be listed.

5. Farradane’s unique definition

The CRG Bulletin n. 6 reads:

> *Unique definition, fundamental classes.* The fundamental class placing of topics which may logically occur in several separated classes was then discussed. Instead of repeating a term in several classes (e.g. Air in Chemistry, Ecology, Hygiene, Transport, etc.) should we not prefer a single schedule of undifferentiated isolates [...]? (341) It was pointed out that even an undifferentiated schedule was in some kind of order.

> What order should be used? Order according to integrative levels was suggested. (342). (Classification Research Group, 1961, 166)

In other words, “bamboo” or “air” should not be repeated in many places in the scheme according to their different contexts, but should just occur once in a given class of phenomena. Also, the classes would be listed according to the series of *integrative levels*, a notion CRG members received from Needham (1943) and Feibleman (1954): these would include “energy, matter... mineral systems... land forms... plants, animals, man” (Classification Research Group, 1969) and every concept would have its place in only one of these levels.

The problem then became: which level? Should “bamboo” be listed among plants, or among human activities? To formulate this question, CRG members used the example of diamond, and arrived to an important point:

> the fundamental class placing of an item, Mr Farradane maintained, should be decided by stripping off extraneous characteristics to leave common (intrinsic, essential) characteristics by which the item was uniquely definable. The uses of Diamond (jewel, industrial) were extraneous properties of this material. It was uniquely definable only as a mineral. (Classification Research Group, 1961, 166)

Jason E. L. Farradane, who proposed this principle in mid-Twentieth century, was an important British information scientist (Bottle et al., 1986; Yates-Mercer, 1989). He had changed his Polish surname to Farradane, coined as a mix of those of two scientists he much admired, physicist Michael Faraday and biologist J.B.S. Haldane. This is just a hint of his scientifically-oriented approach to documentation, which he had expressed in a previous article also containing, among other ideas, his first mention of unique definability:

> An item of knowledge will thus be an object or class of objects, a process or class of processes, or an abstract term or class of such terms, which is clearly and, *at its own level of complexity*, uniquely definable, as far as

> may be possible. Any other item would in reality be composed of two or more concepts, leading to logical confusions. Let us call these items, as defined, *isolates*. (Farradane 1950, 87, italics original).

As it can be seen, unique definition and levels are intimately connected in Farradane's thought, and so remained throughout several decades (cf. Farradane, 1961; Datta & Farradane, 1974, 322-323). Their connection is also apparent in an encyclopedia entry about the CRG written by Farradane himself:

> Foskett introduced the principle of 'levels of integration' as a method of ordering entities […]. Farradane is now also examining new principles of general classification incorporating ideas on levels of integration, relational 'operators', and the construction of classes and systems (heterogeneous groups) at the various levels (Farradane, 1966, 108).

The idea of unique definition was reported by Brian Vickery as follows: "In early days of the CRG, Farradane was defending this idea. Someone said 'but the wind bloweth where it listeth' [Gospel of St. John, § 3, 8]. Jason quickly replied 'I want to list the wind where it bloweth'. We loved it" (email quoted in Gnoli 2012, 13). Unique definition thus is a way to find the single place in a classification where an isolate "bloweth" and should therefore be listed, as opposed to the plurality of equally valid placements supported by the pragmatist views.

Farradane's contribution is also acknowledged in describing the structure of BC2, a later product of CRG members:

> This solution is achieved through the notion of the "place of unique definition" originally proposed by Farradane (1950, 87), which rules that "for any given concept, the minimum information needed to define it is to be taken as the clue to its location" ([Mills & Broughton, 1977, §] 6.214.61) or alternatively, "that class which provides a given concept

with its most fundamental defining characteristics, e.g. Zoology provides the place of unique definition for the concept Horse" ([Mills & Broughton, 1977], 107). (Broughton, 2024)

It may be surprising to find unique definition cited in the presentation of a disciplinary classification as BC2, as we have explained above how disciplinary classifications are less suitable to provide a unique place for a concept than phenomenon-based classifications are. Actually, BC2 is a product of some CRG members (including Jack Mills, Eric Coates, Derek Langridge) who seemed less persuaded, as it appears from later Bulletins, by the new phenomenon-based approach explored in the NATO draft and recommended by members Vickery, Farradane, Barbara Kyle, Douglas Foskett and Derek Austin. Still, BC2 introduction acknowledged the importance of unique definition, which was now adapted to its disciplinary structure.

Let us consider the concept of diamond, cited as an example in the 1961 Bulletin and also focused by Farradane and J.F.P.H. Greene in a special classification of diamond technology (Classification Research Group, 1962, 77-79). While this concept appears in several of the BC2 disciplinary classes, its unique definition should belong to the "level" of chemistry (or more precisely to that of mineralogy which is not developed in the scheme):

C chemistry
CG . chemical species
CGF .. individual elements
CGFLM … carbon
CGFLMJJQ …. allotropes of carbon
CGFLMJJQR ….. graphite
CGFLMGJQT ….. diamond

Diamonds then reappear in later BC2 classes dealing with phenomena at higher levels, that in Farradane's terms would be "composed of two or more concepts", such as rocks and diamonds, or jewels and diamonds:

DG/DY earth sciences
DIC rocks and soils and minerals
DIU . petroleum & natural gas, carbonaceous deposits
DIUD .. diamonds

W the arts
WC . visual arts
WF .. design arts
WGB … decorative art
WGD …. stone
WGE ….. jewellery
WGEK …... gems
WGEP ……. particular gems
WGEPD …….. diamond

While diamonds also occur in jewellery as a raw material and in manufacturing as a cutting tool, these cannot be their unique places, as there are plenty of diamonds which are not used in such ways. Instead, all diamonds have certain mineral properties in any context, so their place of unique definition is the class of minerals. The same we can say of rice: be it used to produce starch, or cultivated as a crop or growing spontaneously, it always is a monocotyledon plant, therefore its place of unique definition is in the class of plants. This idea can also be found occasionally in recent metaphysical literature:

> in characterizing the DNA of bears, we take it to be relevant to note that it causes them to be furry and grow to a large size, but not that it also thereby causes them to be good mascots for football teams. The genetic

> information in bear DNA inherently ‘points to’ or is ‘directed at’ the first outcome, but not the second (Feser, 2009, 47, cited in Tugby, 2024, 3).

In the definition of a concept, a set of properties is implied, as one can realize by looking at a term in a dictionary. What is seldom considered, however, is the priority order of such properties, and this is addressed by Farradane’s principle. This reminds of the citation order of facets, but here properties are only considered in order to identify the appropriate place for a class, rather than combining some of them to express the subject of a document. To give a toy example, with no ambition of real scientificity or exhaustiveness, let us assume that diamond is defined as being made of carbon atoms (as opposed to e.g. iron atoms), being a pure substance (as opposed to a chemical compound), being a good cutter (as opposed to a bad cutter), being beautiful (as opposed to ugly) and being a good thermal conductor (as opposed to insulator). These properties can be listed in different ways when defining diamond:

> carbon, pure, cutting, beautiful, conductor
> pure, cutting, beautiful, carbon, conductor
> pure, carbon, cutting, conductor, beautiful
> beautiful, carbon, pure, cutting, conductor
> etc.

Although they all describe diamond, these combinations of properties follow different priority orders. The first combination gives priority to being made of carbon atoms, a property at the integrative level of atoms. But diamonds are a type of mineral substance rather than a type of atom, so the first combination is not the preferable order to define it. Similarly, giving priority to beauty, cutting ability, or conducibility refer to exceedingly high levels of interaction with other objects and human activities, which are properties only relevant in some circumstances rather than always needed to describe the nature of diamonds. As diamonds are mineral entities, their most relevant property is to be a pure substance made of a single chemical element (carbon in this case), therefore they have to be listed together with other pure mineral substances, like pure iron, rather than together with other cutting, or beautiful, or conductor phenomena. A diamond is a pure substance, made of carbon which is also conductor, cutting, and beautiful.

The example of diamond, though just in this toy version, looks neat as the nature of chemical and mineral substances is nowadays well known, much in the same way as gold is often taken as an example of a natural kind defined as the substance with atomic number 79. Admittedly, concepts in other semantic fields such as anger or human rights are harder to define in terms of a stable list of essential properties. It has been shown that definitions of the same words in different dictionaries emphasize different properties, also depending on different lexicographic schools (Benson, 2001). We are not suggesting that all concepts in a classification can be defined by a final list of essential properties that can then be combined in mechanical ways as Leibniz envisaged, as we are aware that real classifications develop in more qualitative, descriptive ways.

However, we believe that the example of diamond, as well as that of rice and bamboo, are clear illustrations of certain general principles that can work as methodological references in the development or improvement of classifications. Such principles, including CRG's integrative levels and Farradane's unique definition, are significant contributions to a more objectivist approach to classification, as opposed to skepticism about the viability of any all-purpose scheme that is suggested by pragmatist approaches.

6. Applying unique definition by class combination

The principle of unique definition is reaffirmed in the CRG Bulletin n. 9, where we also find a mention of how a concept can be expressed when it occurs in a context different from its unique definition:

> The aim of this research was to establish a basis for recognizing the 'uniquely definable place' for every entity, which need then be set down and notated only once in the scheme. The same notation could then be employed to indicate the reappearance of such an entity in a new context, as when particular rocks, first placed in the schedules of geological entities, appear as materials in such contexts as building and sculpture. (Classification Research Group, 1968, 278)

Indeed, once stated that a concept is uniquely defined at a specific level, the need to express it in the context of other levels is still there. While a disciplinary classification such as BC2, as we have seen above, uses a different notation for diamonds in each different context, what is suggested by the CRG instead is that a stable notation be reused. The stable notation should reflect the level at which the concept is uniquely defined, and can be freely combined with the notation for concepts at other levels.

Let us see how this can be implemented in a phenomenon-based classification such as ILC. In the developing 3rd edition of ILC, diamond is defined (https://www.iskoi.ilc/details.php?no=gtbcd) at the level of bulk matter *g,* subclass of crystals *gt* :

gtb native elements
gtbc . native carbon
gtbcd .. diamond
gtbcg .. graphite
gtbcu .. fullerite

Now, to express diamond jewels in ILC, one does not need to create another, completely unrelated class. She just has to take the notation for jewellery *sfw* in the higher level of artifacts, and combine it with the existing notation for diamond by a relationship of constituent *70*, to get:

sfw70gtbcd "jewellery, made of diamond"

This has the important effect that, in information retrieval applications, a search for *gtbcd* “diamond” will retrieve both diamonds as crystals and jewellery made of diamond, as the query will exploit the constant notation -*gtbcd*- for the diamond concept. In the same way can be constructed the notation for diamond used as a cutting tool in industry, and so on.

Remark that one could hypothetically apply the same principle to carbon, and have diamonds in turn defined as native elements *gtb* made of carbon *eco*, taken from the lower level of elements. This is how BCC would probably work; ILC prefers a more enumerative approach, so to avoid such exceedingly complex classmarks as *sfw70gtb(70eco)* “jewellery, made of native elements (made of carbon)”, and so on in a potentially infinite regress. This means that some classes of ILC, just like all classes of BC2, do have a notation not reflecting some of their defining properties. However, those implicit semantic factors can still be tracked in the classification schedules by a cross reference to the lower-level concept implied in the class definition:

gtb native elements
gtbc . native carbon ← *eco* carbon
gtbcd .. diamond

Such cross reference can be exploited by an information system, to automatically generate expanded queries: when a user searches a database for diamonds, she can be warned that her search may optionally be expanded to include carbon among the results, if desired. Such expansions need to be tuned (Tudhope et al., 2001), however, as interdisciplinary interests are usually limited to one or two steps of relationships: most users looking for information on diamond jewels will hardly be interested in carbon atoms, or in their electrons, etc.

7. Identifying kinds according to unique definition and facets

We have shown how Farradane's notion of unique definition may work to reconcile the needs for a reference classification system with the different perspectives of domain-specific knowledge. Concepts can be analyzed to identify their different ontical levels (Poli, 2001) and determine their appropriate place of unique definition, as well as the appropriate dependence relationships with their occurrences at other levels.

Classes of jewels can be grouped and ordered in a way different from the classes of minerals, depending on which properties are the most relevant at their specific level. At the same time, jewels and minerals can be connected through notation reuse or cross references, so that there is no need to redefine the notion of diamond or that of carbon in each context. Rice and bamboo can belong to different classes at the level of industries, depending on their different uses as food or building material; and at the same time they can belong to the same group at the lower level of living plants. Such a classification can present the general unity of human knowledge (Lowenthal, 2019; Wilson, 1998), while also providing ways to treat it differently at different levels.

Classifications do depend on scientific theories, as claimed by Hjørland. Better, classifications are an integral part of theories, and evolve with them. The Sun was listed among planets in Ptolemaic theory, and is listed among stars in current astronomy; the Earth surface was divided into continents at the time of Wegener's theory, but is now divided differently into plates by contemporary tectonics. In quantum physics, it has been proposed to update the ambiguously dual concept of wave-particle by coining a new class of "quantons" (Lévy-Leblond, 1988).

These changes, however, are not arbitrary, but the result of advancements in understanding our world. Thagard (1992) identifies the key of such advancements in "explanatory coherence". The kinds that we identify and choose for our theories must be "suitably scientific", that is the properties by which they are identified "must reside at a level fundamental enough that they can account for important behavioral characteristics" (Bryant, 2000, 112)

– indeed, the level of their unique definition. As stated already by Mill, these properties are “those which contribute most, either by themselves or by their effects, to render the things like one another, and unlike other things” (Mill, 1843, § IV, vii, 2). Good kinds have a greater number of common attributes independent from each other, so that their sets and the relationships between them form a consistent theory. We can say that the choice of kinds has to follow a principle of optimal generalization.

In modern bibliographic classifications based on facet analysis, as we have seen, attributes can be expressed by facets that are optionally appended to a basic class to specify its properties and relations that are covered in an indexed document. For each main class, a set of relevant facets is defined – plants have such facets as organs, metabolism, means of reproduction, habitat, etc. – and their possible values are listed: means of reproduction can be gemmation, spores, flowers, seeds etc. This set of attributes can be considered as part of the definition of the class itself: plants are those phenomena that have organs, metabolism, means of reproduction, habitat etc., while e.g. minerals do not have them. In ontological terms, this is also called a set of categories (Poli, 2001). Identifying optimal sets of attributes, although done by many classificationists in intuitive, non-formal ways, can be adopted as a method to decide which classes are the best candidates to form natural kinds and be a viable element of a classification. Unique definition will suggest where such kind should be placed in the overall scheme.

As shown by Ørom (2003) in art studies, different classifications prioritize different characteristics of division, for example theme, style, or social context. These clearly are different facets of art (although Ørom does not discuss them in these terms; only in a final section does he consider the facets of the Art and Architecture Thesaurus, including physical attributes, agents, processes, materials and others, but finds that they have a “bricolage character”). The differences among alternative classifications can then be analyzed in terms of different citation orders of facets: should art works be grouped, say, by style then theme, or the other way around? The choice may be justified with reference to different theories or arts. Again, the principle of unique definition may contribute a criterion, by considering what actually is a work of art, at which levels can it occur, and in what combinations with phenomena at other levels (art depicting bamboos; art as a therapy, etc.).

8. Conclusions

This paper has addressed some general problems of classification in both philosophy and information science. It has shown how a basic philosophical dichotomy, that between objectivism and multi-perspectivism in classification, is related to other dichotomies and to their treatment in information science by such techniques as unique definition and facet analysis. While some of these are established parts of the heritage of information professionals, others like Farradane's ideas are almost forgotten today, but deserve to be considered again.

Of course, information science also covers practical tasks that have no specific philosophical interest, such as how documents should be arranged on shelves and in catalogues and how readers should be helped to find those that are most helpful to their current needs. However, we believe that a careful analysis of some principles identified in information science also offers ways to make philosophical discussions less based on abstract, idealized principles. The claim that there can exist many different classifications depending on different purposes may please many thinkers; but will not lead to any further useful knowledge before it is confronted with actual problems and examples. When this is done, overcoming naïve realism in classification does not necessarily lead to complete skepticism.

Bibliographic classifications provide a practical way to apply philosophical approaches, to discuss their underlying principles and to compare different solutions. Recently, digital ontologies are another kind of knowledge organization systems that address metaphysical questions, in an even more explicit way than bibliographic classifications have done (Arp et al., 2015). Unfortunately, the terminology of digital ontologies, originated from both computer science and logic, does not match that of bibliographic classifications, meaning that large research corpuses may be unnoticed by scholars of either field and studies are resumed and developed without taking advantage of what was done already. While an enormous number of digital ontologies for special purposes are being created, some general principles of classification, as well as some classification schemes that are the result of good conceptual analyses, are available already. An additional challenge is the new opportunity of obtaining taxonomies by generative artificial intelligence, where similar principles are probably involved, although they are currently not made explicit to the user.

Bibliographic classifications, digital ontologies and AI-driven taxonomies have many problems in common with metaphysics, that are covered in the field of knowledge organization (Gnoli, 2025). While this field has developed mainly within library and information science until now, we wish that it also becomes more open towards philosophy, and as a consequence becomes better known by philosophers. In this paper we hope to have shown how an important philosophical debate, the one concerning the status of natural kinds and their occurrence with different roles in alternative systems, corresponds to analogous problems in the theory of bibliographic classification and can benefit of some relevant insights from it. Although we are nowadays aware of the pragmatist remarks concerning alternative perspectives related to different purposes in human activities, such notions as levels, facets and unique definition prove to be relevant in pursuing the timeless quest for an all-purpose system.

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