Ingetraut Dahlberg

A Referent-Oriented, Analytical Concept Theory for INTERCONCEPT[1]

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The concept theory presented, meant to serve as a basis for conceptual analyses of all terminological efforts, implies that every concept has a referent (be this a set of objects, a single object, an activity, a fact, a topic, etc.) about which verifyable statements determining the properties and relationships of the referent in question can be made. The totality of all the verifiable and necessary statements on a referent may be summarized and/or synthesized by a term which will then represent a concept in any communication process. A concept is thus regarded as a knowledge unit, and the statements about its referent are found to be the knowledge elements, also known as the characteristics, of the given concept. The possibility of thus determining the characteristics of concepts permits the analysis, construction, reconstruction, correlation, categorization and definition of concepts as well as the formation and control of adequate terms and the construction and comparison of concept systems. (Author)

1. Introduction: linking up COCTA with INTERCONCEPT

The starting point for COCTA[2] was furnished by the requirements of social scientists as users of concepts, in the light of contemporary analytic frameworks provided by logic and the philosophy of science. By contrast, the starting point of INTERCONCEPT was UNESCO's need to establish norms and facilities in order to support its General Information Program and, more specifically, to implement its planned Social Science Information Program[3]. Within the latter context, the theoretical and methodological framework of INTERCONCEPT was provided by Infoterm[4], the pioneer work of the late Eugen Wüster[5], and by the recommendations of Technical Committee 37 of the International Standardisation Organisation (ISO/TC 37) as reflected especially in its draft standards on the theory and metaconcepts of terminological work[6].

What is now clearly needed is an understanding of certain problems that must be solved so that a useful bridge linking up COCTA and INTERCONCEPT can be built, thus facilitating the utilization of the proposed UNESCO-sponsored terminology bank by social scientists who can now, potentially, be reached through a network of interested scholars, organized primarily by subject fields, as reflected, however crudely, in the established research committees of the member associations of the International Social Science Council, for which COCTA serves as a Standing Committee.

If we look at the metaconceptual problems that need to be solved in order to link up the "information-oriented" work of the proposed INTERCONCEPT terminological service with the social science user orientations of COCTA, we can identify some questions that require answers on each side of the bridge. On the INTERCONCEPT side, a fundamental constraint of the terminological work sponsored by ISO/TC 37 has been its primary orientiation to the needs of technology and the natural sciences, both of which differ from the social sciences with respect to their disposition toward "standardization" or "normalization". First, the economic and administrative sanctions which undergird standards in technological fields scarcely apply to the social sciences, and second, the capacity of the natural sciences to coin neologisms for new concepts provides a motive and possibility for normalization not available to social scientists. By contrast, clearly, the only sanctions available to social scientists are those of peer pressure exercised via the discourse communities into which the numerous fields of knowledge in the social sciences are divided. Moreover, the almost exclusive reliance by social scientists on the use of terms derived from ordinary language usages results in an extreme proliferation of the meanings in which the most commonly used words are employed, thus producing a polysemantic jumble which appears to defy all normalizing efforts.

The latter point helps us to understand a salient feature of the first stage of COCTA's work, namely its efforts to promote conceptual and terminological analysis in their use of some key terms through what has been termed 'reconstruction' and 'construction' of concepts. At the Uppsala Congress the other COCTA Panels were devoted to the analysis of such concepts, as signified by the uses of words like 'power', 'integration', 'alienation', 'consensus', 'political culture', and 'bureaucracy'.

Although such exercises powerfully dramatize to social scientists some of the underlying problems of conceptual analysis as well as the need for a special effort to overcome the increasingly prevalent "Tower of Babel" manifested in their writings, it is clearly also the intention of COCTA, as indicated by its debate on "Guidelines" at the Skokloster Workshop which preceded the Aug. 1978 ISA Congress at Uppsala to press toward a later stage of analysis based on sets of interrelated concepts as they are used in selected subject fields or discourse communities, starting from interconnected definitions of the central concepts used by the members of such groups. The performance of such a task has until now proved so costly and difficult that it has scarcely been feasible, but it is our belief that the proposed INTERCONCEPT terminology bank will, once it is operational, provide a resource base and a tool that can be used to facilitate the systematic analysis of the related concepts used in any subject field, thus leading to the preparation of appropriate instruments that will

reflect current and proposed usages as determined by scholar-users.

In order to build the proposed bridge between INTERCONCEPT and the social science community via COCTA, we need to establish a mutually acceptable basis for understanding what we mean by 'concept', 'term', 'definition', 'intension', 'extension', 'referent', and the like, notably the metaconcepts required for conceptual and terminological work. A glossary of such metaconcepts was prepared by G. Sartori for the symposium on key concepts[7], and this glossary will be further revised for publication in the light of the comments and experiences of the authors of the papers for the symposium volume. A different, though overlapping, set of concepts and terms was presented in the ISO/TC 37 Draft Recommendation "Vocabulary of Terminology" and it is implicit in the associated methodological and theoretical draft recommendation on "Naming Principles"[8].

It seems, therefore, that the time has come for independent contributions to this cooperative venture.

In this paper, accordingly, I offer as a personal contribution a suggested model of analysis designed to clarify the nature and structure of concepts, and to support procedures appropriate for their study, which model might perhaps be helpful both to COCTA and to INTERCONCEPT as the process of bridge-building proceeds[9].

2. The concept as a whole and its parts

2.1 What are concepts?

Concepts have been defined by the ISO Draft Recommendations mentioned, as "units of thought" (R 1087) or "mental constructs" (R 704). They are also held to be "meanings of a term" (linguistic understanding) or "units of thinking"[10].

Clearly, concepts are units. However, if we regard them as "units of thought" it seems that we are unable to grasp such a unit, it remains something subjective, something that is in the head of someone who happens to think it.

By contrast I should like to propose to regard a concept as a "unit of knowledge". This, however, presupposes first of all that we can acquire a common understanding of 'knowledge'.

If knowledge may be regarded as the totality of true propositions about this world, existing – in general – in documents or in the heads of persons, then knowledge may be seen to exist also in every true statement (in every judgment) and in all of the scientific propositions which obey the truth postulate. It has been proposed to regard a science as the set of such propositions about an area of study being brought together in a foundational relationship (Begründungszusammenhang)[11]. If our sciences are built up on propositions and these in turn on components which may be looked at as knowledge units, then such units must be amenable to scientific verification. How can this be achieved?

Assuming that man has the ability to make correct statements both about real things (empirical items) and about ideas existing only in his brain, we may set up a "model for concept construction" as given in Fig. 1[12].

Starting from a *universe of items,* we select one item as the *item of reference* for our purposes, i.e. the "referent". Such referents may be a single object, a set of objects considered as a unit, or a property, an action, a dimension, etc. or any combination of these. *Correct statements* about such a referent may be verified through evidence or through intersubjective agreement. Such verified statements are then accepted as true statements in a *verbal form* that can be conveniently used, a term or a name. With such a verbal form we are then able to communicate in speaking and in writing about the contents (the judgments about a referent) of a concept, hence to apply a concept in our statements, in the *universe of our discourses.*

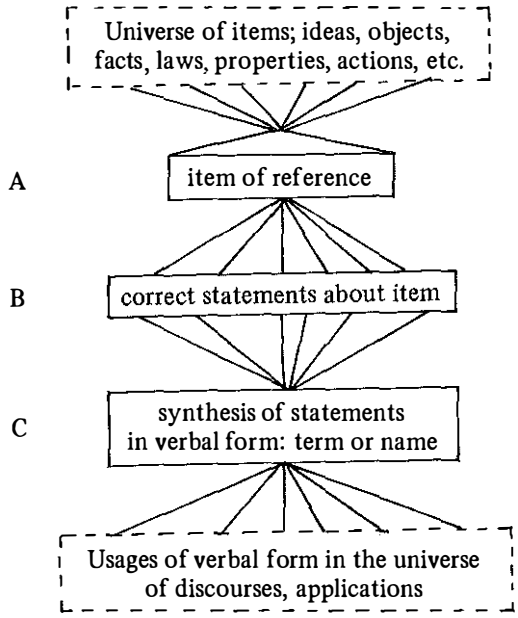

Fig. 1: Model for concept construction

This model for concept construction demonstrates how a concept may be generated which does not yet exist as such. The necessary components of such a concept are, then, its referent (A), judgments about the referent (B) and the verbal form (C) used to represent it. Each correct statement about A yields an *element of knowledge* about A and the sum total of correct statements about A furnishes the *knowledge unit* about A. Note that in Fig. 1 the "universe of items: ideas, objects, facts, etc." as well as the "usages of a verbal form in the universe of discourse" are given in a half open frame, as against the steps A to C, represented in closed frames. By this, I suggest that these universes are open ones, whereas the concept constructing steps are closed whenever one item of reference is selected. The "case" becomes closed for the construction of a concept designating this referent: what is to be predicated in B and to be termed or given a name in C, is established by A. We may now define:

(1) A *concept* is a knowledge unit, comprising *verifiable statements* about a selected *item of reference,* represented in a *verbal form.*

We may also define each of the three components of such a knowledge unit:

(2) A *verifiable statement* is the component of a concept which states an attribute of its *item of reference.*
(3) An *item of reference* is the component of a concept to which its *verifiable statements* and its *verbal form* are directly related, thus its *"referent"*.
(4) A *verbal form* (term/name) of a concept is the component which conveniently summarizes or synthesizes and represents a concept for the purpose of designating a concept in communication.

Here two remarks must be added:

a. The "verifiable statements" (B) are usually known as the characteristics of a concept, since any statement about an item of reference yields an attribute of this item which may be a property, a state, a dimension or the like.

b. The sum total of necessary "verifiable statements" to be made about an "item of reference" and thus the sum total of characteristics of a concept form the *contents of a concept*. Thus we may add two additional definitions:

(5) A *characteristic* is the component of a concept which is derived from a statement about its referent, or (regarding statements as contents).
(5a) A *characteristic* is an element of the contents of a concept.

More simply, then, the above definition (1) of a concept can be re-phrased as

(1a) A *concept* is a knowledge unit comprising the characteristics of a referent by a term or a name.

Regarding the steps involved in the construction of a concept, we may speak of them as

the referential step (A)
the predicational step (B)
the representational step (C).

These components may also be represented graphically in the form of a triangle in a similar way as proposed by Sartori[13]. However, whereas Sartori's triangle is rather an angle, placing the components of a concept in the following form

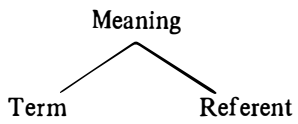

Fig. 2: Concept angle according to Sartori

putting 'meaning' at the top of the angle and 'term' and 'referent' at the left and right respectively, one may consider from the above that the two additional items of the model of concept formation, i.e., the 'universe of items' as the ground of concept formation and the 'universe of discourse' as its application are not included. These two would have to be added to the Term and the Referent respectively.

Symbolizing Fig. 1 within the concept triangle, or rather, placing the sources of concept creation at the top, as in Fig. 3, and the "meaning" – which may be looked at as the representation of the characteristics – at the bottom left corner to symbolize their primacy in conceptualization, results in having to place the term in the bottom right corner as the last (rather than the first) part to be determined.

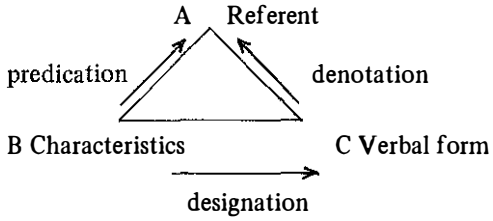

Fig. 3: The concept triangle

From Fig. 3 it also becomes obvious what kind of activities/relations exist between the components mentioned, namely predication (B, A), designation (B, C), and denotation (C, A).

2.2 Referents of concepts

Philosophers of our times still distinguish between 'theoretical' and 'empirical concepts', the former occurring in theoretical contexts and the latter referring to objects of reality[14]. As this dichotomy is not based on one characteristic of division one will soon find that those classified as 'theoretical concepts' include empirical ones, which means that these are then empirical as well as theoretical. 'Integration' is truly a process in a social framework, but one should talk about it in a theoretical mode just as well as with regard to cases of integration having actually taken place. A 'unicorn' has no empirical counterpart in today's animal world; however, it may well be regarded as a concept of an immaterial object, namely of one in the world of existing theatre plays, fairy tales, or fables.

From our point of view this distinction is an unnecessary one, it does not help to sort or to class concepts into mutually exclusive categories. A proper categorization of concepts may rather follow a categorization of referents. And here we may realize that there exist already a number of proposals from the part of information classification. The Indian classificationist S. R. Ranganathan[15] established five "fundamental categories", namely 'personality', 'matter', 'energy', 'space', and 'time' and related these to the concepts in his classification system to form facets accordingly. The British Classification Research Group (CRG) distinguished between 'entities' and 'attributes' as the ultimate kinds of categories[16]. The importance of a basic categorization of the referents of concepts was also indicated by H. Teune's discussion of this problem under the headings of 'object' and 'property' concepts, and, under the former, his 'aggregates' and 'systems'[17]. The scheme which I found most helpful is the one established along the lines of Aristotle's categories, through which all items of reference may ultimately be sorted into four form categories, each of which may then be subdivided into three subcategories, according to the scheme presented in Fig. 4. Perhaps, in light of the special needs and frameworks of the social sciences, some other categorization would prove more useful[18]. The main point to be made here is that such a classification of referents, as Teune's proposal indicates, provides the necessary foundation for systematic efforts to analyze the concepts of any subject field.

It should be pointed out that the list of subcategories mentioned in Fig. 4 cannot entirely be traced back to Aristotle. He distinguished between the category of the

one substance (here entities) and the categories of the nine accidentals, although he mentioned the latter in almost the same manner.

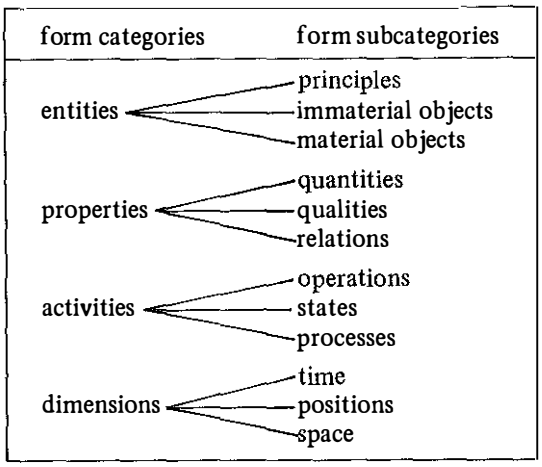

Fig. 4: Concept referents

Usually, of course, one does not start from a referent that can immediately be classed as belonging to just one of the 12 subcategories of Fig. 4. Rather, one starts with a referent belonging to some combination of them. However, in "analyzing" the components one typically generates hierarchies, terminating, at the most general level, in a form category which, in turn, facilitates the identification of the contents (in terms of characteristics) as well as the structure of the concept in question.

The final determination of referents through predication may thus take the form of a "ladder of characteristics" or "ladder of concepts", since characteristics are concepts too. Starting from any base and predicating the predicates up to an ultimate form subcategory one can establish the form class for one of the characteristics of a concept. The procedure can be illustrated by any randomly selected referent, such as, for example, a "weekly paper":

entities
  material objects
    information carriers
      documents
        periodically appearing documents
          newspapers
            weekly newspapers

Fig. 5: Concept ladder/Ladder of characteristics

It should be noted that in each case the next step up in the hierarchy of characteristics implies that a true statement can be made about the items found in lower levels of the sequence[19]. If a so-called 'broader concept' does not hold for all its narrower species and individua, then the hierarchy may be said to be defective.

Concludingly we may state that all our concepts are abstractions of reality in the sense that they are products and instruments of man's ability to think and speak about reality to the extent permitted by his knowledge of reality. They differ, however, in the degree of abstraction, ranging from the most specific and individual ones to specific ones to the most general ones.

2.3 Concept characteristics

If it is agreed that ultimately there are only four basic kinds of concepts(according to the form categorial referents mentioned above), then we may also say that there are only four kinds of characteristics to be derived from predicating the predications of a referent and thereby establishing ladders of characteristics as seen in Fig. 5. Characteristics are also concepts, we said it already. However, with regard to the analysis of any given concept, a characteristic is only an element in that concept. From the ladder of characteristics displayed in Fig. 5, then, we may also see that the concept of a higher step is included in the concept of a lower step; the lowest concept of such a ladder contains the entire sequence of concepts as its characteristics in itself. We will come back to this point later on.

Besides this we may recognize certain types of characteristics according to and derivable from the statements about the properties of a referent in addition to the ones constituting the ultimate category of a concept, namely its specialising ones. With regard to Fig. 5 these are e.g. 'periodicity' and 'kind of periodicity' as well as the individualizing ones, namely the ones that would belong only to a certain item of reference, e.g. "to be published in Hamburg", "to appear on Aug.31" etc. There are altogether three general types of predications which will yield three types of characteristics, namely those which may be stated

1 – of all the referents of a given kind
  (e.g. of all 'documents' it can be said that they are information carriers)
2 – of some of the referents of a given kind
  (e.g. of some 'documents' it can be said that they have a periodicity)
3 – of only one referent in question
  (e.g. of the newspaper published in Hamburg, named DIE ZEIT)

Correspondingly we may distinguish between

1 – characteristics applying to all referent of a given kind to be called *'essential characteristics'*
2 – characteristics applying to only some referents of a given kind to be called *'accidental characteristics'*
3 – characteristics applying to a singel referent to be called *'individualizing characteristics'*

In addition to this trichotomy one might also distinguish between characteristics which constitute a concept, namely either those under 1, or under 1 and 2, or under 1 and 2 and 3, which may be called *"concept-constituting characteristics"* or "necessary characteristics" as opposed to "possible characteristics" which are any of those which a referent of a given kind may possibly acquire but which are not needed for the constituting of a concept in question. Then there are also characteristics which follow from the concept constituting ones in given cases, as e.g. those mentioned under 1a) and 2a) in the following example (Fig. 6), which may be called *"consecutive or implied characteristics"* since they follow from the concept constituting ones by implication, e.g. if something is a material object, it follows that it has physical and chemical properties, a form or a structure and a shape. Or, if something is a living being, it follows that it is (on this earth) a material object with all its implications mentioned and its own ones, namely that it must live and grow, reproduce itself and die. The

example in Fig. 6 should not be evaluated according to its contents but rather to its form.

1) *Essential (and constituting) characteristics of man:*
to have the body of a primate; to have a mind; to have a spirit
1a) *Essential and implied characteristics of man:*
to live and grow, to reproduce himself and to die
to possess consciousness and brainpower
to have willpower and the ability to symbolize and to create
2) *Accidental characteristics of man:*
to be a male, to be a female person
2a) *Accidental implied characteristics:*
to differ in growth, in way of reproduction,etc.
to possess varying degrees of consciousness and brainpower
to have a stronger or less stronger will, to be able to symbolize and to create in different ways
3) *Individualizing characteristics of man:*
to have a certain heritage, parents and/or relatives
to have a certain location and time of birth and life on earth

Fig. 6: Types of characteristics; referent "human beings"

Altogether we may now distinguish between
a) Form-categorial characteristics = the ones referring to form-categories and form subcategories
b) Ontological characteristics = the ones referring to categories of being, as e.g. "to be a material object", "to be a living being", "to be a human being", "to be an information carrier"
c) Concept constituting characteristics (the essential, accidental and individualizing characteristics) = the ones referring to either all, or some cases or a single case of a given item of reference
d) Consecutive or implied characteristics = the ones following from the essential and accidental characteristics by implication and possible diversity[20]

It should be kept in mind that structure, nature and amount of characteristics of a concept in question play a very important role in concept analysis and in the handling of concepts. We shall come back to these questions soon.

2.4 Verbal forms of concepts

The third component of each concept – as it was stated in Sect. 2.1 – concerns the verbal form or, in short, its term or name. It should be noted here that 'term' was used formerly to stand for both: for the name of a concept and for the concept itself, which has been identified here as the concept triangle. The history of this use can be traced back to Boethius' translation of Aristotle into Latin, in which Boethius called 'terminus' what has been understood by Aristotle as being 'logos', 'horos', 'pragma'. Whereas in German philosophy and history of science we speak of "Begriff" meaning 'concept', the Anglo-American philosophers still use 'term' in the sense of 'concept'. Quite recently there has been a reorientation so that we are now able to distinguish the verbal form, the term, from the knowledge it designates.

As long as one is concerned with concept construction – that is, creation of new concepts – one needs to "create" also the verbal form for such a concept. Whenever a verbal form exists already and a reorientation, or – what has been termed a 'reconstruction' of a concept must take place by finding its correctly corresponding referent and by establishing the characteristics thereof – then the question arises whether the verbal form existing is adequate or whether a change should be considered.

Generally speaking there may always be more than one form for the verbalization of a concept. However, in order to facilitate communication it is advisable to search for and to establish, if possible in a normalized way, the best fitting form. For this, principles exist and deserve to be mentioned here in short:

Principle 1: Compliance with referent

The verbal form of a concept should comply with the referent of a concept.

a) If the referent of a concept is of such a general nature as to represent a form category or a form subcategory and its immediate subdivisions then the verbal form should be of a similar degree of generality, i.e. it should be a so-called *general term*, as e.g. most of the words of ordinary language are.

b) If the referent is a specification of some degree and represents a subset of case a), then the verbal form should reflect this by containing at least two parts: the general term and a specifier which then will result in a so-called *special term* or mostly just *term*. (Example: general term: 'development', special terms: 'social development', 'urban development', 'child development'.)

c) If the referent is an individual, then the verbal form should reflect this through the *proper name* (or just 'name') of this individual or the individual case. This applies also to combinations, as e.g. "the Treaty of Versailles", where 'treaty' is the general term combined with the proper name of the place where the treaty was signed. One should avoid – on the other hand – to combine a proper name with a general term if a general or a special concept is represented, e.g. one should not create a term like "Röntgen rays" when a certain kind of ultrahard rays are to be denoted, since these are not the rays of Mr. Röntgen, he was only their discoverer. The systematic position of a concept with such a wrong verbalization can be determined from such a term only with difficulty, if at all.

Principle 2: Reflection of characteristics

A verbal form of a concept should, if possible, reflect the nature of a concept, i.e. its necessary characteristics or concept-constituting characteristics. For example, a kind of administration may be termed either according to its structure or according to its function. In the former case we would have combinations with 'company-', 'city-' or 'municipal', 'state-', 'federal' and in the latter case combinations with 'finance', 'law', 'health/public health', 'military' etc. In cases of anything man-made the purpose plays a more important role than the structure or composition, so that the specifying characteristics would have to be selected from the latter list.

Principle 3: Minimum length of term

Since the verbal form of a concept will enter discourse and will be used as often as necessary it follows that the length of such a form should be kept to a minimum. Here Zipf's law, the law of easiest and minimum requirement, of least effort applies. This means also that during the introductory phase of a term in which some of the necessary characteristics have been dropped for purposes of abbreviation it is often necessary to have its definition accompany it.

Principle 4: Verbal derivability

If possible one should select such a verbal form in a given case which possesses derivational potentials, as e.g.

metal in 'metallic', 'metalliferous', 'metalline', 'metallist', 'to metallize', 'metalloid', 'metal-box'.

Principle 5: Internationality

For reasons of international understanding it is advisable to create terms which contain Latin or Greek elements, thus being equally understandable in different languages, such as

Latin 'vocare' may be found in 'vocabulary' and 'vocabulaire'

Greek 'systeme' may be found in 'System', 'system', système etc.

See for this also ISO-Recommendation No. R 860 "international unification of concepts and terms".

2.5 Metaconcepts concerning kinds of terms

A short characterization of some of the metaconcepts concerning terms may follow:

One speaks of *monosemes* whenever a single term stands for a single concept, of *polysemes* whenever a single term stands for several concepts which are not so far apart; *homonyms* are terms which have the same form but which represent quite different concepts; *synonyms* are different terms for one and the same concept; *quasi-* or *near-synonyms* are terms which stand for rather similar concepts. *Hypernyms* are terms that refer to a more general concept than *hyponyms* which are terms referring to the specific concepts of a general concept[21].

3. Properties of concepts and of characteristics

We shall now turn our attention to the metaconcepts concerning the properties of concepts as found in a concept typology, in the relationships of concepts and in their intension and extension.

3.1 Types of concepts

In the existing literature about concepts one may always encounter the dichotomy between "general" versus "individual" concepts. However, taking into account the role which the referent plays in categorizing a concept we may recognize that there is not on the one hand the individual case and on the other hand the case of a totality of such individuals, as e.g. a certain weekly periodical as against all weekly periodicals of this world, but that there are numerous groupings in between which specialize such concepts, here 'weeklies', according to certain characteristics. Whereas the characteristics which all weeklies have in common are those which constitute their general concept (i.e. their essential ones), there are other characteristics which only some weeklies have in common (i.e. accidental characteristics); these constitute – together with the essential ones mentioned – the special concepts. Thus we may easily distinguish between three types of concepts, namely the general, special and individual ones. The following matrix may show this more clearly, where in the row of headings one finds the "three steps in differentiation" and in the left column the "three steps in construction" of a concept:

steps in differentiation / steps in construction	all referents of a given kind	some referents of a given kind	a single referent
A referential	GENUS (general ref.)	SPECIES (spec.ref.of a general one)	INDIVIDUUM (individual ref. of a special one)
B predicational	essential characteristics	essential + accidental ch.	essential+accidental+individualizing char.
C representational	general terms (ordinary lang.)	special terms/ technical terms	names/ proper names
Σ A+B+C	general concepts	special concepts	individual concepts

Fig. 7: Types of a concept according to number of referents

This trichotomy of any concept should not be confused with the representation of a concept hierarchy showing different concepts on the steps of a concept ladder. Fig. 7 does *not* e.g. represent such levels as

periodicals – weekly periodicals – DIE ZEIT

but rather

all weekly periodicals – some weekly periodicals – one weekly periodical

or, similarly

all developments – some developments – a single development.

We may thus define

(6) a general concept = a concept whose referent points to all items (a genus) of a given kind

(7) a special concept = a concept whose referent points to some items (a species) of a given kind

(8) an individual concept = a concept whose referent points to a single item (an individual) of a given kind.

There may still be some open questions: what, e.g., is the individual in the case of e.g. DIE ZEIT? Is it the weekly periodical DIE ZEIT in general, an entire edition, all editions? Or is it just the specific issue here on my desk? Obviously, then there are degrees of individuality, just as there are degrees of speciality and of generality for every concept. The presentation in Fig. 7 then, is not meant to show how concepts may be categorized in general, but rather what are the three main cases of each concept roughly. It holds, though, for all kinds of referents, as e.g. entities, properties, actions and dimensions and their combinations.

3.2 Concept relationships

If we accept the definition of a concept given above (see Section 2.1) where a concept may be regarded as a whole or a set comprising as its elements characteristics, then we may also recognize that it is the characteristics forming the contents of a concept which constitute its relationships to other concepts. If two or more concepts have at least one characteristic in common, then clearly a relationship must exist between these concepts.

One may distinguish between two major kinds of relationships, namely

a quantitative and

a qualitative one,

where the *quantitative relationship* measures the amount and similarity of characteristics in a concept, of which at least four kinds should be mentioned:

concept identity = the characteristics found in two concepts are the same

concept inclusion = all the characteristics of one concept are contained in the greater number of characteristics of another concept

concept intersection = the characteristics of two concepts overlap

concept disjunction = the characteristics of two concepts have nothing in common.

The *qualitative relationships* may be subdivided

formally according to the kinds of concepts as discussed in Section 2.1, i.e. according to concept referents (form categories)

(Note: The establishment of concept hierarchies according to form-categories will yield the so-called "facets" of the well-known facet classification systems if applied to special fields.)

materially or ontologically according to the ultimate object category of a concept (e.g. microorganisms, plants, animals would ontologically belong to the object area of living beings).

Among the latter kind of relationships we may also find four kinds or relationships based on characteristics, namely

(9) *hierarchical relationship* = the relationship between genus-species, species-species and species-individua[22]

(10) *partition relationship* = the relationship between a whole and its parts, between the parts and between parts and sub-parts

(11) *opposition relationship* = the relationship of contradiction, contrarity and PIN (positive-neutral-indifferent)

(12) *functional relationship* = the relationship between the components of a statement/a proposition, depending on the semantic valencies of an acitivity-related concept (e.g. 'to produce' demands that a producer, a consumer, a product, etc. be involved).

These kinds of material relationships should be illustrated by examples. To save space, however, the reader is referred to a recent publication[23] where they have been outlined in extenso.

The knowledge about concept relationships plays an important role in the comparison and in the construction of concept systems and thus in the systematics and display of knowledge units belonging to a field of study, a discipline or a plurality of such. One should also keep in mind that once a systematic ordering of concepts is accomplished it becomes possible to construct more satisfactory definitions of them, a subject to be treated below (see Sect. 4). Such concept systems may also be regarded as classification systems, the function of which is to create order among elements of reality. The elements of such classification systems – especially those organized formally according to qualitative relationships – may be combined according to syntactic rules to form complex classes according to the demands of a complex element of reality, as e.g. the contents of a document.

3.3 Intension and extension of a concept

After having considered the origin of concept characteristics and the relationships of concepts we may now more easily understand what is meant by the 'intension' and the 'extension' of a concept.

(13) The *intension* of a concept is the sum total of its characteristics which is the same as the sum total of concepts of its concept hierarchies plus its specifying characteristic(s).
(Note: The intension covers only the necessary characteristics (essential and accidental ones) which lead to a certain position in the hierarchy of a concept. It does not include the possible characteristics which may be the specifying ones of lower hierarchies of a concept.)

(14) The *extension* of a concept is the sum total of its special concepts and their individual concepts, that is, the set of concepts for which the intension of a concept holds true.
(Note: the extension of a concept is understood by some also as covering the actual objects, i.e. the items which may become items of reference of concepts. One must keep in mind that the intension and extension of concepts can only cover concepts – surely of different types.)

In order to see this graphically, we may refer to the concept ladder in Fig. 5 and recognize that the intension of a concept includes all its broader concepts (according to the hierarchical relationship as well as according to its formal qualitative relationship) while its extension covers all its narrower ones, as becomes obvious from Fig.8.

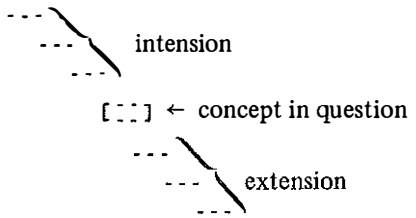

Fig. 8: The intension and extension of a concept

4. Definitions of concepts

4.1 What is a definition?

In order to use concepts and their terms correctly and precisely in given cases of discourse we must know exactly what they stand for, that is, what their intension is. A definition may be regarded as an instrument for the establishment of boundaries for the intension of a concept, or, rather, as the sum of those characteristics which make up this intension and which is represented in communication (texts or speech) by terms. One may easily

see, though, that only those concepts need definitions whose referent does not point to individuals. Individual concepts cannot be confused with each other; as their characteristics can be checked at any time against the existing individual.

How can one establish the boundaries of the intension of a concept? The answer is very simple: since intensions are represented by terms one needs to equate a term in question with the intension of the concept in question. In such an equation one starts with the term, the definiendum, and equates it with the statement containing the necessary concept characteristics (preferably in a structured way), the definiens. Thus we may define

(15) *Definition* is the establishment of an equivalence between the term (the definiendum) and the necessary characteristics of the referent of a concept (the definiens) for the purpose of delimiting the use of the term in discourse[24].

If we go back to the concept triangle displayed above (Fig.3) we will recognize that this definition of a definition as well as others can easily be derived from this triangle, namely through the equation

C = B with reference to A.

4.2 Kinds of definitions

A look into the literature about definitions will reveal that there are quite a number of different kinds, a recent investigation[25] rounded up altogether some 72 terms denoting such different kinds. In the following we shall only deal with the most important ones and show especially also their relationship to the concept triangle.

The kind of definition which underlies the above definition (15) has been called in logic a *'real definition'*, since it includes the consideration of a reality in the referent as against others which neglect referents and remain on the verbal level only by "defining" just the *term*. Such definitions have been termed *'nominal definitions'*, since they are only concerned with the 'nomen', the term, and its "meaning"[26], not with the referent and its item, subject or object. Still another kind of known definition which equally neglects one part of the triangle is the *ostensive* one, which equates a term with a referent and forgets about the characteristics, or which points from a term or a name directly to a referent. In using the positions of the concept triangle of Fig.3 we may establish the following equations for these 3 different kinds of definitions:

real definition; C = B with reference to A

nominal definition: C = B, neglecting A

(a term is equalized with an expression of characteristics without reference to any item of reality)

ostensive definition: C = A, neglecting B

(a term is equalized with a referent without expression of characteristics of this referent).

There is a number of *different forms of real definitions* depending on the kinds of referents; the different forms are revealed through different structures of statements in angle B, the definiens.

The best known structure of the definiens is the age-old one by *genus proximum and differentia specifica*, because it relates a given concept by its first predication to a broader concept (genus proximum), thus establishing a connection to something known. Quite often this kind is replaced by one which puts in the first hand the form-categorial concept. E.g. in defining an action, the definiens often starts with C = a process which . . ., thus establishing a relation to the genus supremum of such a form-categorial concept. Such procedures are of course necessary if there is no other way to define, especially if there is only one characteristic in addition to this form categorial concept. It can be seen that this kind of a definition rests on the same principle as the *hierarchical relationship* (see Sect. 3.2). Thus, any classification system using this relationship is truly a definitional one.

The application of the *partition relationship* has led to the belief that one may also be able to define a concept by the parts of any item of reference. Surely every entity consists of parts, however these parts do not always stand for the necessary characteristics of such an entity. The parts, of e.g. a human being are also the parts of a primate or the parts of a mammal. Thus they become implied characteristics in the collection of the true statements on a referent in question.

The *opposition relationship* is often used in definitions for illustrative purposes, e.g. when the opposite concept is mentioned to clarify a given case.

The *functional relationship* is employed very often in the hierarchical relationship, namely whenever a broader concept is specified by a sort of a functional characteristic, e.g. "purpose" – machine – printing machine.

A newer kind of definition is the *operational* one, which provides rules for the creation of a referent in question, as e.g.

X = the ratio of a distance travelled in a certain time.

The term X stands for the result of the operation: to divide a certain distance by the hours needed to cover it. It is at the same time the definiendum of such an operational definition. The definiens on the right side of the equation establishes both the referent and the operation by which it can be constructed at the same time.

Besides this, one may also often find what has been termed a *'conditional definition'* or, by Teune, a "dispositional definition"[27]. This kind is given whenever a condition must be fulfilled so that a referent may be established, e.g.

thesaurus (in the field of information storage and retrieval) = a list of terms and/or of other signs (or symbols) indicating relationships among these elements, provided that the following criteria hold:

(a) the list contains a significant proportion of non-preferred terms and/or of preferred terms not used as descriptors;

(b) terminological control is intended[28].

The condition to be fulfilled is expressed by the term or words "provided that". It follows that those lists of terms must not be called 'thesauri' for which the criteria mentioned do not hold.

4.3 Discussion

As has been shown, definitions are always intensional definitions in that they equate the intension of a given concept with its term. Thus the expression 'intensional definition' is a tautology and superfluous, especially since its counterpart, an 'extensional definition' does

not exist; definitions were defined as establishing the boundaries of an intension. The extension of a concept is, however, without any limits; a definition by extension would therefore be a contradictio in adiecto.

We said above that definientia must contain the necessary characteristics of a concept. These are then also called the 'defining characteristics'. Very often it is helpful to add to them some of the narrower or the subconcepts of a given concept as examples for the extension and a help in the application of a concept. It must be kept in mind, though, that these do not belong to the concept and definition in question.

Rules have been established for the construction of definitions[29], however, this very field has not yet been explored with the help of a suitable and adequate material so as to lead to a manual for the consistent construction of all kinds of definitions for the many differing kinds of concepts. Much more research and development should, therefore, be devoted to this field since we are not only in need of a sound basis for improved lexicographical and terminological tools but also of one for conceptual systems to be derived from such definitions, especially for an improved overall view of the knowledge we have acquired so far.

5. Conclusion

It has been frequently stated that the terminological situation in the different schools of thought – including Marxism – and in the different subject areas is "a mess". In my opinion this "mess" is mostly due to the fact that the metaconcepts of the concepts outlined above have been confused to a very large extent in everybody's mind, since no theoretical framework for their understanding and correct use has been available so far.

This referent-oriented, analytical concept theory outlined is based on the assumption that man is able to formulate correct statements about the items of his direct and indirect cognition of this world. These statements may be used as knowledge elements or elements of knowledge units for a number of different purposes, such as

- the analysis of concepts
- the construction and reconstruction of concepts
- the comparison and correlation of concepts
- the categorization of concepts
- the definition of concepts
- the construction of terms
- the control of the adequacy of terms
- the construction of concept systems
- the comparison of concept systems

and may thus be fruitfully applied to all those cases which deal with the fundamentals of our knowledge. The identification of knowledge elements or characteristics of concepts thus facilitates the understanding of concepts in general, it creates a foundation for the formation of concepts and explains the existence of relationships between them. It seems, therefore, that this concept theory could be used as a helpful tool for the purposes of INTERCONCEPT, COCTA and ISO/TC 37 as well as in other application areas whenever and wherever problems of concept clarification and concept systematization occur.

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Notes:

1 Paper presented at the COCTA Panel 3.3, 9th International Conference of Sociology, Uppsala, Aug. 17, 1978 (revised and enlarged).
2 COCTA = Committee on Conceptual and Terminological Analysis of the ISSC (International Social Science Council), IPSA (International Political Science Association), and ISA (International Sociological Association. See also (1).
3 See the report about INTERCONCEPT in Intern. Classificat. 5 (1978) No.2, p. 102.
4 Infoterm = International Information Center for Terminology in Vienna, sponsored by the Unesco.
5 E. Wüster's first edition of (2) appeared in 1931. Afterwards he was highly influential in starting international and national standardization activities in terminology (and other fields as well).
6 To mention just the most important ones in this context: ISO/R 704 "Naming principles" and ISO/R 1087 "Vocabulary of terminology".
7 See the annex to the still internal document "Guidelines for concept analysis" by G. Sartori, Aug. 1978, 26 p.
8 Both recommendations are at present undergoing substantial revision.
9 This reflects work that went into the publications listed under (3–7).
10 See Sartori in (1), p.2.
11 This propositional concept of science has been supported by Diemer, see (8), (9) and (10).
12 Formerly I called this process 'concept formation' (see (7)), however, since psychologists use this term to denote the formation of mental constructs mostly in child psychology, it seemed more adequate to call the conscious procedure of establishing the elements of a concept: concept construction, also since it is indeed a kind of building up a whole by its elements and giving it an external form. It seems to come very close to the understanding of this concept in the COCTA glossary.
13 See the document cited in Note 7 (above), p. 1.
14 It must be mentioned that in a recent publication (14) Paul Feyerabend recommends the dropping of the distinction between theoretical and observational terms, (see p.230) "since these don't play any role in scientific practice."
15 This result was based on the analysis of hundred of thousands of documents. See also (12) and (13).
16 Cf. the reports published in (11).
17 See Teune in (1), p. 83–91.
18 Although I cannot think of any such at the moment.
19 One may perhaps argue that the concept ladder in Fig.5 contains one unnecessary step, namely 'Periodically appearing documents'. I included it, however, for another reason.
20 Some others distinguished also between 'intrinsic' and 'extrincic' (ISO/R 1087) characteristics; inherent ones were also found (DIN 2330). I cannot consider these distinctions as very helpful in our context.
21 The latter terms were introduced by Lyons (see (15), chapter 10.3); he also speaks of "co-hyponymy" meaning the hyponymy in one array.
22 This relationship has also been called 'generic' and 'relationship of abstraction'.
23 See the publication under (7), p. 21–24 or (5) for these relationships in German.
24 Somewhere else (in (5)) I defined "Definition = die Feststellung oder Festsetzung eines Begriffsinhaltes" which, unlike the definition (15) given here, does not yet consider the components of the concept triangle.
25 Cf. H. Mönke in (16).

26 Here again we encounter the approach "meaning of a term", which presupposes that a verbal form has a meaning in itself rather than standing for an intension established by predicating an item of reference.
27 Cf. Teune in (1), p. 89.
28 This definition was given by Soergel in (17), p. 38–39).
29 See for this also (5), Sect.4 and Riggs, F.: The definition of concepts. In (1), p. 39–76.

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