one. Not in the last place is this the case with such composite concepts, as e.g. 'knowledge acquisition', 'knowledge representation' and 'knowledge processing', which are defined differently depending on whether they are viewed from the aspect of human memory or from that of computer application. This does not strike one as being particularly conducive to facilitating the development of semantic and classificatory means for supporting *human knowledge processing* prior and up to the point where computer application is being resorted to.

No less important is the definitional 'transillumination' of the word 'concept' as used in the sense where concepts are seen as units of our knowledge, but also in the sense where they are seen as units of human perception and thinking (B.Seiler, Darmstadt).

A detailed explanation of the TOSCANA ('Tools of Concept Analysis') system can be found in the paper by W.Kollewe, M.Skorsky, F.Vogt, and R.Wille, where the problems of data analysis and data exploration are likewise gone into more closely.

In the paper by Ingetraut Dahlberg, Frankfurt, the concept 'Knowledge Organization' is looked at under various aspects, and the highly topical importance of this new knowledge field is explained.

The often widely varying subtopics of the main topic 'Conceptual Knowledge Processing' illustrate how a multidisciplinary approach may help to bring highly complex problems closer to a solution. Gerd Bauer

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INGENERF, Josef: **Benutzeranpassbare semantische Sprachanalyse und Begriffsrepräsentation für die medizinische Dokumentation** (User-adaptable semantic language analysis and concept representation for medical documentation). St.Augustin: Infix 1993. 345p., refs., Diss.Künstl.Intelligenz, 43

The aim pursued by Josef Ingenerf in the book under review is described precisely in its title: what he wishes to accomplish is to develop a system permitting the automatic analysis and representation of medical terms according to their meaning, such to be done in a way that is particularly suited to medical documentation purposes and capable of being adapted to user-specific requirements. Thus an ambitious, but current and urgent desideratum of medical informatics has been formulated and a beginning been made with its implementation. Let it be said right away that Ingenerf makes an impressive attempt to live up to the claim formulated. He is in full posssession of, respectively thoroughly familiar with, the required interdisciplinary knowledge and methods from such fields as medical terminology, philosophical semantics, language processing as practised in informatics, and Artificial Intelligence, and he applies this knowledge in a commendably lucid way to the task of solving his problem, not restricting himself in so doing to theoretical considerations, but pursuing his endeavors to the point where he can outline a prototypical implementation of his system in PROLOG.

Specifically, his approach is based on

- a reconstruction of the semantic categories and those relationships existing between them which constitute the disease concepts used in diagnostics (termed the "model of diagnosis");
- a representation formalism patterned after the "terminological representation formalisms" such as they have been developed since the KL-ONE system;
- an associated grammar, realized through a feature-based grammar formalism;
- a chart parsing algorithm which performs the grammatical derivation and, with it, the semantic language analysis on the basis of the other components.

This overall concept is marked by a high degree of originality and is based on diverse considerations and further developments by the author himself of the current state of the art in the fields concerned, so that a variety of starting points for further scientific work results. It is hardly possible, particularly within the scope of a book review, to go into all problems brought up and points of discussion highlighted. I will therefore restrict myself in the following to discussing that aspect of his overall concept which is the most important one from the point of view of the problems of knowledge representation, while otherwise recommending this book for reading by all those concerned with concepts relevant here.

Following Ingenerf's method, the meaning of a medical term is reconstructed by being translated into the terminological (concept) representation formalism adopted. For diagnostic disease concepts this formalism has a metamodel ("model of diagnosis") available which supplies semantic basic categories as well as semantic roles, with the latter specifying the relational linking-up possibilities between the categories. As syntactic constructs for the linking-up of concepts Ingenerf uses the conjunction, the all-quantified value restriction and the cardinality restriction. What semantic categories and roles are to be used as basis is something for the user of the system to decide, respectively for the user of a terminology to indicate; that's what the 'user adaptability' of Ingenerf's system consists of. The flexibility thereby obtained means at the same time, however, an abstraction from the question as to the criteria for a *contents-wise* adequate modeling of medical concepts and terms. On this matter, Ingenerf's book contains, on the one hand, examples of "models of diagnosis" (36, 50, 118, 121) evidently deemed adequate by him, and on the other hand discussions of principles and critical analyses of existing terminological systems and nomenclatures.

In the discussion of principles, Ingenerf singles out the principles of semantic compositionality, of intensionally oriented concept classification and of differentiation between lingualogical levels as being essential for semantic language analysis (4-8, 13-29). From this point of view, Ingenerf exposes such established concept classifications as ICD and SNOMED as manifesting major shortcomings (292-33). His own illustrative modeling is, as it were, a further development ('decomposition') of the SNOMED categories, notably of topography and morphology, with the

classification of ROHEN's 'Lehrbuch der funktionellen Anatomie' (Manual for Functional Anatomy) being reverted to for the decomposition of the topography. According to this classification, (topographo-)anatomically one needs to distinguish between three semantic categories: general systems (including tissues), organs, and regions, to which a fourth category, that of 'pseudotopography', must be added (34-36). The latter comprises, so it seems, the multiply used and, as a result, ambiguous anatomical concepts and terms which can occur as components of compound words or expressions (such as the German word 'Becken' (= pelvis) as occurring both in 'Nierenbecken' (= renal pelvis) and in 'Beckenniere' (= pelvic kidney). This fourth category, remaining somewhat unclear though it does, probably comprises the so-called 'termini generales' of the anatomical nomenclature, such as they are compiled e.g. in the appendix to Feneis's 'Bildwörterbuch' (= illustrated dictionary).

With the additional category 'Krankheit' (= illness, disease), ten relationships may then be indicated, each directionally linking up two categories with one another through indicating a localization by means of the preposition 'an' (= 'on', 'at', 'to', or 'of') (35-36), e.g.

- 'Illness' localized$_1$ *at* 'organic system' (inflammation *of* kidney)
- 'Illness' localized$_2$ *at* 'general system' (sclerosis *of* artery), or

'General system' localized$_3$ *at* 'organic system' (artery *to* kidney).

(The different indices attached to 'localized' remind us of the fact that we are dealing here with relationships that need to be formally distinguished!). Although Ingenerf does not say so, one may surmise that the three illustrative compound expressions cited parenthetically are meant to be representations of 'nephritis', 'arteriosclerosis' and 'kidney (or renal) artery' (cave: 'arteria renalis' or 'arteria renis'?). By such means, e.g. 'Beckenniere' may be distinguished as 'kidney localized$_4$ at pelvis' and 'Nierenbecken' as 'pelvis localized$_5$ at kidney'. Later (50, 118), Ingenerf expands these illustrative modelings by further categories and relationships for etiology, morphology, function as well as for nosological, oncological and topographic 'modifiers'. A concept like 'Osteally and hepatically metastasizing mammary carcinoma, left' will thus become, as a matter of principle, formally analyzable and representable.

The, in comparison with systems like ICD and SNOMED, increased efficiency of Ingenerf's approach has thus been demonstrated beyond a doubt. In conclusion I would like to discuss, however, to what extent this formal representation already encompasses a semantic analysis of the medical terms. To this end, let us take a renewed look at two examples used by Ingenerf himself:

1. The - aforecited - analyses of 'Beckenniere' as 'Niere an Becken' and of 'Nierenbecken' as 'Becken an Niere' can, on closer inspection, hardly be regarded as 'analysis of meaning or 'definitions'. By 'Beckenniere' we mean rather the 'congenital positional anomaly of a kidney in the ilial or sacral region as a consequence of a disturbed biogenetic ascent'. Only this definition enables us to conceptually delineate e.g. a 'pelvic kidney' from a nephroptosis or a pelvic transplantation kidney. Nor is the 'renal pelvis' adequately characerized by terming it some pelviform thing on the kidney; it is rather a specific anatomical structure of typical form, histology and function, biogenetically originating from the Wolffian duct and connecting the renal calyces with the ureter. Only this definition enables us to validly distinguish the renal pelvis from a possibly pelviform renal cyst or an artificial pelviform plastic drainage.

2. Ingenerf remarks that a 'seemingly self-evident inferential rule' cannot, on the basis of his (intensional) analysis, be endorsed, namely the rule which would permit one to infer a 'nephrosclerosis' from a 'nephro-arterio-sclerosis', or a 'nephritis' from a 'pyelitis' (this being only a matter, as it were, of 'summarizing' the localization relations 'localized$_n$ at').- Now while in medicine this inference admittedly is correct for the case of nephro-sclerosis and (pyelo-)nephritis, it is wrong e.g. in the case of inflammation of the renal arteries: an arteriitis renalis (or arteriitis arteriarum renis) is by no means a nephritis! The reason for this heretogeneity of the terminological inferences can only be found out if the concepts and definitions concerned are subjected to a semantic analysis going beyond the categories drawn upon by Ingenerf, i.e. an analysis for which 'nephritis' does not simply mean 'inflammation localized$_x$ on kidney'.

Much to be welcomed as it is, therefore, that Ingenerf has made the definitions of medical terms a topic for discussion at all and has assigned them a systematic relative value, his modeling examples nevertheless also indicate the deficit existing both in medical theory and medical informatics with respect to the reconstruction of these definitions. It is a sobering realization, resulting from all experience with knowledge-based systems in medicine, that for the establishment of medical knowledge bases or expert systems - as well as for 'mere' semantic language analysis - it is impossible, on the one hand, to dispense with a reconstruction, true to details, of the definitions of medical terms with all their 'facets', while on the other hand such reconstruction requires a full measure of work on the fundamentals of medical theory, a job which can by no means be regarded as completed yet. To make Ingenerf's approach really 'work', we will just have to do this job.

Probably we should be more modest. The approach proposed by Ingenerf constitutes so big an advance, or at least a step in the right direction(s), that the scientific communities involved will need time anyway to accept this increase in complexity. During this time the realization of the necessity of a detailed analysis and reconstruction of medical terms and concepts may ripen. By that time, maybe, this final step in forms of cooperation between medical men and theoreticians of medicine, informatics specialists, and specialists in medical informatics, can be taken.

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