

# The Scientific Study of Subject Literatures

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The paper addresses fundamental questions concerning the nature, genesis, and function of a subject literature—all knowledge records pertaining to a subject. A generalizable notion of a subject literature is developed and discussed in the terms of object, content, and use, and their interrelationships. The main areas of a scientific study of subject literatures are indicated. Structural interpretation is shown to be a promising strategic assumption for basic theoretical efforts and analytic research. The results of such studies aimed at explanation are examined as to their practical significance.

“When a man desires ardently to know the truth, his first effort will be to imagine what that truth can be.”—*Charles Sanders Peirce*

In order to judge a proposition, we seek answers to questions of what, how, and why. This paper attempts to address some of these questions as they concern the proposition to study scientifically subject literatures.

## THE SUBJECT AND ITS LITERATURE

### *Notion of a Subject Literature*

With a licit degree of circularity we may identify as a subject literature all knowledge records pertaining to a subject. Not everything physicians read classifies as medical literature, even though it may help make them better physicians. But the subject literature of medicine does comprise all known knowledge records considered at one time or another as dealing with, or related to matters medical. The concern with achieving, maintaining, and restoring physical and mental health *generates* this literature, which records, stores, displays, and transmits pertinent states of knowledge attained at a given point in time.<sup>1</sup> For instance, the statement of Hippocrates that “the art consists of these three: the disease, the

patient, and the physician”<sup>2</sup> suggests a model in terms of which we today may approach the literature of medicine; isolate basic concerns, assumptions, and activities; note specific areas and relationships; survey characteristics of change, innovation, and re-interpretation; make quantitative observations, comparisons, external and internal descriptions and inventories; and so on. We are doing this with regard to a literature, i.e., knowledge records viewed as some sort of entity, which in our example is predicated on the subject of medicine as mapped by Hippocrates (Figure 1).

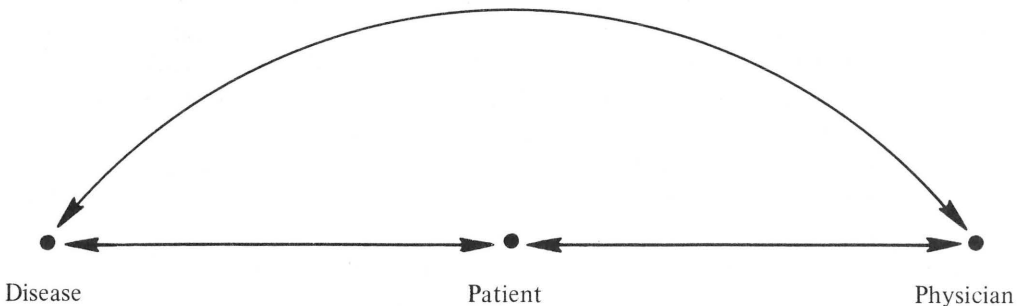
If we attempt to clarify this notion of a subject literature we have to ascertain the way things are. (The Bridgmanian phrase is intended.)

*S, L, and SL: The State of Affairs*

Inquiry is purposive action. If it is conducted rationally<sup>3</sup> (and broadened by formal study and research), it produces a body of knowledge based on concepts and conceptual patterns which “determine the questions one asks and the answers one can get.”<sup>4</sup>

S. In our case this involves a body of knowledge organized as a subject field. Here, the overall purpose of inquiry concerns a department of knowledge which “objectively, is an intrinsically determined unit,”<sup>5</sup> characterized by certain goals and concerns, methods, techniques, etc., related to the situations and requirements of the subject matter.

Figure 1. Hippocrates: the disease, the patient, and the physician.



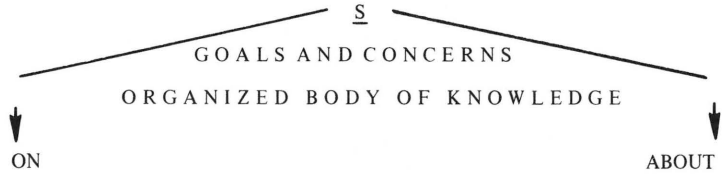
In any such subject field *S* these situations and requirements can be examined in terms of basic subject matter and materials: objects, events and processes, activities, and the like; conceptual structure; the ways in which the subject knowledge is produced; a comparison of these ways with those obtaining in other areas of knowledge (levels *A, B, C, D* in Figure 2); as well as the dominant epistemic modes which follow from these analytic considerations.<sup>6</sup>

These levels hold for all possible goals and concerns of reflective inquiry which, in turn, order themselves essentially in four related strata:

1. assertions concerning reality: subject queries aimed at *truth* in the sense of shared reality, public facts, knowledge which can be intersubjectively confirmed;
2. *res facta*: creative efforts aimed at *substantiation*<sup>7</sup> of a virtual reality expressing private facts, imagination, and fiction;
3. performance: the manual and intellectual actions needed to do 1 or 2;
4. criticism: *evaluation* of 1, 2, 3.<sup>8</sup>

The organized body of knowledge of subject field *S* permits a further distinction. It comprises knowledge of *S* as knowledge with a direct bearing *on S* (i.e., the requisite knowledge in order to know and do *S*), and knowledge *about* knowing and doing *S* or aspects of knowing and doing *S*. Knowledge *on* and knowledge *about S* are not orthogonal, but they represent different perspectives allowing shifts in interpretation which find important counterparts in the literature of *S*. It is one thing to consider the antibiotic properties of streptomycin, and another to study the methods that led to S. A. Waksman's discovery in 1943. "Any scientist who talks about electrons or genes or stars may also want to say things about his statements *about* the electrons or genes or stars."<sup>9</sup> In fact, knowledge *about S* could originate in areas wholly extraneous to *S*. Thurber's daydreaming Walter Mitty displays astounding knowledge about surgery when he imagines being a surgeon who fixes the faltering machine in the operating room with a fountain pen.<sup>10</sup> The distinction of knowledge *on* and knowledge *about* a subject may suggest more sophisticated considerations.<sup>11</sup> Right now, it is sufficient to make this rough distinction and to stress its heuristic usefulness.

SUBJECT



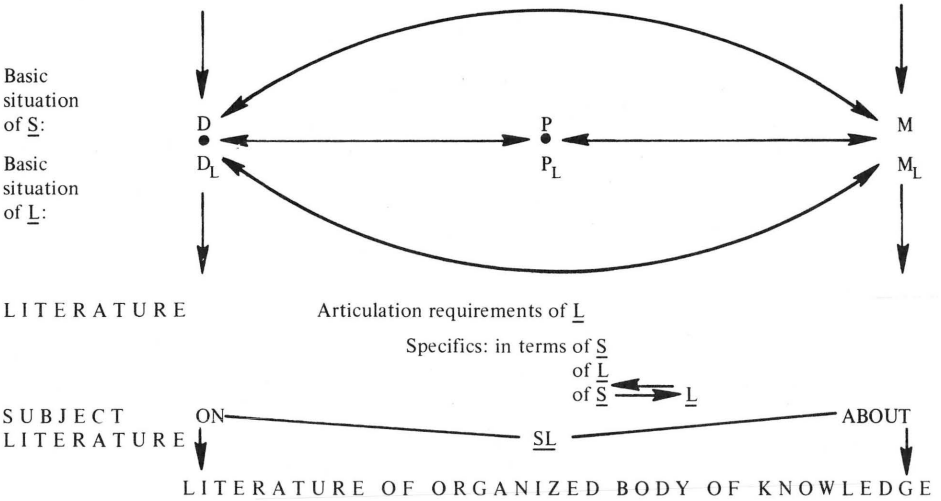
Levels: A basic subject matter and materials; objects; events and processes; activities; etc.

B conceptual structure

C ways in which the subject knowledge is produced

D comparison of these ways with those obtaining in other knowledge areas

- Strata: 1 asserting aimed at confirmable truth  
 2 making aimed at substantiation  
 3 performance in order to accomplish 1 or 2  
 4 critical evaluation of 1, 2, 3



D disease      M physician      P patient

Figure 2. The subject and its literature.

$S \supset L$ .<sup>12</sup> The production of knowledge involves communication in the sense of “all procedures by which one mind can affect another”<sup>13</sup> and, within this dominant context of message making, the articulation of knowledge on and about  $S$  in form of a literature  $L$  as a requirement—if we are to “have” and to share  $S$  as an organized body of knowledge. Daniel Bell acknowledges this state of affairs when he speaks of knowledge as “a set of organized statements of facts or ideas, presenting a reasoned judgment or an experimental result, which is transmitted to others through some communication medium in some systematic form.”<sup>14</sup>

Little need be said about the fact that students of a subject think and work with reference to available knowledge in all its forms. Yet it is important to note that discovering is not identical with stating the discovery by talking and writing on and about it, for certain purposes, and *qua* certain conventions and devices.<sup>15</sup> Here the immediate effort—the *in order to* operator as it were—applies to articulation as literature and not to knowing and doing  $S$ , which remains the superordinate purpose and, as such, motivates the efforts concerning articulation as literature.<sup>16</sup>

What then is involved in the articulation as literature required for the existence and function of  $S$  as an organized body of knowledge?

Reflective inquiry is essentially a private activity.<sup>17</sup> The result is upon the actor’s mind, so to speak. Reporting this reflexive activity and its outcomes to others necessitates expression.<sup>18</sup> This expression must be appropriate to the goals and concerns, the levels, epistemic modes, and strata of  $S$  (above and Figure 2). It must also be appropriate as an expression (e.g., in English) and as an expression of  $S$  in terms of the purpose it is intended to serve. Articulation as literature involves this characteristic purposive expression of  $S$ . It involves furthermore the devices used to record, store, display, and transmit  $S$ . The properties of these devices act as a constraint. It is upon the condition of these properties that the process of articulation has to operate if it is to accomplish its goal: the expression of  $S$  in literary form. To articulate knowledge as literature we must negotiate the requirements of communication and of those specific instruments of communication peculiar to literatures and/or a given literature. “The new design, the new

utterance, are tested with and against the exemplary legacy.”<sup>19</sup> An author is not only a producer of knowledge, but also a producer of a literature unit. He succeeds or fails as an author by his ability or inability to be both. Similarly, use of a literature requires dealing with literature units and their characteristic properties. Figures 2 and 3 attempt to sketch these circumstances for our Hippocratic map.

Figure 2 shows the organized body of knowledge on and about subject field  $S$  generated by goals and concerns (in regard to alleviating, curing, and preventing disease), ordered in Hippocrates’ terms of *disease* ( $D$ ), *patient* ( $P$ ), and *physician* ( $M$ ), and their interrelationships. This knowledge situation is established as a *literature on and about disease* ( $D_L$ ), *patient* ( $P_L$ ), and *physician* ( $M_L$ ), and their interrelationships, which involves (1) the requirements for articulation as literature we have mentioned; and (2) the specifics resulting from the interaction of these articulation requirements and  $S$  (i.e., knowledge on and about  $D$ ,  $P$ ,  $M$ , and their interrelationships).

Figure 3 focuses on the implicit terms of translation. Within the dominant context of message making and its requisites (indicted here by Weaver’s well known three aspects<sup>20</sup>) knowledge on and about the Hippocratic subjects is articulated in form of messages of a particular kind, namely, literature units. This entails the device (object  $O$ ); the subject knowledge expressed to be recorded, stored, displayed, and transmitted as content ( $C$ ); and the use potential ( $U$ ).  $O$ ,  $C$ , and  $U$  are correlative terms which hold true for any human literature, at any given point in time. In order to make a literature unit we have to express knowledge as its content, and state this content not only in a fashion suited to the subject and our specific objectives, but also in a fashion suited to the device we have chosen to serve as its vehicle. If, for instance, we adopt a “paper and pencil” operation, then articulation involves (a) what in terms of  $S$  should be written down in order to attain certain general and specific goals believed to be relevant, and the language, form, manner, etc., in which it is to be written down to attain a text, satisfactory as a meaningful text, but satisfactory also in terms of the goals believed to be relevant; and (b) all that which paper and pencil do or do not allow us to do. If photo-

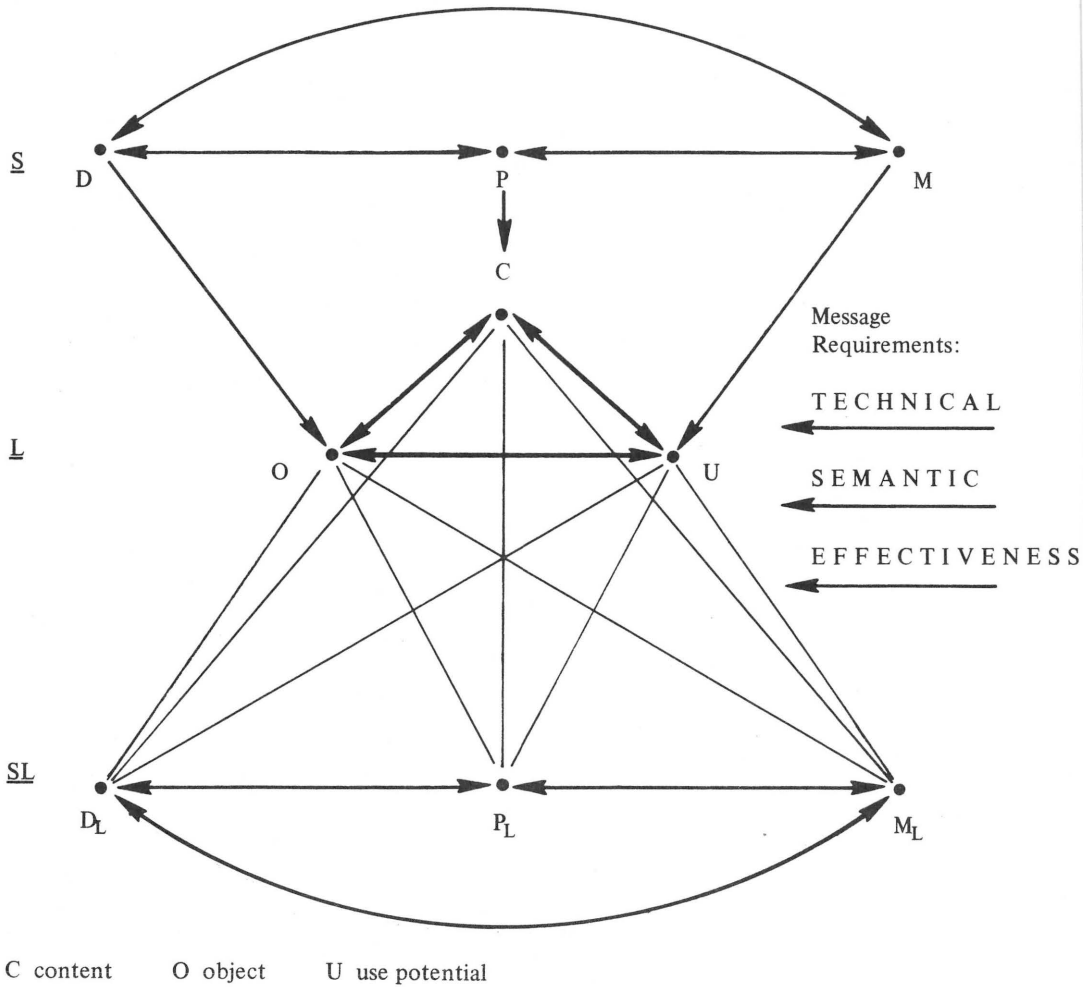


Figure 3. The subject and its literature: invariant properties.

micrographs are required, the technology of paper and pencil will be a poor substitute; if the subject is timbre of the singing voice, meaningful description of vocal qualities will be sharply curtailed by the limitations of pencil on paper notation; if color is a significant factor, full color illustrations may be more effective than pencil sketches.

Both the expression of knowledge and its physical modulation as a literature unit are purposive; they are intended for a certain use. Once made, the literature unit may be used consciously or intuitively as its maker(s) intended, or in some other way—but always as determined by given properties which derive from the object ( $O$ ) designed for  $C$  and  $U$ ; the content ( $C$ ) designed for  $O$  and  $U$ ; and the use potential ( $U$ ) of this  $O$  and  $C$ .<sup>21</sup> In order to write a paper ( $D_L$ ) on a certain disease ( $D$ ) a researcher expresses his findings (using language, special terminology, cognitive style, idiom, personal style, etc.) in keeping with his specific objective (e.g., to address fellow researchers, clinical personnel, etc.). But as he does this he negotiates continuously the  $O-C-U$  syndrome that obtains for ( $D_L$ ). He notates expressions in accordance with both the requirements of his subject and the graphic standards of the publishing journal; chooses forms of presentation with certain readers, professional customs (the “rules of the game”), and various other requirements in mind; negotiates problems of format, sequence, and reprographic technology; cites or does not cite; etc. Conversely, the literature unit ( $D_L$ ) thus produced will be understood or not understood, found practical, impractical, useful or not useful along similar lines. Also implied now, of course, is not intended use “elsewhere,” i.e., outside the purposive field which produced ( $D_L$ )—even employment of the soft-cover journal containing ( $D_L$ ) as a flyswatter.<sup>22</sup>

All this is belaboring the fact that the  $O-C-U$  syndrome is the *conditio sine qua non* of all literature units. A literature *is* in terms of object, content, and use potential, and their functional interplay. It is not uninteresting to note that while the logic of everyday use operates in terms of these properties and relationships, reconstructions of any kind have been slow to recognize their significance as points of description and analysis, let alone their promise as “speculative instruments.”<sup>23</sup>

*SL*. The subject literature *SL* comprises all made literature units concerning *S*. This means all that has been recorded (and is or was available) on and about knowing and doing *S*. As such, the *SL* exhibits knowledge records, i.e., literature units and their characteristics as to object, content, and use potential; certain modes of bibliographic organization and control ranging from desultory text references (“as pointed out by George Sarton”), indexes, analytical and systematic bibliographies, abstract journals, reviews, handbooks, media guides, etc., to complex information systems, with their knowledge-, storage/recall-, and data processing subsystems; and, indeed, the referential relationships that motivate this aggregate.

Included in this *SL* are the substantive core-achievements of the past: law, theory, application, and instrumentation as related to the goals and concerns, the levels, epistemic modes, and strata of *S*. Normal science, representing the currently accepted research tradition,<sup>24</sup> specific “states of the art,” and the subject knowledge considered at one time or another as “most worth having” function within the chronological sequence of this *SL*, which by definition is totally retrospective. The latest book is a finished book.

As the record of the past the *SL* holds the record of change: literature units produced by the interaction of knowledge and technical possibilities within ideational and social contexts and the motives and opportunities for action afforded by these contexts.<sup>25</sup> Over time, the *SL* “displays the varieties of scientific method and intellectual manoeuvre on which any properly inductive analysis of scientific thinking must be based, it exposes us to the surprise that effective scientific thinking could be based on assumptions and have objectives so various and often so different from our own, and it enables us to distinguish the historically accidental from the logically essential elements in the succession of scientific systems.”<sup>26</sup> The *SL* documents the growth of knowledge in a subject field, hence functions as a data matrix for all efforts to study this growth. The *SL* functions also as a matrix of discovery in the sense that it furnishes known knowledge and information, inferential or otherwise, pertaining to *knowledge to be known* (although this knowledge to be known may not necessarily be desired for *S* or, once it is known, judged to be on and about *S*). Conversely, the organized

body of knowledge available through the *SL* may function as a constraint, foster paradigms, scientific logics-in-use, styles of inquiry, fashions, disciplinary ethnocentrism (explicated by Campbell as “the symptoms of tribalism or nationalism or ingroup partnership . . . in academic disciplines”<sup>27</sup>), etc., and, under given circumstances, inhibit discovery.<sup>28</sup>

#### THE SCIENTIFIC TASK

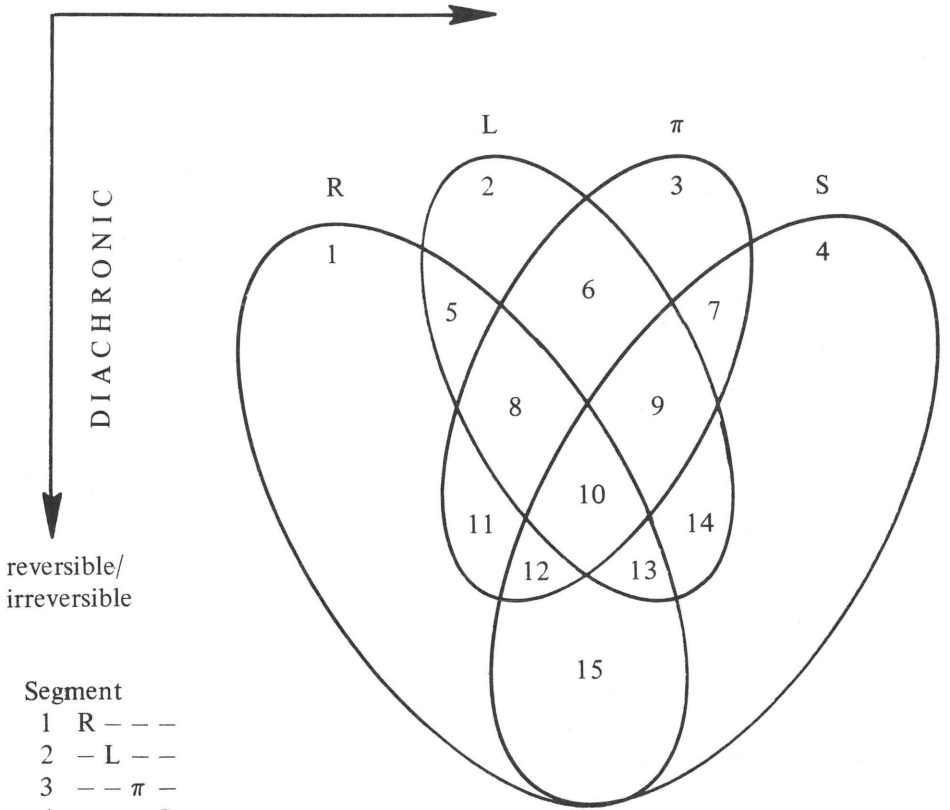
##### *The SL as a Problem of Inquiry*

When we inquire scientifically we engage in observation, speculative thinking, deductive reasoning, and experimentation because, for some reason, we really want to know.<sup>29</sup> Seeking to know for sure implies seeking to gain a certain kind of subject knowledge made up of grounded and testable statements which allow us to answer reason-seeking questions of credibility (of the type: “Why should it be believed that  $x$ ?”) and explanation-seeking questions of intelligibility (of the type: “Why is it the case that  $x$ ?”). Based on analytic efforts to grasp the subject we strive to understand (1) *that* something is the case; and (2) *why* this is so—to *become familiar* with the facts and to *explain* them.<sup>30</sup>

As a problem of inquiry the *SL* becomes the object of these efforts to grasp and to understand. Thus the student of the subject literature of medicine is not concerned with medicine, but with literature units designed to record, store, display, and transmit the organized body of knowledge “medicine.” A topic on the Hippocratic map becomes now a literature *of* this topic, exhibiting certain properties and relationships, characteristic situations and contexts as a literature of a subfield connected in some form with the medical literature to which it belongs. The locus of inquiry is the *SL*. The large and small why-questions we seek to answer pertain to this *SL*. It is in terms of the *SL* that we seek Aristotle’s intellectual achievement, i.e., knowledge of fundamental concepts and of the elements necessary for explanation.<sup>31</sup>

The main areas of concern for inquiries of this kind are indicated in Figure 4,<sup>32</sup> which shows the possible relationships of the *subject* (*S*) in the sense of all knowable knowledge (i.e., both, the known knowledge and the knowledge to be known on and about *S*);

SYNCHRONIC



reversible/  
irreversible

Segment

- 1 R - - -
- 2 - L - -
- 3 - - π -
- 4 - - - S
- 5 R L - -
- 6 - L π -
- 7 - - π S
- 8 R L π -
- 9 - L π S
- 10 R L π S
- 11 R - π -
- 12 R - π S
- 13 R L - S
- 14 - L - S
- 15 R - - S

R research: objectives, purposes, motivations, methods  
L articulation as literature: conditions and requirements  
π public knowledge on and about S  
S subject: knowable and known knowledge on and about S

Figure 4. The study of a subject literature: main areas of inquiry.

*research* (*R*) as knowledge and literature unit producing efforts; the requirements and specifics of *articulation as literature* (*L*); and the prevailing state of *public knowledge* ( $\pi$ ), the “rational consensus of ideas and information on the subject,”<sup>33</sup> affecting the extant *SL*. As the eye moves out from core-segment 10 (which suggests the essentials of *any* literature unit), it encounters the various implicit relationships, and finally arrives at the outlying meta-segments 1, 2, 3, 4 (which suggest basic studies of *R*, *L*,  $\pi$ , and *S* as such). Actively considered, the diagram provides a map for plotting specifics. Our inquiry may proceed along *synchronic* lines, single out aspects of a given *SL*, establish certain attributes of quality and quantity, distinguish wholes and parts, study the relationship functions and processes that obtain, attempt to assess the relative importance, at a point in time, of the traits under consideration, and so on; or, it may concentrate on *diachronic* phenomena, the behavior of the *SL* or some of its constituents over time, factors such as invention and variation, entrance and position in temporal sequence, continuity, stability and change, “life” span;<sup>34</sup> and on comparative analyses of chronologically distant states, the irreversible aspects, which occur only in one direction over the course of time, and reversible ones, “which seem to shift from one pole to another and back again.”<sup>35</sup>

Studies such as these furnish the groundwork for comparison, abstraction, and systemization. Yet they do not necessarily “add up.” They remain discrete thrusts of inquiry until ordered in terms of the dominant problem and its requirement for principles: that “minimal apparatus of underived terms and statements”<sup>36</sup> applicable to all subject literatures and valid for all possible approaches, within clearly statable limits and/or under clearly statable conditions. This, of course, poses the paradox of having to anticipate that which we want to find. The only way to negotiate this existential dilemma is by trial and error—conjectures and refutations in search of notions suggesting a framework and connective links for specific studies which otherwise might remain conceptually isolated and independent of each other.<sup>37</sup>

### *In Search of Structure*

In our case, as pointed out heretofore, the most promising operational notion is that of *structure*.<sup>38</sup> “Structure” is an abstract notion, which we assign at will and which allows us to map familiar pieces and relations into a broader context and to search for other pieces and relations this context implies. This is R. Buckminster Fuller’s strategy of the posited whole in order to ferret out and map its dimensions which as such may not be readily observable<sup>39</sup>—to gain an “‘awareness of structure’ absent from the original confrontation with a complex of phenomena.”<sup>40</sup> Such a *structural model* is itself a notion in terms of which we raise questions of scope and validity, analogy, and form. It serves as a prototype for the particular models necessary for the treatment of particular questions, supplies the conceptual framework for the creation of “small-scale working mechanisms designed to tell us which gear meshes with which,” and suggests the theorems that can be derived.

Widely discussed in the recent past, the structural model entails key aspects of wholeness, transformation, and self-regulation. None of its elements undergoes change without effecting changes in all other elements; its order relationships allow transformational derivation of related models without need to introduce new components, and anticipation of its behavior if one or more of its constituent elements are modified. Yet the logical truth of a model does not guarantee its empirical truth as representing relevant properties of reality, i.e., the *SL*. The model raises rather than answers the question whether or not the system is systemic and suggests the importance of corroboration, i.e., testing and evaluating in terms of critically observed facts. It also raises questions in regard to a *language* permitting statements of sufficient precision concerning the warp and woof and the overall behavior of subject literatures to be represented by the structural model.<sup>41</sup>

The scientific study of subject literatures thus involves reflective inquiry aimed at (1) the development of a structural model; (2) the statement of systemic properties; and (3) suitable connective terms of interpretation (operational definitions, etc.) under which the stated model can be expected to *inforce* subject matters by making observed facts intelligible. These tasks are interdependent

and are essential for all further efforts in search of a simple unified account of *SL* phenomena which rests on a solid scientific foundation and permits explanation and prediction.<sup>42</sup>

I first raised the issue of a structural interpretation in 1968, aware of the work done by Lotka, Bradford, Zipf, Mandelbrot, Simon, Kendall, and Booth; Price; and Goffman; and Piaget's synoptic *Logique et connaissance scientifique* (1967).<sup>43</sup> Since then, a considerable number of studies conducted in various subject fields seems to justify the assumption of structure and to supply important information on relevant aspects of a structural model. Here may be noted the basic theoretical efforts and analytic research concerning the structure of subject literatures and the dynamics of knowledge communication under way at Case Western Reserve University;<sup>44</sup> and the growing interest in bibliometrics—the “quantitative treatment of the properties of recorded discourse and behaviour appertaining to it,”<sup>45</sup> the relationships between the subject and its literature, and the growth of subject knowledge and subject literatures,<sup>46</sup> as well as in the social and organismic structures which may have a bearing on these topics.<sup>47</sup>

#### REMARKS ON FRUITFULNESS

Undertaking “an exploration of discovery, the results of which may not be anticipated,” has been defended by P. W. Bridgman. “We cannot tell until we go whether the results the expedition brings back will prove to be important. But even if the results are disappointing, there is still a certain intrinsic interest in finding out something about the nature of the unknown territory.”<sup>48</sup> There can be little doubt as to the intrinsic interest of the scores of topics that beckon on every step of our inquiry. In many respects we have as yet to identify and gather the empirical “natural history” data which are embedded in conventions of practice and use. Even if our results provide only an epistemic mapping of sorts, hence better terms and concepts, we have not returned empty-handed. For those who work with the literature units of the *SL* this means a new awareness and an improved basis for making decisions; for those who study the *SL*, another step toward a systematic interpretation from which follows that the data should be what they are.

However, it can be argued that certain results of our “exploration of discovery” may in fact be anticipated.

Given at the outset are (1) the product—literature units and their properties; (2) the situations which relate to the making of these literature units; (3) the subject *S* the *SL* is on and about. *S* constitutes the dominant knowledge goal. It is the constraint which bounds the *SL*, and this includes its use as *SL*. As public knowledge *S* is available only through its *SL*. There is no alternative: If we desire to obtain knowledge on and about *S*, then we must use its *SL*, and come to terms with the object, content, and use requirements implicit in its literature units and the relationships obtaining between them. It is up to us to read Goethe’s *Farbenlehre* (1810) as a contribution to science, a text by the great German writer or an example of early nineteenth-century German prose, etc. But as soon as we read Goethe’s work as what he intended it to be, a theory of color, we have no rational choice but to do so *in terms of* the problem, i.e., the subject. It “is” this *subject* which plots and weighs, allows or disallows Goethe’s direct, qualitative, phenomenological approach, as compared to Newton’s analytical, experimental, and quantitative one, etc.<sup>49</sup> Goethe’s book takes its place *within the fabric* of the *SL*, in proximity to or distant from other literature units dealing with its topics. Thus, it is probable that based on better descriptions propositions designating generic as well as specific properties of a given *SL* and, eventually, true lawlike statements based on these propositions can be formulated which tell us how given subjects and their literatures behave and can be expected to behave.

It is here that the promise of fruitfulness transcends the sheer sport of the search. Since the *SL* clearly bears on user behavior and that subset of “making available” which comprises the librarian’s activities in anticipation of user behavior, all that pertains to its nature is of potential importance. The *SL* is in fact one of the foremost problem areas of librarianship. Knowledge on and about subject literatures ranging from simple insights concerning prevailing object characteristics in a specific *SL* (e.g., “the literature of geography includes atlases and large maps requiring stack-facilities capable of housing outsize materials”), to sophisticated statements of the structure and growth of knowledge, and

the supporting formal techniques, relates directly to the fundamental purposes, functions, and operations which constitute the native grounds of librarianship.<sup>50</sup> In this sense, all basic findings concerning the nature of subject literatures are also basic to the professional knowledge in terms of which the librarian acts.

Common sense is "a particular kind and degree of untutored judiciousness in coping with slightly out of the way, practical contingencies"<sup>51</sup> and closely tied to *ad hoc* perception and decision. It offers only a minimal set of directives regulating practice and every day activity. Professional experience, no matter how extensive and carefully reconstructed, is after-the-fact knowledge predicated upon a multitude of largely unidentified factors, hence, *unreliable* knowledge when it comes to forecast and responding to change. Rules based on common sense and experience can and may have to be broken as the circumstances change. On the other hand, true lawlike statements based upon deductively formulated and confirmed findings "may neither be 'broken' nor 'obeyed.' They simply are the way things behave."<sup>52</sup> Where available, these explanatory results of reflective inquiry permit the librarian to dispense with hopeful guesswork and act with certainty when anticipating, planning, and instituting techniques and routine procedures as he strives to deal with the increasing complexity of our semantic environment.<sup>53</sup> This is the librarian's stake in the scientific study of subject literatures.

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3. Hempel, C. G. "Rational Action" (1961), reprinted in *Readings in the Theory of Action*, ed. N. S. Care and C. Landesman (Bloomington, Ind., 1968), 281-305.
4. Thomson, G. *The Inspiration of Science* (London, 1961), 4.
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6. Rawski, C. H. "The Interdisciplinarity of Librarianship" in his *Toward a Theory of Librarianship* (Metuchen, N.J., 1973), 121-123 and fig. 1.
7. The term is Etienne Gilson's. Cf. his *Painting and Reality*, Bollingen Series xxxv, IV (New York, 1957), 153-155.

8. Rawski, C. H. "Subject Literatures and Librarianship" in *Library School Teaching Methods: Courses in the Selection of Adult Materials*, ed. L. E. Bone (Urbana, Ill., 1969), 103-107. Cf. also Buchler, J. *Nature and Judgment* (New York, 1955), especially, 70-71; and Bunge, M. *Metascientific Queries* (Springfield, Ill., 1959), chap. 5.
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11. Passmore, J. "The Concept of Philosophical Scholarship" in R. A. Chisholm, et al.: *Philosophy; Humanistic Scholarship in America: The Princeton Studies* (Englewood Cliffs, N.J., 1964), 5. Ryle, G. "'About'" in his *Collected Papers*, II (New York, 1971), 82-84. Nagel, E. *The Structure of Science* (New York, 1961), chap. 15.
12. The symbol  $\supset$  is a connective denoting implication. In English it corresponds roughly to the conditional "if . . . then." Cf., e.g., Quine, W. V. *Elementary Logic* (Boston, 1941), 20 f.
13. Shannon, C. E., and W. Weaver. *The Mathematical Theory of Communication* (Urbana, Ill., 1949), 3.
14. Bell, D. *The Coming of Post-Industrial Society* (New York, 1973), 175.
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18. Machlup, F. *The Production and Distribution of Knowledge in the United States* (Princeton, N.J., 1962), 30. On the process of articulation cf. Buchler, J. *Nature and Judgment* (New York, 1955); Betti, E. *Allgemeine Auslegungslehre als Methode der Geisteswissenschaften* (Tuebingen, 1967), 33a; Maritain, J. *Creative Intuition in Art and Poetry*. Bollingen Series xxv, I (New York, 1953), 319.
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20. Shannon and Weaver, 4-6; 24-28.
21. Rawski, C. H. "Subject Literatures and Librarianship," 97-98; *idem*: *Toward a Theory of Librarianship*, 127-130.
22. Cf. Meredith, P. *Instruments of Communication* (Oxford, 1966); Polanyi, M. *Personal Knowledge* (Chicago, 1958), especially chap. 5, "Articulation."
23. Note, for example, the lack of discussion in professional publications devoted to information storage and retrieval of significant contributions toward a systematic approach to the object properties of literatures, such as Frankl, P. *Das System der Kunstwissenschaft* (Bruenn, 1938); Gerstner, K.: *Compendium for Literates; A System of Writing* (1970), English transl. (Cambridge, Mass., 1973); and Dondis, D. A. *A Primer of Visual Literacy* (Cambridge, Mass., 1973). Cf. also Kochen, M. *Integrative Mechanisms in Literature Growth* (Westport, Conn., 1974), 14, 27, 183 f.
24. Kuhn, T. S. *The Structure of Scientific Revolutions* (Chicago, 1962), 10-11; rev. ed., in *Foundations of the Unity of Science*, ed. O. Neurath, et al., II (Chicago, 1970), 72-73.

25. Parsons, T., and G. M. Platt. *The American University* (Cambridge, Mass., 1973), 1-89, "Some General Theoretical Paradigms," 423-447.
26. Crombie, A. C. *Scientific Change* (New York, 1963), 4-5.
27. Campbell, D. T. "Ethnocentrism of Disciplines and the Fish-Scale Model of Omniscience" in *Interdisciplinary Relationships in the Social Sciences*, ed. M. and C. W. Sherif (Chicago, 1969), 328-348.
28. On the *SL* and the origin and diffusion of ideas, cf. Merton, R. K. *The Sociology of Science* (Chicago, 1973); Ziman, J. *The Force of Knowledge* (Cambridge, 1976), chap. 5, and his *Public Knowledge* (Cambridge, 1968); Kuhn, T. S. *The Structure of Scientific Revolutions* (Chicago, 1962, 1970); and the discussions in Scheffler, I. *Science and Subjectivity* (Indianapolis, 1967), Lakatos, I., and A. Musgrave. *Criticism and the Growth of Knowledge* (Cambridge, 1970), and *The Structure of Scientific Theories*, ed. F. Suppe (Urbana, 1974); as well as Rogers, E. M., and F. F. Shoemaker. *Communication of Innovations* (New York, 1971). An altogether remarkable case study is Gruber, H. E., and P. H. Barrett. *Darwin On Man* (New York, 1974).
29. Margenau, H. *Open Vistas* (New Haven, Conn., 1961), 3.
30. Hempel, C. G. *Aspects of Scientific Explanation* (New York, 1965), 334 f., 487 f. Cf. also Ryle, G. *The Concept of Mind* (London, 1949, and later), chap. ii; and Hanson, N. R. *Observation and Explanation* (New York, 1971), 43-45.
31. Aristotle, *Metaphysics* A 982 a.
32. On J. Venn's original diagram, Gardner, M. *Logic Machines and Diagrams* (New York), 42 f., 104 f.; and the misleading diagrammatic representation in Morris, C. *Signification and Significance* (Cambridge, Mass., 1964), 57.
33. Ziman, J. M. "Information, Communication, Knowledge," *Nature*, CCXXIV (Oct. 25, 1969), 318.
34. On this, Kubler, G. *The Shape of Time* (New Haven, Conn., 1962), especially chaps. 2 and 3.
35. Gardner, H. *The Quest for Mind* (New York, 1972), 24; note also his model of synchronic and diachronic aspects, pp. 40-42. Cf. Garfield, E. "Historiographs, Librarianship, and the History of Science" in *Toward a Theory of Librarianship*, 380-402; and Wilson, E. O. *Sociobiology: The New Synthesis* (Cambridge, Mass., 1975), 4-6.
36. Goodman, N. "Uniformity and Simplicity" in *Uniformity and Simplicity*, ed. C. C. Albritton, Special GSA Papers 89 (New York, 1967), 97.
37. Popper, K. R. *Conjectures and Refutations; The Growth of Scientific Knowledge* (New York, 1965), chap. 1.
38. Rawski, C. H. "Subject Literatures and Librarianship," 107-110; *idem*: "Subject Literatures as a Problem of Inquiry" in *Information in the Health Sciences*, ed. R. G. Cheshier (Cleveland, 1972), 55-59.
39. Fuller, R. B., and E. J. Applewhite. *Synergetics* (New York, 1975), 9.
40. Hanson, N. R. *Observation and Explanation* (New York, 1971), 81.
41. Woodger, J. H. *Biology and Language* (Cambridge, 1952), Lecture i, 1. Cf. Tarski's truth concept in Popper, K. R. *The Open Society and Its Enemies* (Princeton, N.J., 1950), 720, n. 7. Shera, J. H., and C. H. Rawski. "The Diagram Is the Message," *Journal of Typographic Research* (now *Visible Language*), II (1968), especially 185-188.
42. Northrop, F. S. C. *The Logic of the Sciences and the Humanities* (New York, 1947 and later), chap. 13. Platt, J. R. "Strong Inference," *Science*, CXLVI (1964), 347-353.

43. On Lotka, Bradford, Zipf, Mandelbrot, Kendall, and Goffman see Fairthorne, R. A. "Progress in Documentation. Empirical Hyperbolic Distributions (Bradford-Zipf-Mandelbrot) for Bibliometric Description and Prediction," *Journal of Documentation*, XXV (1969), 319-343. Simon, H. A. "On a Class of Skew Distribution Functions," *Biometrika*, XLII (1955), 425-440. Booth, A. D. "A 'Law' of Occurrences for Words of Low Frequency," *Information and Control*, X (1967), 386-393. Price, D. J. *Science Since Babylon* (New Haven, Conn., 1961); *idem: Little Science, Big Science* (New York, 1963). Piaget, J. *Logique et connaissance scientifique*. Encyclopédie de la Pléiade, XXII (Paris, 1967).
44. Cf. the later work of William Goffman discussed in Brookes, B. C. "Jesse Shera and the Theory of Bibliography," *Journal of Librarianship*, V (1973), 241-244; and in Fairthorne (1969) and Brookes (1973) listed below, Note 45; and the following dissertations: Donohue, J. C. "A Method for the Analysis of a Subject Literature" (1970); Baughman, J. C. "A Model for Establishing a Curriculum and Its Core Literature Source" (1971); Maurstad, B. L. "Concerning Structural Properties in the Literature of the Art Historian: A Bibliometric Study" (1972); Pao, M. L. "A General Method to Establish Quality Filtering Systems for Biomedical Literature" (1973); Boyce, B. R. "A Literature Filter of Variable Permeability" (1973); Dikeman, R. K. "On the Relationship Between the Epidemic Theory and the Bradford Law" (1974), *Directory, Ph.D. Program in Library and Information Science, Case Western Reserve University* (Cleveland, 1976).
45. Fairthorne, R. A. "Progress in Documentation. . . ." 319. Cf. also Brookes, B. C. "Numerical Methods of Bibliographic Analysis," *Library Trends*, XXII (1973), 18-43; Avramescu, A. "Contribution to the Foundation of Bibliometric Laws," *Studii Si Cercetari de Documentare*, XV (1973), 3-19; and Donohue, J. C. *Understanding Subject Literatures: A Bibliometric Approach* (Cambridge, Mass., 1973).
46. Kochen, M. *Integrative Mechanisms in Literature Growth* (Westport, Conn., 1974) and the literature cited there. Cf. also Hanson, N. R. *The Concept of the Positron* (Cambridge, 1963), and Gruber, H. E., and P. H. Barrett. *Darwin On Man* (New York, 1974).
47. Gardner, H. *The Quest for Mind* (New York, 1972); Piaget, J. *Structuralism* (New York, 1970); Caws, P. "Structuralism" in *Dictionary of the History of Ideas*, ed. P. P. Wiener, IV (New York, 1973), 322-330; and Merton, R. K. *The Sociology of Science* (Chicago, 1973).
48. Bridgman, P. W. *The Way Things Are* (Cambridge, Mass., 1959), 3.
49. Carnap, R. *Philosophical Foundations of Physics*, ed. M. Gardner (New York, 1966), 109-112; Gillispie, C. C. *The Edge of Objectivity* (Princeton, N.J., 1960), 192-201.
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51. Ryle, G. *Dilemmas* (Cambridge, 1954), 3.
52. Wartofsky, M. W. *Conceptual Foundations of Scientific Thought* (New York, 1968), 39.
53. Weinberg, A. M. *Reflections on Big Science* (Cambridge, Mass., 1967), 24 f.

## Stereogrammic Relations

At the conclusion of his article, "Linguistics: Science or Pseudo-Science?" in the Welsh periodical *Trivium* (volume 9, pages 1-18), Ronald Englefield commented on the fact that linguistics "can be made to look like science if the facts collected, however insignificant, are expressed in forbidding terminology." He contributed the following "in a style which will be familiar to the connoisseurs of modern linguistic jargon."

*Stereogrammic relations.* These affect what is commonly and somewhat inaccurately known as "writing." The more important relations which we have to discuss are metastrephosis and anokatosis, with or without metagnome. We will take a simple example first to illustrate. The letters of the word *pip* may be inverted without change of form or meaning; thus, if we number the letters of this word 1, 2, 3 and then re-write the word in the order 3, 2, 1, we obtain the same word unchanged. This is metastrephosis without metagnome. On the other hand if we apply the same treatment to *god* we obtain *dog*, and this is metastrephosis *with* metagnome. Metastrephosis also applies to letters. The grammic elements (x) and (o), (A), (M), (V), and others are amenable to metastrephosis without metagnome. Metastrephosis with metagnome is rare in grammic elements, though under certain typographical conventions (p) and (q), (d) and (b) come near to illustrating the phenomenon.

Anokatosis is similar to metastrephosis but occurs in a different dimension. The graphic element Z is an example of anokatosis without metagnome. You may, to express it approximately, turn it upside-down without any stereomorphic alteration, and consequently with no metagnome. And here we may state a general principle of considerable interest: in the absence of stereomorphic alteration there can, in grammic elements, be no metagnome. Examples of anokatosis with metagnome are (b) and (q) and (d) and (p). It will be noticed that the four graphic elements (b), (d), (p) and (q) are related to one another both metastrephosically and anokatotically, but not in the same pairs. This is known as an epallactic relation.