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Librarianship and the Philosophy of Information

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"My purpose is to tell of bodies which have been transformed into shapes of a different kind." Ovid, *Metamorphoses*

Part I. Library Philosophy

Provocation

Information seems to be ubiquitous, diaphanous, a-categorical, discrete, a-dimensional, and knowing.

- **Ubiquitous**. Information is ever-present and pervasive in our technology and beyond in our thinking about the world, appearing to be a generic 'thing' arising from all of our contacts with each other and our environment, whether thought of in terms of communication or cognition. For librarians information is a universal concept, at its greatest extent total in content and comprehensive in scope, even though we may not agree that all information is library information.

- **Diaphanous**. Due to its virtuality, the manner in which information has the capacity to make an effect, information is freedom. In many aspects it exhibits a transparent quality, a window-like clarity as between source and patron in an ideal interface or a perfect exchange without bias. Information also seems to be a most subtle form of knowledge, whether from being considered fundamental or elemental.

- **A-categorical**. Information happens without pre-definition into certain or rigid structures, orders or classes in any exclusive or preferred way. Information is rich in potential taxonomies and capable of varying interpretation schematically, while at the same time conditional and dependent in the sense of not having an assigned final status.

- **Discrete**. Following the sense of integer arithmetic, as in the case of digital computing and possibly for computation in general, including quantum computing, we think of information as of the nature of distinction and distinctness.

Information seems to play a role between mind and matter, an interaction among separate minds and yet associated with a physical medium.

- **A-dimensional**. Both dimensional and non-dimensional forms of information are observable. In some respects information is measurable, as with our familiar bibliographic and computational metrics, and in others it is quite pure, such as when described in terms of states and spaces and in other mathematical guises.

- **Knowing**. Information study has long been intertwined with processes of learning and knowledge. Recent investigations explicitly link information to cognition and the mind, to consciousness and evolution. The identification of life itself, through models of complex adaptive systems or genetic communication networks or other sophisticated ecologies, now infuses information with a substantial function.

Whatever our operational understanding of information, as librarians we have come to regard its diverse conceptuality with familiarity within our traditional systems, designs, plans and processes. Our philosophy of information remains implicit while history shows our intimate participation in the emergence of an ostensible epoch.

Librarianship

The perennial duty of the librarian as midwife to the birth of knowledge has not changed appreciably with the passing of centuries. If anything there has been increased recognition of our responsibilities for preserving cultural heritages in an age of virtuality and transience.[1] Our procedures and materials have been found and lost and found again, invented and re-invented, named and re-named, as have our titles changed repeatedly. But the tradition of the librarian as a critical mediator in the flow of knowledge between creators and clients of tablets, scrolls, manuscripts, books, documents, recordings, pages and files has endured. Within the automated architectures of proliferating technology we are sought after for our intellectual methods and communication model. With the global maturation of our professional associations comes our responsiveness and effectiveness. We have expanded our introspective awareness into an overview of this efficacy, becoming reflective about our tradition of meta-scholarship conducted in collaborative effort.

Librarianship, predating both documentation and computing as specific disciplines, has not surprisingly previously realized episodes of crises of its identity. Library science in the 19th century evolved from, among other things, the application of a "scientific" method in the form of an industrial or "economic" organization of the existing scholarly field of bibliography. Bibliography, like astronomy, stood to be revolutionized by the new technologies of photography and electronics. A distinct opportunity for print-based librarians to modernize and expand their theory materialized in the perfection of photographic processes and in particular the graphic reproduction of bibliographic text in micro-space. The

scale of miniaturization was seen initially as a solution to the volume of descriptive cataloging required following a rapid expansion of library collections.

Further globalization of corporate enterprises and multi-nationalization of government and non-business institutions which increasingly relied upon standardized documentary communications ensued. Special libraries and information centers responded to an imperative for effective inter-communications, somewhat at the time of the earliest development of statistical tabulators and adding machines and well ahead of general-purpose computing devices. Military thinkers very early on realized the importance of organized technical intelligence following advances in telegraphy, aviation and radio. Signal corps organizations introduced new techniques for recording and reporting of information and its systematic analysis, over and above transmission demand.

Special libraries and information bureaus, in fact, comprised a third prong of development with documentation and bibliography, similarly pre-dating and anticipating the design of automated information processes. In 1924, Philip Cunliffe-Lister Swinton, then President of the British Board of Trade, sent the following message to the first Association of Special Libraries and Information Bureaux (ASLIB) Conference:

> "The growth of knowledge during the living memory has been remarkable and its application evident in every direction. Whilst it is generally recognized that 'knowledge is power,' it is none the less true that a considerable proportion of accumulated knowledge, whether in the domain of science, business, sociology, education or elsewhere is unfortunately lying dormant and untapped.

> "An immense amount of extremely valuable information is in existence if only one knows where to find it . . . The volume . . . being far beyond the mental grasp of any individual or group of persons, however erudite, it becomes a vital necessity to provide a master key whereby the common storehouse may be unlocked."[2]

Swinton's message indicates an information concept already advanced beyond mere virtual space. These are not the roots of the cyber orchard for the information society: the trees have bloomed and ladders are being erected to gather the fruit! Swinton's imagery conjures up data mining, data warehousing, an independent information raw material and commodity and commerce. Bibliographic control as applied to books expanded to include newspapers, journals and other periodic literature, government documents such as patents and technical data, industrial reports, plus photography and other recordings.[3] Libraries struggled to adapt their physical communal spaces to a continuity of services extending beyond the substitution of the delivery of symbols on paper in favor of coded signals—a metamorphosis of information, over some time and by some means, such that the new subsumed the old: All things in all libraries at all times became information.

At the Level of Design

How has this come to pass? Michael Buckland puts forward the history of documentation as one avenue towards a deeper investigation of two possible roots of information science: documentation and computing. He cites the key contributions of Paul Otlet, Emanuel Goldberg and Walter Schuermeyer prior to the oft-cited and influential published speculations of Vannevar Bush in 1945.[4] Works of S.R. Ranganathan on documentation follow Indian philosophical tradition and herald the depth and breadth of the global movement. Paul Otlet provided a conceptual breakthrough of sorts as early as 1903, extending bibliographic study and research beyond written and graphic records to include objects as well. Otlet envisioned libraries as stations in a global information network deriving this new information as a kind of restructured or recodified knowledge.[5] This modern view follows even earlier design principles.

While Swinton quotes Francis Bacon he is more significantly echoing the archetype philosopher-librarian Leibniz for the proposition that vast knowledge is not in books. Rudolf Blum recapitulates what is reliably known of the extent and nature of the library collections of scrolls at Alexandria in Egypt some 2,300 years ago and how processes evolved in the creation of scholarly catalogs.[6] The long history of administrative expertise in Egypt in organizing Pharaonic possessions certainly included inventories of official archives and "book" collections. Such practice informed the activities at Alexandria and formed the basis for what Blum asserts is the significant breakthrough of Kallimachos in library theory: an invention of a "new means of conveying information….the transmission and dissemination of information from the literature and about the literature."[7] Where Zenodotos was responsible for creating the physical classification of works through systematic analysis of their contents, Kallimachos concentrated on using the works themselves as sources of knowledge for a systematic mediation of holdings information to an outside audience. Blum's work indicates feedback of re-cursive metadata in the ancient world, a reflective knowledge in the sense of reference and self-reference, identification and identity.

At the Root of Librarianship

H. Curtis Wright has argued outright that information is a subject of philosophy, due to its non-material and non-physical basis.[8] Joseph Z. Nitecki cites Wright and Kaplan for the proposition that librarianship "is centered on the human mind" with "the assumption that philosophy can be based either on order, structure, and form, or on substance and content."[9] Nitecki has created a massive survey of the literature concerning what he sees as the philosophy of the domain of librarianship.[10] Another major work stands as an early portal to the topic.[11] One may take stock of Nitecki's annotated lists and categories of library philosophies and extract positions on the philosophy of information. Wright for his part shares Nitecki's concern with primarily this quest for self-knowledge within librarianship. "Librarianship and philosophy, while each possessing unique material content (such as it is), very probably have the same ultimate forms; and they are both metasciences par excellence."[12] Is information our deepest common agenda?

Information has emblazoned the heraldic crest of our profession, regardless of what terms and titles have come to describe our work. We and our colleagues in information sciences are struggling to define its parameters and to understand its nature. We have debated use of the term for decades and most recently have intensively embarked upon deep research into its philosophical meaning. In an edited collection Pertti Vakkari and Blaise Cronin present papers selected from an international conference in Finland, including an historical assessment by W. Boyd Rayward and philosophical approaches by Ivar A. Hoel, Rafael Capurro, Søren Brier and Peter Ingwersen, among others. Hermeneutics, semiotics and cybernetics are among the strongest internal themes among these researchers.[13]

Philosophy of Information

Luciano Floridi has recently spearheaded an effort in the area of computing in the hopes of producing a systematic treatment of the philosophical foundations of our information society. Where he makes slight mention of library theories in recounting the growth of human knowledge and emergence of the modern "infosphere," Floridi artfully weaves an understanding of databases with Novalis and encyclopedias with Plato.[14] I believe the emergence of a library philosophy of information should be apparent from his observation that in the development of the history of philosophy the "central focus has moved from being, to knowledge, to meaning, to information."[15] Librarianship has applied itself as a lens to such a focus in its endeavor to serve as a recording instrument of history.

Floridi proposes to define his Philosophy of Information as "the description as well as normative branch of philosophy primarily concerned with the conceptual and foundational investigation into the nature of information, its dynamics and utilization." Dynamics here includes "the constitution of information environments, with their systemic properties, interactions, internal developments, etc. and …information life cycles…" A life cycle includes "discovering, designing, authoring…collecting, validating, modifying, organizing, indexing, classifying, filtering, updating, sorting, storing, networking, distributing, accessing, retrieving, transmitting…monitoring, modeling, analyzing, explaining, planning, forecasting, decision-making, instructing, educating, learning, etc." This sense of information in computing is more narrow and uniform than in our tradition, but Floridi's arguments are bold and innovative and well expressed.

Mark Alfino's philosophical coursework from 1995 is instructive: "To think about information rigorously you must read from several disciplines, since information is not the specfic object of study of any one field. The division in thinking about information is between more or less technical accounts which suppose that information can be studied as a distinct object in relative isolation from culture and scholars who feel that we can only talk about information in relation to a 'cultural semiotic.'"[16] The plethora of information objects from all disciplines is another sign that information deserves special attention. Librarianship has a unique status among disciplines and should contribute energetically to the philosophy of information.

Part II. Library Practice

Experience

To the extent that librarianship is an applied philosophy of information, it seeks to discover the roots of phases of information dynamics in the course of our traditional work. Together with research beyond librarianship, our goal has ever been the design and functioning of effective information services. Investigation of the nature of information should reveal characteristics and properties which serve to better our understanding of its relationships with other types of things. The results of such efforts should enhance the many avenues of existing practice and at least take expression in these familiar terms.

Authority

Authority in our parlance refers to an accepted source of information and its bibliographic description, usually given as the exercise of authority control. Judgment, command, control, precedence, expertise and influence are in a sense unified and correctly implied in the performance of authority both within librarianship and without. Though Kallimachos is credited with the creation of bio-bibliography some 2,300 years ago, a broader quest for verification of authenticity of records must predate him. The main thrust of bibliography since ancient times stems from this second-order identification of authorship, a kind of meta-level description of pre-existing written works. Patrick Wilson has led a new development of interest in cognitive authority, or the process by which our personal world of knowledge interacts with public sources of information.[17] Sue Easun has worked to investigate Wilson's theories and extend his research into new directions.[18] Wilson's theory has been characterized as social epistemology and in general is a kind of shared cognitive process between two minds. This powerful model is distinguished from idealizations of information processing wherein a single mind interacts with its environment, the latter typical of mathematical theories of cognition, the former compatible with mathematical theories of communication. Judgment is typically cited as the value added to information in the creation of knowledge, particularly but not exclusively for those who posit a continuum from data to information to knowledge to wisdom.

Cataloging

Fremont Rider in 1944 represented the traditional goal of catalogs as more than local, independent and isolated lists, that of freely-distributed, holographic meta-descriptions.[19] The manner in which the lone philosopher organizes her own collection of research materials reflects her own thinking. Once this information is to be shared, however, this level of specialization or particularization must at some point interact with the generalized and globalized systems. The analogous situation for libraries holds true. Modern cataloging has as much required knowledge specialties as ever: languages, scripts, arts, sciences, for most of which automation has little as yet to offer. The library catalog may itself be described as a relational database system when in an online electronic format. Then what was it previously in paper and in design? Another kind of information object or the same?

Cataloging has depended upon the convention of the title page in printed works as a standard "source of information." The progress of bibliography through the era of manuscripts had been laborious in large part due to the multiplicity and variability of the written records. The value of local catalogs should never be lost in the transition to the shared systems; what does transpire is common to the appearance of compromises in tandem with the adoption of standards. Every suggestion to digitize collections entails cataloging at an equal or greater depth of effort—electronic records, contrary to general misconception, do not inherently possess bibliographic structure (unless your ontological view of information says they do).[20]

Barbara Tillett says "we are still in the dark ages awaiting the evolution of a conventional device like the title page to become ubiquitous for electronic documents. What we may find instead are 'self-describing entities,' manifestations with headers that embed standard descriptive information (metadata) as part of the electronic text."[21] Tillett observes that catalogs deliver surrogates for their collections, which are given structure by subject analysis provided by humans expressing relationships using logical connections. IFLA's goal of dynamically-created bibliographic records may be realized in a realm of collaborative linking of intellectual work among all involved between author and user.

Classification

Classification refers to the systematic arrangement of books and materials, a topic rich in historical detail and theoretical import. Classification as hypothesis is a subject of logic in scientific investigation and classification schemes invariably accompany theorists and experimentalists alike as explanatory tools and reference guides. The notion is tightly intertwined with that of categories and the complex task of library cataloging involves the creation of both classification and categorization aspects in parallel in meta-level records and utilizing special vocabularies and thesauri. The assignment of terms to records is analogous to deciding membership in a class.

Library classification was created as a system of symbols for the physical arrangement of books rather than a philosophical or theoretical classification of human knowledge. Fremont Rider makes the distinction, however, between this function and that of the scholarly, taxonomic and systematic level of classification represented by bibliographic theory.[22] Georg Schneider put it this way: "Although it might be convenient and desirable to adopt, for use in subdividing the literature in a bibliography, the division and evaluation of knowledge that is found in the philosophical-encyclopedic systems, that cannot, as a rule, be done. Nevertheless, this constitutes a tie, a partial integration of the two fields, that is closer than any that could be seen in the relation of bibliography to the other sciences."[23] Though Schneider here is subscribing to the retrograde definition of bibliography as the mere study of lists of literature, his contention most certainly captures the essence of an argument which if anything has become stronger with time.

Nitecki reminds us of the foundational role of Aristotle's distinctions of genera and species in the construction of knowledge classifications. The library literature is rich with historical and philosophical details regarding past classification systems up through modern

facet analysis and its dependence upon categories and notation.[24] It is instructive and interesting to compare Nitecki's analysis of the domain of information with Muhammad Ali Khalidi's discussion of domains, disciplines and subdisciplines.[25] A great resource for future studies in philosophy of information along these lines is being produced by the ASIS SIG/CR Classification Research Workshop.[26]

Epistemology

The definition of "information" has itself become a famous subject of intense scrutiny and debate. The textbook purposes of definition are five-fold: to increase vocabulary, to eliminate ambiguity, to reduce vagueness, to explain theoretically, and to influence attitudes. An applied philosophy of information would classify streams of debate about the definition of the term "information" within this framework and in so doing characterize these diverse efforts in library science, information science and elsewhere. Flückiger characterizes two main types of information theory: functional-cybernetic, represented by Peters, Dretske and Ebeling; and structural-attributive, represented by MacKay, Nauta, Devlin and Stonier. These endeavors to unify information theories are themselves beset by the staggering diversity of research, such as within the Foundations of Information Science movement.[27]

Professor Dick of the University of South Africa has recently analyzed the library and information science literature for epistemological positions.[28] He identifies some of the major players and their influences, Shera and Fuller in social epistemology, Brookes on Popper, Swanson in information retrieval, and the works of Budd, Farradane, Foskett and Nitecki. Although Dick proposes his own epistemological theory of holistic perspectivism, his survey and method also deserve our attention. We should consider poly-epistemological systems in light of Maruyama and delve further into the roots of cybernetics and information by reading von Foerster.[29] The traditional theory of knowledge has been superseded by unstated adherence to what once formed a "systems" point of view.

Logic

Library and other information systems have long utilized Boolean logical operators in automated retrieval and these functions have prominence within the programming of search engines. Boole immediately followed work of de Morgan, who first joined a logical analysis of all mathematical symbols, operations and laws with the desire to express logical concepts in mathematical forms. Both men were completing foundational work laid even earlier by Peacock, Babbage and Herschel (all astronomers as well, seeking automated calculation for ephemeris tables) and somewhat in parallel with Arbogast, Servois, Gergonne and Bolzano. All sought a symbolic logic finally given modern form by Boole in the propositional calculus thought by Boole to represent how the mind performs reasoning and perhaps ultimately reflecting upon the nature and constitution of the human mind itself. Leibniz is often credited with having idealized this plan for coordinated, mechanized symbol-exchange through binary logic. One may read the stark outlines for the design of such a perfect deductive system in the ponderings of Tim Berners-Lee, for whom the human mind, however, becomes secondary in importance to machine communications.[30]

Jevons, de Morgan, Peirce, Schröder and Hankel solidified algebraic principles and moved beyond the strict forms of classical logic. Frege and then Peano brilliantly set the stage for Hilbert, Whitehead and Russell and 20th century metamathematics.[31] Now the propositional calculus only extends over logical sentences that use connectives; the full system, with quantifiers, is more general and is called the predicate calculus. The analysis of basic propositions yields constituent objects and properties, or predicates. Claude Shannon's master's thesis of 1938 applied Boolean algebra as a powerful technique in the design of complicated digital circuits, though not in the sense of a mechanized predicate calculus.

Keith Devlin has published an introduction to situation theory and situation semantics, as well as a more general account in which he describes the evolution of modern logic.[32]

Devlin goes as far as saying that the original goal of logic as a science of all reasoning was lost and replaced by the idea of logic as the science of mathematical reasoning, or reasoning in mathematics, very far from Boole's initiative towards a comprehensive study of human reasoning. Success, however, flowed from the efforts of logicians to the extent that Devlin also asserts that mathematical logic became the paradigm under which an array of remarkable discoveries occurred in the first half of the 20th century, to be followed by a phase in which applied logic employed vast mathematical techniques to the complexities of everyday reasoning and everyday language, such as communications theory.

Devlin has also participated in the interdisciplinary, inter-institutional collaboration by Stanford, SRI International and Xerox PARC known as CSLI, the Center for the Study of Language and Information. CSLI investigates a new science of information, computing and cognition, identified as originating in the 1970s as a "shared interest in how agents, whether biological or artificial, acquire, process, and convey information."[33] This has become the new meaning of ontology within information science.

Ontology

Ontology has this newly acquired meaning among information scientists in the context of the formulation of human-computer interfaces: a description of concepts and relationships for an agent or community of agents, expressed in terms of formal programming specifications as sets of objects, names of entities, shared vocabularies and such. This meaning is outside traditional philosophy and pertains to the sharing of knowledge among agents (machines, artificial intelligences). Briefing this literature is like crossing a bridge between philosophy and librarianship. Christopher Fox brought the importance of the ontological status of information to the forefront of librarianship with his groundbreaking dissertation and publication in the early 1980s.[34] His analysis places information into a category of abstract objects, specifically as propositions, and owes a debt of recognition to Frege.

Michael Dummett has produced a lengthy commentary on the classification of concrete and abstract objects according to his reading of Frege.[35] Philosopher John Collier's

recent work suggesting that information connects logic and causation arrives at the same conclusion as Fox, that information is a proposition, but from this syllogism: the basic idea of information is a distinction; the logic of distinctions (laws of form) is equivalent to propositional logic, thus information is a proposition. Collier adopts the sense of <u>Tractatus</u> in the Fregean ontological scheme.[36] Dummett enters deep discussion of Frege's links to Aristotle as opposed to the early Wittgenstein's agreement with Frege. He notes further: "a concrete object can take part in causal interactions; an abstract object can neither be the cause nor the subject of change."[37]

William S. Cooper expresses the desire for the concept of information to provide a platform for the integration of logic and language. Cooper too cites Frege as critical to the intellectual development of model-theoretic semantics, one of the promising modes of analysis suggested in such an integrated scientific framework.[38] Another ontological formulation, attributed to Willard Van Orman Quine that 'To be is to be the value of a variable' comes to us in a bold article by Robert Losee, who calls information the characteristics of the output of a process which describes both the process and the input.[39]

The interpretation of information as propositions may derive from, among other sources, a confluence of Balzano and Euler. Euler's method takes propositions to refer to collections of objects. Balzano first used the term "set" and established its pertinence in these regards in 1847, prior to Cantor's foundational work creating set theory. Balzano was considering "an embodiment of the idea or concept which we conceive then we regard the arrangement of its parts as a matter of indifference."[40] This notion of distinction and generalized content coincided with Babbage's Analytical Engine, which required two groups of cards: operations and variables. Babbage explicitly linked the concepts of set, library and program. Though rebirth of professional librarianship in the 19th century did not turn on questions of the ultimate reality of information or its objects or their situation in the world, serious scholarship would follow as would dramatic transformation of that reality.[41]

Mind

Mathematical physics and the Vienna school of positivist logicians heavily influenced the early cybernetic vision. General systems theory advanced with discoveries in biology and evolution and brought the notion of complexity to paradigms of social interaction. Identification of the cellular and genetic bases for life and chemical-molecular signaling all raised information to new levels of investigation. Fundamental questions remain as to whether information exists independently in nature or is a phenomenon of mind. Wheeler, Freidman and Deutsch in physics and Rucker in mathematics have advocated views in which information is posited as a primordial essence of reality. The classical models of interaction in exchange of information between minds or machines, between mind and environment, all are open to revision prompted by new scientific and philosophical hypotheses.

Quantum information theory seems to be in the process of emerging as a generalized form of computation. It is unclear what are the ramifications for our understanding of information based on qubits. In Relativity theory concepts such as frames, signals and causality are tightly bound with the nature of information. Is information transmitted or

structural, can information be explained by causal lines or sets? Incompleteness theory has a reformulation in algorithmic information theory.[42] Discussions of information and mind appear in the works of philosophers David Chalmers and Gregory Mulhauser.[43] Chalmers posits a post-Shannon mental information space. Mulhauser applies algorithmic information theory to cognitive processes, as does physicist Murray Gell-Mann. Both Chalmers and Mulhauser utilize mathematical constructs involving information as a logical space, akin to the treatment of time by Von Fraasen borrowing from early Wittgenstein.[44]

Information is a key component in models of complex adaptive systems in emerging studies in a developing science of consciousness. Gell-Mann and Hartle propose a complex adaptive system acting as an observer, known as an information gathering and utilizing system or IGUS.[45] Such an IGUS may or may not provide a basis for self-awareness or consciousness or mind, but in any case information is central to this paradigm of cognitive science. Brier opposes this functionalistic approach, created by ontological positions of Wiener, von Neumann, Shannon, and Turing, and supported by Fodor, with a second-order cybernetic approach represented by works of Prigogine, Maturana, Varela, von Foerster, Spencer-Brown and Luhmann.[46]

In Conclusion

Libraries are clearly associated with 5,000 years of civilization. Where Lewis Mumford inspires a view of the "city" as the human artifact of storage, classification and memory, actual libraries have performed these specialized tasks in high pursuit of our abilities to discern, abstract, sort, see, remember and precisely use elements of our world. Legitimate questions of cultural introspection and philosophizing infuse the very substance of librarianship and its activities. If we inherit the tasks of operating an interactive museum of global library systems, we become at the same time curators of the human mind. This does not hinge on questions whether information must be digital or whether the rate of growth in volume of information is significant.

I do not believe that this new philosophical thing called "information" in some manner overwhelms the importance of books or printed knowledge or music or sound and other realia. A pan-information view is utopian and artificial. We are dedicated to service and cooperation, yet our tools are essential also to organized violence and war-making. Our ideal of shared human memory belies a century of extinction of oral traditions and diverse languages. The rhetoric of automatic learning and intelligent documents does no justice to a legacy of machine instruction and monolithic models of cognition. The new function of information was derided for its lack of compassion, hence the oft-cited passage from the poet.[47] I do not suggest that librarians have to choose a particular philosophical position in relation to information. We must recognize, however, that the dawning of this age of information brings to light a host of subtle changes in how we think we share our experiences. We should be active participants in the debate over philosophies of information.

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dark as to the meaning of our work.'....We must try to stop our present recataloging of the same book a thousand times in a thousand libraries. If we could eliminate *that*, then we could retain on our catalog cards every scrap of the 'bibliographic' information that we find useful there—and might even add more…" Rider, Fremont. (1944) *The Scholar and the Future of the Research Library: A Problem and Its Solution.* Hadham Press, New York. Pp. 34,35,39

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29. Von Foerster, Heinz. (1980) "Epistemology of Communication," in *The Myths of Information.* Pp. 18+; Von Foerster sees likening of information with signals an artifact of militarist 'command mode' thinking endemic to historic development of general purpose computers In the same volume, Magoroh Maruyama, "Information and Communication in Poly-Epistemological Systems," 28+ See also his "Metaorganization of Information," *Cybernetica*, 8 (1965), 224-36.

30. Tim Berners-Lee, with Mark Fischetti. (1999) *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web by Its Inventor.* HarperSanFrancisco, San Francisco.

31. "Boole got control over the logical connectives *or, and,* and *not*; Frege took care of *implies* and *for all*; Peano introduced a flexible symbolism; Russell showed how to put all of mathematics into a standard logical form; Hilbert showed how to build up logical systems of many
different kinds." Rucker, Rudy v. B. (1987) *Mind Tools: The Five Levels of Mathematical Reality.* Houghton Mifflin, Boston. P. 208

32. Devlin, Keith. (1991) *Logic and Information.* Cambridge Univ. Press, Cambridge; and (1997) *Goodbye Descartes: The End of Logic and the Search for a New Cosmology of the Mind*. Wiley, New York.

33. Stanford University. Center for the Study of Language and Information. www-csli.Stanford.edu/info

34. Fox, Christopher John. (1983) *Information and Misinformation: An Investigation of the Notions of Information, Misinformation, and Misinforming.* Greenwood Press, Westport, Conn.

35. Dummett, Michael. (1973) *Frege: Philosophy of Language.* Harper & Row, New York.
Dummett repeats the importance of the Fregean analysis in a new framing of the fundamental question of ontology:
" 'What is there?', where, of course, since an actual inventory is not required, the intention of the question is, 'What kinds of thing are there?'. How the question is broken down then depends upon the basic principles of categorization. On the traditional conception, the first step towards breaking it down consists of specializing to the two questions, 'What particulars are there?' and 'Are there universals, and, if so, what universals are there?', where, of course, the second question raises the problem of nominalism as traditionally conceived. The question, 'What objects are there?', on the other hand, arises only against the background of a Fregean ontological perspective, and its companions are, 'Are there concepts?, 'Are there relations?', 'Are there functions?' and 'Are there truth-values?'. The question about objects then may be broken down further into ones concerning concrete objects and abstract objects." at 473.
This reasoning is cited by Newton-Smith. Information apart from librarianship and information science may evolve a philosophical literature as rich and complex as has time. See fn. 44, below.

36. "[Wittgenstein] thought there was a basic set of propositions that constitute the facts of the world. I would say that there is just a basic set of factual content about objects, which may, and usually does, generate multiple equivalent propositions." Collier, John. (2000) *Notes for a Talk: Information Connects Logic and Causation.* University of Newcastle. Department of Philosophy. 16 March, 2000.
www.newcastle.edu.au/department/pl/Staff/JohnCollier/papers/infcauslogic.notes.pdf

37. Dummett (1973) at 491.

38. Cooper, William S. (1978) *Foundations of Logico-Linguistics: A Unified Theory of Information.* D. Reidel, Dordrecht.

39. Losee, Robert M. (1997) "A Discipline Independent Definition of Information" 48 *JASIS* Issue 3 (1997)

40. "The Beginnings of Set Theory" in *The MacTutor History of Mathematics Archive*. University of St. Andrews. School of Mathematics & Statistics. [n.d.] www-groups.dcs.st-and.ac.uk/~history/HistTopics/Beginnings_of_set_theory.html

41. Litwin, Rory. (1998) *Intellectual Foundations of Modern Librarianship.* www.biermans.com/culminating/litwin1.html

42. Chaitin, Gregory J. (1982) "Gödel's Theorem and Information" *International Journal of Theoretical Physics* 22 (1982), 941-954. www.cs.auckland.ac.nz/CDMTCS/chaitin/georgia.html

43. Chalmers, D. J. (1996) *The Conscious Mind: In Search of a Fundamental Theory.* Oxford University Press, New York.   Mulhauser, Gregory R. (1997) *Mind Out of Matter: Topics in the Physical Foundations of Consciousness and Cognition.* Kluwer Academic, Dordrecht.

44. Newton-Smith, W.H. (1980), *The Structure of Time.* Routlege & Kegan Paul, London.

45. Gell-Mann, Murray. (1994) *The Quark and the Jaguar: Adventures in the Simple and the Complex.* W.H. Freeman, New York.

46. Brier, Søren. (1999) "What is a Possible Ontological and Epistemological Framework for a True Universal 'Information Science'? The Suggestion of a Cybersemiotics." in *The Quest for a Unified Theory of Information.* Gordon and Breach, Amsterdam.

47. T.S. Eliot (1934) *The Rock,* stanza I: "Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?*"*