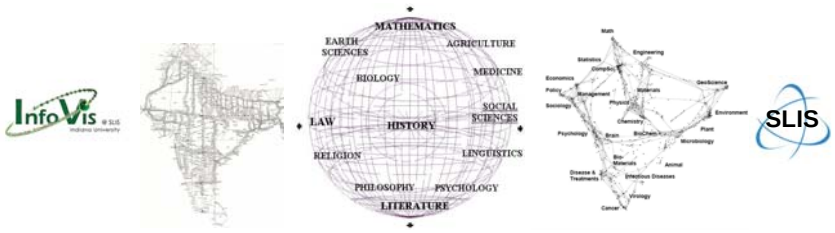
# Knowledge Domain Visualizations




## Research Interests

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http://ella.slis.indiana.edu/~pahook
Places & Spaces (Informal Meeting on Mapping Science)
Philadelphia, Pennsylvania
December 1, 2005

# Research Interests

- Cognitive Justification for Domain Maps
- Pedagogical Use of Domain Maps
- User Testing of Domain Maps
- History of Domain Maps
- Mapping Legal Topics

# History of KDVs

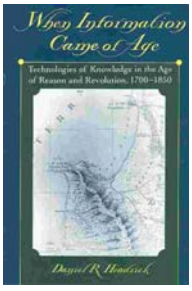
## Descriptive → Scientific Cartography

Prior to the 1600's cartography was predominately descriptive. Advances in calculating location on the planet made it scientific.

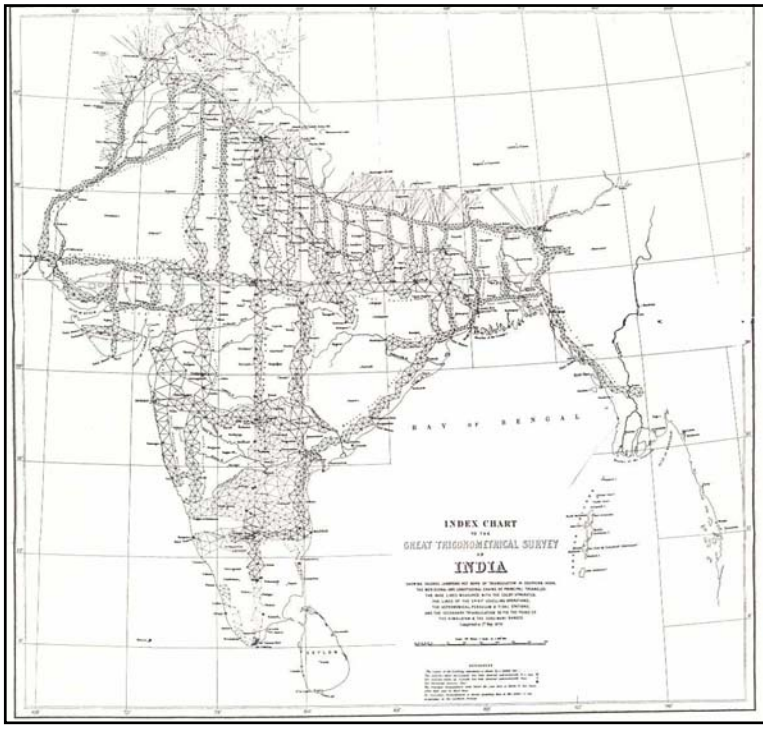
- Triangulation over large distances from a known base measure.
- Using the moons of Jupiter to establish longitude on land.
- Using accurate time pieces to establish longitude at sea.
- Accurately measuring depth and altitude, and representing them on maps.

The same is now occurring with domain maps.

- We had descriptive maps for a long time.
- Now they have become methodologically rigorous and scientific.



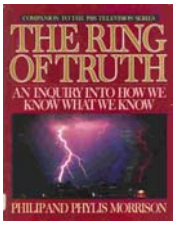

Headrick, Daniel R. (2000). *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700-1850.* New York: Oxford University Press.

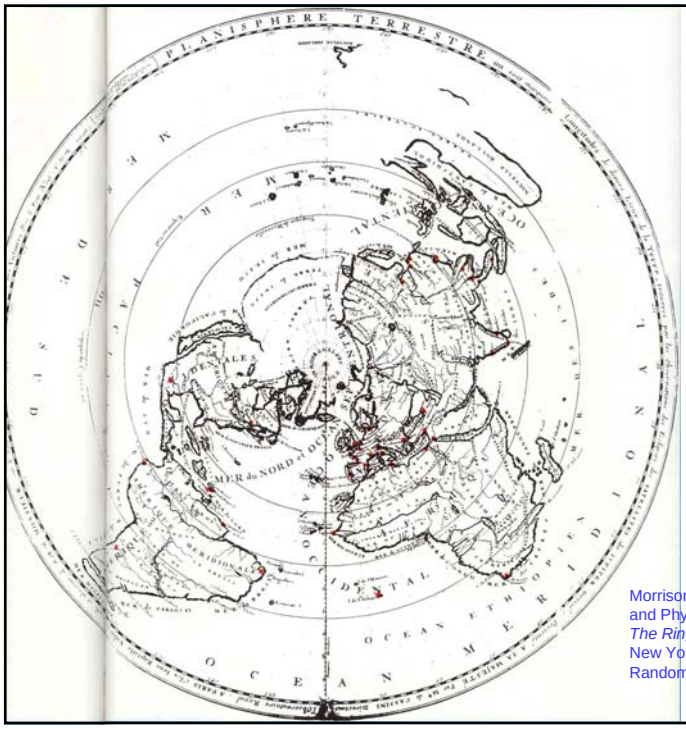



## 1870

- The mapping of India by triangulation.
- Captain George Everest

Morrison, Philip and Phylis (1987). *The Ring of Truth.* New York: Random House.



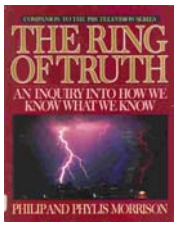




## 1696

- First Accurate Map of the Earth
- 40 points of accurate longitude
- Based on Moons of Jupiter to compare with local time in Paris.

- Cassini.

Morrison, Philip and Phylis (1987). *The Ring of Truth.* New York: Random House.



# Pre-Bibliometric History

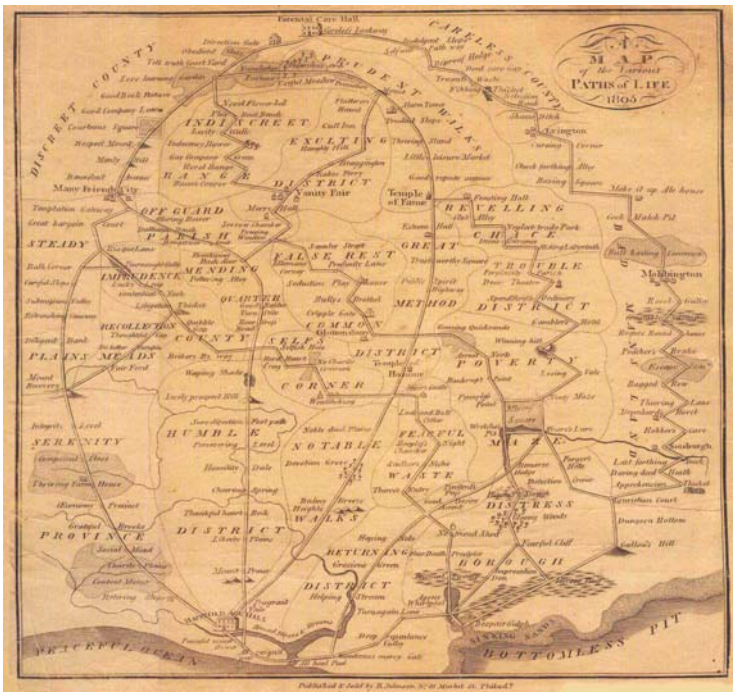
Domain Maps utilizing the distance—similarity metaphor for non-spatial data are created by hand based on the viewpoint and experience of the creator.


**1654**

From: *Creating French Culture: Treasures from the Bibliotheque Nationale de France,* Library of Congress, Available at:http://www.loc.gov/exhibits/bnf/bnf0004.html

Madeleine de Scudéry (b. 1607-d. 1701), *Clélie, histoire romaine, première partie (Clélie: A Roman Story, part I)*, Paris, 1654, Reserve of Rare and Precious Books, Rés. Yý. 1496

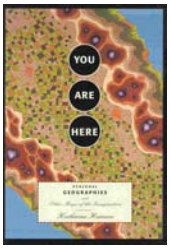
"Madeleine de Scudéry's novel, *Clélie*, served as pretext for the description of acquaintances, stately residences, and palaces, and for dialogues based on actual conversations of her salon. The most immediate stir was created by the *Carte du tendre (Map of Affection)*, engraved by François Chauveau and inserted in the first part of the novel. A salon game, the Map sparked a fad for "amorous geography" that took the form of allegorical almanacs and imaginary maps."

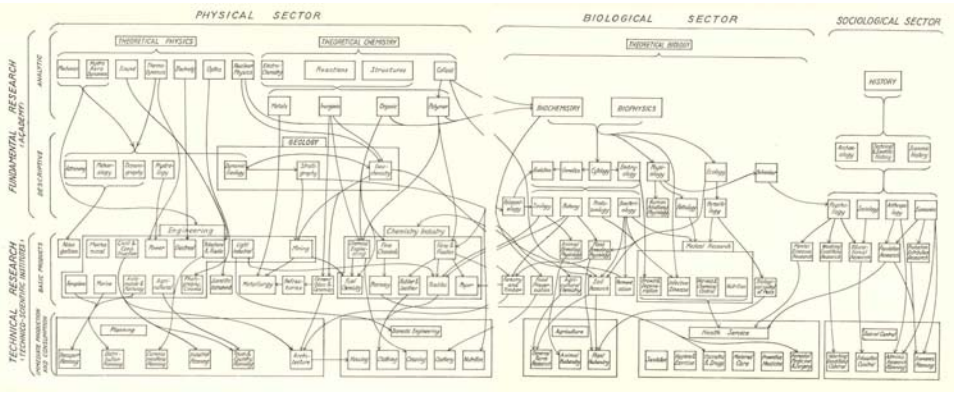



## 1794

*Map of the Various Paths of Life*, Benjamin Johnson, Philadelphia, 1805, originally published as a jigsaw puzzle in 1794, Map Collection, Yale University Library.

From: Harmon, Katherine (2004). *You Are Here: Personal Geographies and Other Maps of the Imagination.* New York: Princeton Architectural Press.

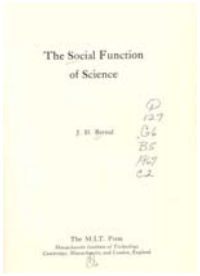


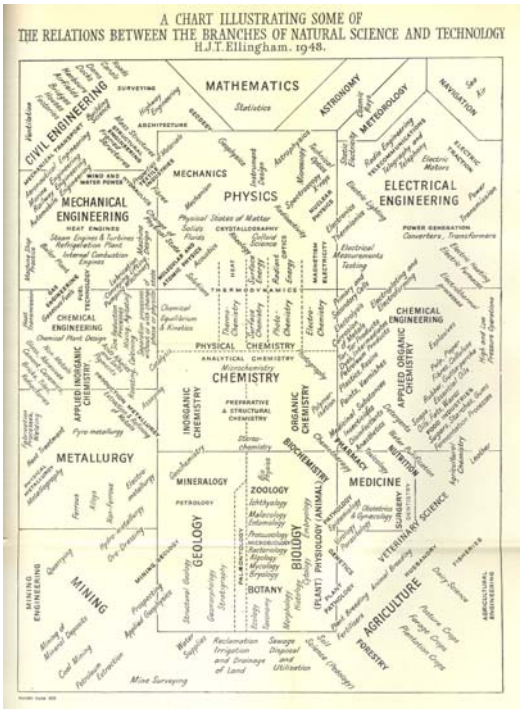




## 1939

John D. Bernal was a world renowned physicist, a historian of science, and a sociologist of science. He is considered to have produced one of the first 'maps' of science.

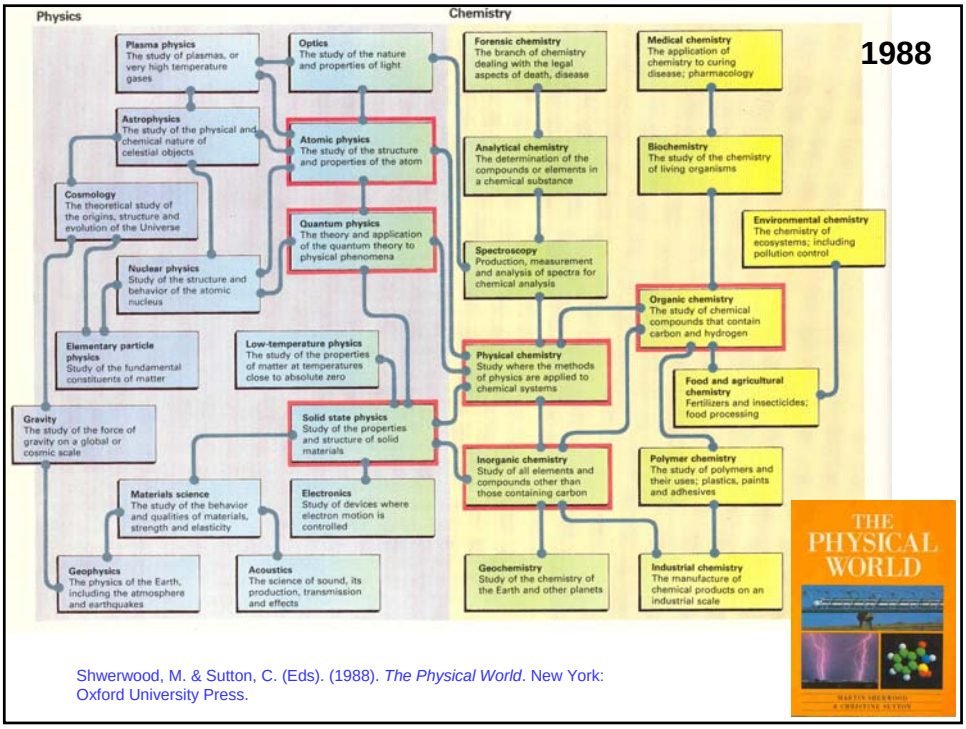
Bernal, J.D. (1939). *The Social Function of Science.* London: Routledge & Kegan Ltd.




## 1948

Ellingham, H. J. T. (1948), Divisions of Natural Science and Technology, in Reports and Papers of the Royal Society Scientific Information Conference, 21 June – 2 July, 1948. London: The Royal Society, Burlington House.




## 1988

Shwerwood, M. & Sutton, C. (Eds). (1988). *The Physical World*. New York: Oxford University Press.

**1895**

# 1st Otlet and then De Solla Price Contemplate Domain Maps

1895 – Paul Otlet realizes that Melvil Dewey's Decimal Classification could be used to map knowledge domains. Begins work on converting Dewey's system into the more faceted Universal Decimal Classification (UDC).

1918 – Otlet states again that the UDC may be used to create "an immense map of the domains of knowledge" (Otlet, 1918, p. 78).

Rayword, B. (1994). Visions of Xanadu: Paul Otlet (1868-1944) and hypertext. JASIS, 45(4), 235-250.

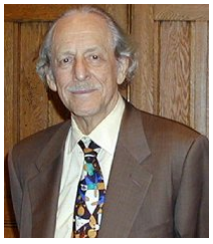
1965 – **Derek De Solla Price** - published contemplation of using bibliometric techniques to create maps of scientific literatures.

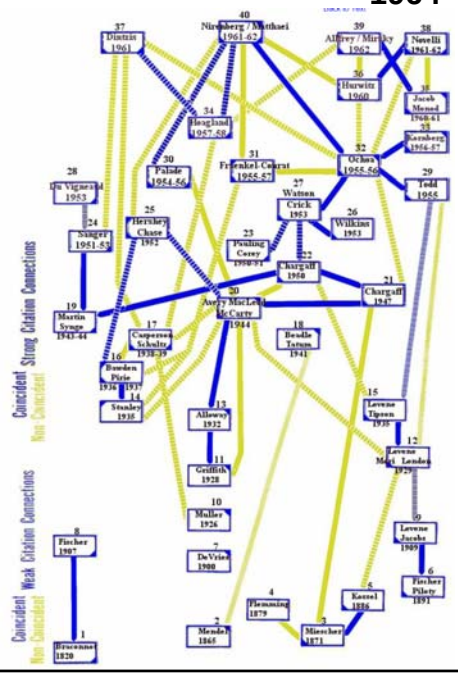
De Solla Price, Derek J. (1965). Networks of Scientific Papers *Science*, New Series, Vol. 149, No. 3683. (Jul. 30, 1965), pp. 510-515.

**1964**

**Historiograph of DNA Development**
*(Garfield, Sher, & Torpie, 1964)*
*"The Use of Citation Data in Writing the History of Science." Published by The Institute for Scientific Information, December 1964. Report of research for Air Force Office of Scientific Research under contract F49(638)-1256.*

**Eugene Garfield**, recent photo. Creator of the ISI Web of Science citation database.






http://www.garfield.library.upenn.edu/

**1973**

**Co – Discoveries / Implementation**

Using Co-Citation to create domain maps.

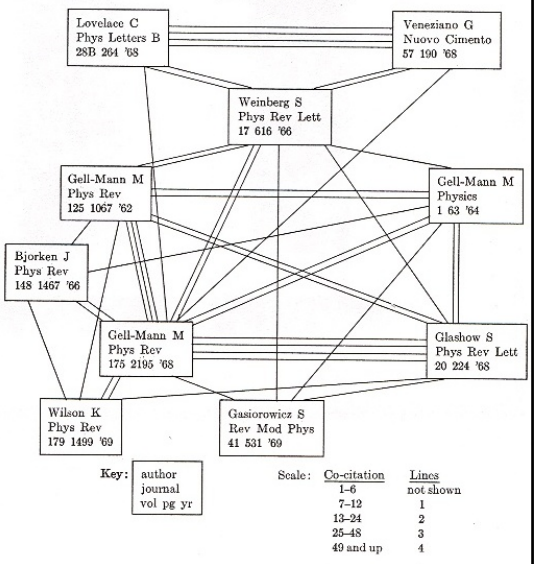
• Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. JASIS, 24, 265-269.

• Marshakova, I.V. (1973). A system of document connections based on references. Scientific and Technical Information Serial of VINITI, 6, 3-8.


Henry Small

FIGURE 1

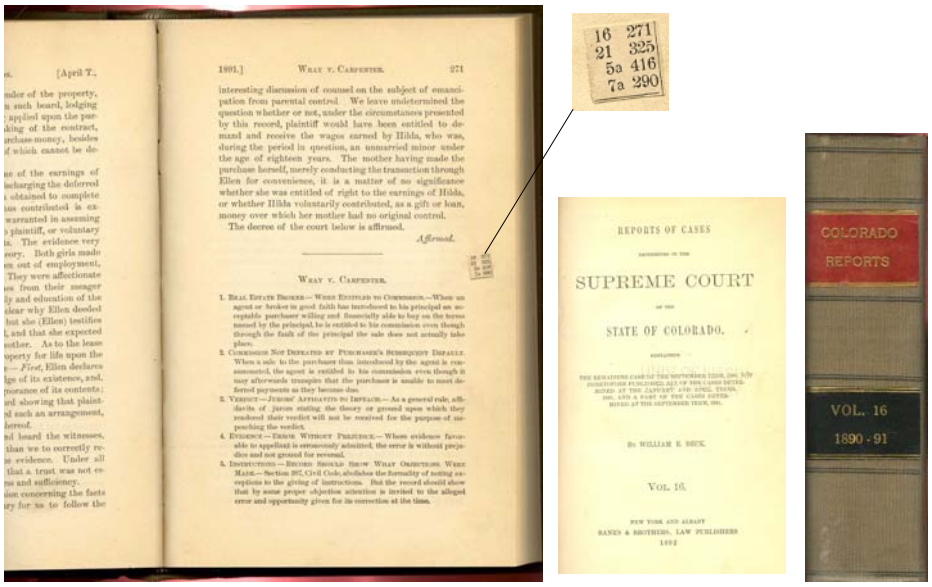
Co-citation Network for Frequently Cited Papers in Particle Physics
(Data from the 1971 *SCI*)




(1875) Frank Shepard (1953) Eugene Garfield (1996) Page and Brin

## Shepard's Citations

- 1875, Frank Shepard published his first citator, Illinois Citations.
- He was a business person with no legal training.
- Manual Hyperlinks.



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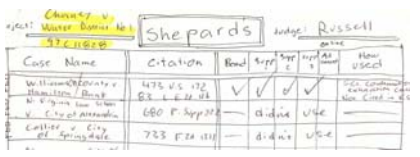



**History of Case**

| | | |
|---|---|---|
| a | (affirmed) | Same case affirmed on appeal to a higher level court. |
| cc | (connected case) | The case is related to your case in some way in that it involves either the same parties or arises out of the same subject matter. However, it is not the same action on the merits. |
| D | (dismissed) | An action which has been appealed from a lower court to a higher court has been discontinued without further hearing. |
| m | (modified) | The lower court's decision is changed in some way, either during a rehearing or by action of a higher court. For example, if a court of appeals affirms a trial court decision in part and reverses it in part, that trial court decision is shown as modified by the court of appeals. |
| r | (reversed) | The lower court is reversed on appeal to a higher court. |
| s | (same case) | The case is the identical action to your case, although at a different stage of the proceedings. "Same case" refers to many different situations, including motions and opinions that preceded your case. It is important to read these cases if you need to know exactly what occured. |
| S | (superseded) | A subsequent opinion has been substituted for your case. |
| v | (vacated) | The opinion has been rendered void and is no longer of precedential value. |
| US | cert den | Certiorari has been denied by the U. S. Supreme Court. |
| US | cert dis | Certiorari has been dismissed by the U. S. Supreme Court. |
| US | reh den | Rehearing has been denied by the U. S. Supreme Court. |
| US | reh dis | Rehearing has been dismissed by the U. S. Supreme Court. |

**Treatment of Case**

| | | |
|---|---|---|
| c | (criticised) | The court is disagreeing with the soundness of your decision, although the court may not have the jurisdiction or the authority to materially affect its precedential value. |
| d | (distinguished) | The case is different from your case in significant aspects. It involves either a dissimilar fact situation or a different application of the law. |
| e | (explained) | The court is interpreting your case in a significant way. |
| f | (followed) | Your case is being relied upon as controlling or persuasive authority. |
| h | (harmonized) | The cases differ in some way; however, the court finds a way to reconcile the differences. |
| j | (dissenting opinion) | Your case is cited in the dissent of this opinion. |
| L | (limited) | The court restricts the application of your opinion. The court usually finds that the reasoning of your opinion applies only in very specific instances. |
| o | (overruled) | The court has determined that the reasoning in your case is no longer valid, either in part or in its entirety. |
| p | (parallel) | This letter is usually found in older cases where your case was described as "on all fours" or "parallel" to the citing case. Your case is being relied upon as controlling or persuasive authority. |
| q | (questioned) | The soundness of your case is at issue. For example, your decision may have been legislatively overruled, or its reasoning may have been overruled by an opposing line of authority. |

ABBREVIATIONS—COURTS

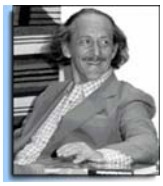
Cir. DC–U.S. Court of Appeals, District of Columbia Circuit
Cir. (number)–U.S. Court of Appeals Circuit (number)
Cir. Fed.–U.S. Court of Appeals, Federal Circuit
CCPA–Court of Customs and Patent Appeals
CIT–United States Court of International Trade
ClCl–Claims Court (U.S.)
CtCl–Court of Claims (U.S.)
CuCt–Customs Court
ECA–Temporary Emergency Court of Appeals
ML–Judicial Panel on Multidistrict Litigation
RRR–Special Court Regional Rail Reorganization Act of 1973

GEBL–Pollard/Burton, Guide to Effective Bankruptcy Litigation (Shepard's, 1988)
Geo–Georgetown Law Journal
GICL–Vishny, Guide to International Commerce Law (Shepard's, 1984)
GMS–Schwartz, Lee & Kelly, Guide to Multistate Litigation (Shepard's, 1985)
GPPS–Dunkle, Guide to Pension and Profit Sharing Plans (Shepard's, 1984)
HCC–Haralambie, Handling Child Custody Cases (Shepard's, 1983)
HHb–Binder, Hearsay Handbook (Shepard's, 1983)
HHb(3)–Binder, Hearsay Handbook, Third Edition (Shepard's, 1991)
HLR–Harvard Law Review
HPWT–Aron & Rosner, How to Prepare Witnesses for Trial (Shepard's, 1985)
ICCD–Turner, Insurance Coverage of Construction Disputes (Shepard's, 1992)
JBK–The Journal of the Bar Association of the State of Kansas
JCB–Kansas Judicial Council Bulletin
JuS–Jordan, Jury Selection (Shepard's, 1980)
JuS(2)–Jordan & Gobert, Jury Selection, Second Edition (Shepard's, 1990)
JV–Nachmias/Nasuti, Joint Ventures (Shepard's, 1988)
Kan–Kansas Reports
KanA–Kansas Court of Appeals Reports
KA2d–Kansas Court of Appeals Reports, Second Series
KLR–University of Kansas Law Review
LASB–Zeidman, Legal Aspects of Selling and Buying (Shepard's, 1983)
LASB(2)–Zeidman, Legal Aspects of Selling and Buying, Second Edition (Shepard's, 1991)
LCP–Law and Contemporary Problems
LCP(3)–Law and Contemporary Problems, Part 3
LE–Lawyers' Edition, United States Supreme Court Reports

# Garfield's Model For ISI

- And in 1953 I learned, through William C. Adair, a former vice president of Shepard's Citations, that there was an index to the case literature of the law that used citations. Shepard's Citations is the oldest major citation index in existence; it was started in 1873 to provide the legal profession with a tool for searching legal decisions. … **The legal "citator" system provided a model of how a citation index could be organized to function as an effective search tool.**

Garfield, Eugene (1979). *Citation Indexing—Its Theory and Application In Science, Technology, and Humanities*. Philadelphia: ISI Press. p.7.



# Google: PageRank Relevance Algorithm

- Developed by Stanford PhD Computer Science Students in 1996
- Larry Page and Sergey Brin
- "Inspired by citation analysis, Page theorized that a raw count of links to a page would be a useful guide to the page's rank."

Battelle, John (2005). *The Search: How Google and Its Rivals Rewrote the Rules of Business and Transformed Our Culture.* Portfolio: New York

Larry Page - 32

Sergey Brin - 32

# Legal Citation Practices

## Law -- Attribution with Precision

- Legal style guide for citations is a 300+ page book known as the Bluebook


- Tradition of Student Edited Journals
- Extensive Cite Checking and Validation
- Does Not Rest on the Credibility of the Author
- Every non-obvious original thought is attributed to a specific page or paragraph.

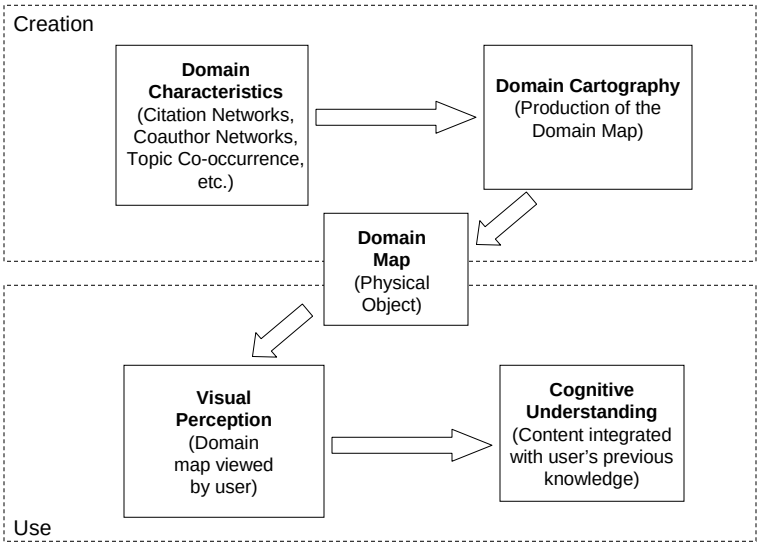
# Example Citations (Case)

- We examine the posture of respondent's cause of action first by viewing it as stating a claim under the Just Compensation Clause. This Court often has referred to regulation that "goes too far," *Pennsylvania Coal Co. v. Mahon,* 260 U.S. 393, 415, 43 S.Ct. 158, 160, 67 L.Ed. 322 (1922), as a "taking." See, *e.g., Ruckelshaus v. Monsanto Co., 467 U.S. 986, 1004-1005, 104 S.Ct. 2862, 2873-2874, 81 L.Ed.2d 815 (1984); Agins v. Tiburon, 447 U.S., at 260, 100 S.Ct., at 2141; PruneYard Shopping Center v. Robins, 447 U.S. 74, 83, 100 S.Ct. 2035, 2041, 64 L.Ed.2d 741 (1980); Kaiser Aetna v. United States, 444 U.S. 164, 174, 100 S.Ct. 383, 390, 62 L.Ed.2d 332 (1979); Andrus v. Allard, 444 U.S. 51, 65-66, 100 S.Ct. 318, 326-327, 62 L.Ed.2d 210 (1979); Penn Central Transp. Co. v. New York City, 438 U.S. 104, 124, 98 S.Ct. 2646, 2659, 57 L.Ed.2d 631 (1978); Goldblatt v. Hempstead, 369 U.S. 590, 594, 82 S.Ct. 987, 990, 8 L.Ed.2d 130 (1962); United States v. Central Eureka Mining Co., 357 U.S. 155, 168, 78 S.Ct. 1097, 1104, 2 L.Ed.2d 1228 (1958).*

- *Even assuming that those decisions meant to refer literally to the Taking Clause of the Fifth Amendment, and therefore stand for the proposition that regulation may effect a taking for which the Fifth Amendment requires just compensation, see San Diego, 450 U.S., at 647-653, 101 S.Ct., at 1302-1304 (dissenting opinion), and even assuming further that the Fifth Amendment requires the payment of money damages to compensate for such a taking, the jury verdict in this case cannot be upheld.*

# Cognitive Justification and Pedagogy

# Process of KDV Creation and Usage




Hook, Peter A. and Börner, Katy. (in press) Educational Knowledge Domain Visualizations: Tools to Navigate, Understand, and Internalize the Structure of Scholarly Knowledge and Expertise. In Amanda Spink and Charles Cole (eds.) New Directions in Cognitive Information Retrieval. Springer-Verlag.
http://ella.slis.indiana.edu/~pahook/product/05-educ-kdvis.pdf

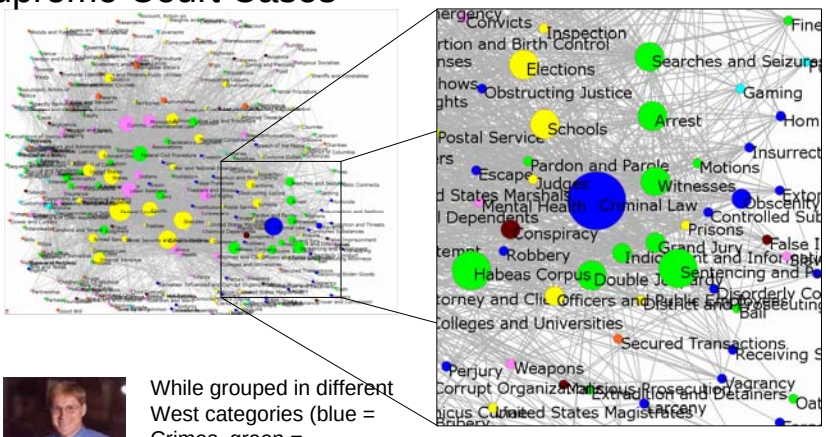
# Benefits of the Big Picture

- Provides a structure or scaffolding that students may use to organize the details of a particular subject.
- Information is better assimilated with the student's existing knowledge.
- Visualization enhances recall.
- Makes explicit the connections between conceptual subparts and how they are related to the whole.
- Helps to signal to the student which concepts are most important to learn.

# Mapping Legal Topics

## Co-Occurrence of West Topics in Supreme Court Cases

**2004**



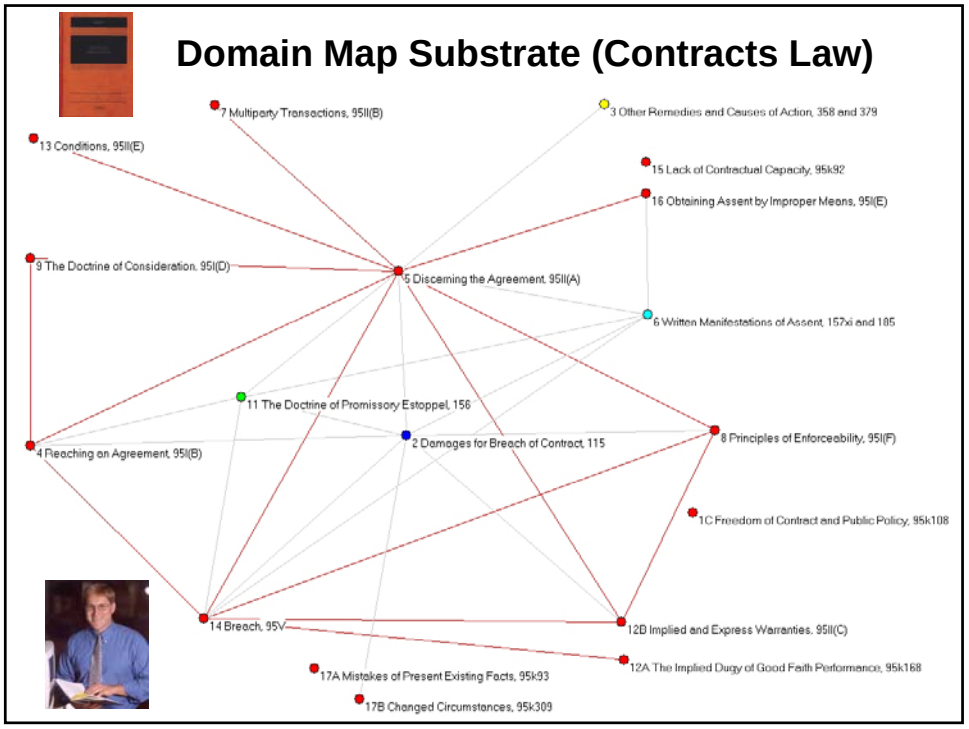

While grouped in different West categories (blue = Crimes, green = Remedies), it appears that Criminal Law more closely relates to some Remedies topics than Crimes topics.

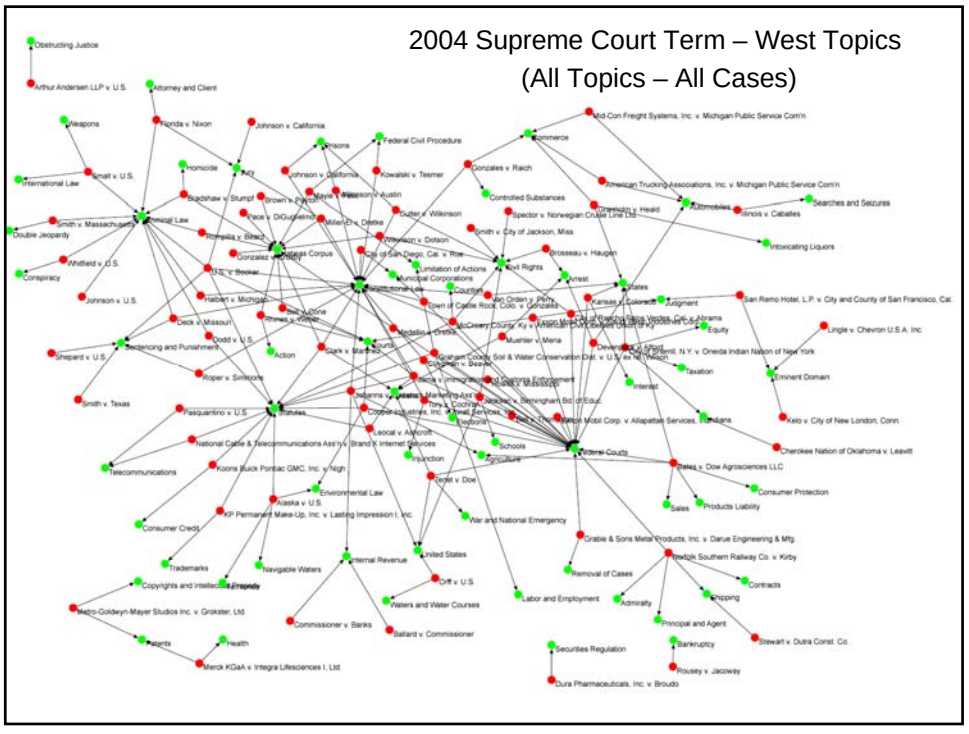
**Color Code:**

- 1. Persons
- 2. Property
- 3. Contracts
- 4. Torts
- 5. Crimes
- 6. Remedies
- 7. Government

**Node Size** ~ Number of times topic appears in the dataset

**Node Color** ~ West Category


Domain Map Substrate (Contracts Law)
7 Multiparty Transactions, 95II(B)
3 Other Remedies and Causes of Action, 358 and 379
13 Conditions, 95II(E)
15 Lack of Contractual Capacity, 95k92
16 Obtaining Assent by Improper Means, 95I(E)
9 The Doctrine of Consideration, 95I(D)
5 Discerning the Agreement, 95II(A)
6 Written Manifestations of Assent, 157xi and 185
11 The Doctrine of Promissory Estoppel, 156
2 Damages for Breach of Contract, 115
8 Principles of Enforceability, 95I(F)
4 Reaching an Agreement, 95I(B)
1C Freedom of Contract and Public Policy, 95k108
14 Breach, 95V
12D Implied and Express Warranties, 95II(C)
12A The Implied Duty of Good Faith Performance, 95k168
17A Mistakes of Present Existing Facts, 95k93
17B Changed Circumstances, 95k309


2004 Supreme Court Term – West Topics
(All Topics – All Cases)

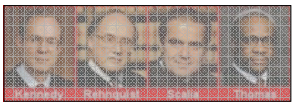
# Frequency of Voting Blocks in 5-4 Cases

(1994 -2003 Supreme Court Terms)

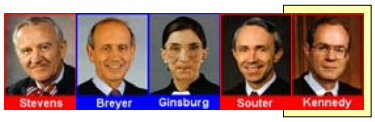


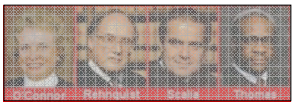


47%

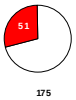

16%




8%

ALL OTHER GROUPINGS OF 5
(34 different groupings)
(Highest repetition – 3 times)

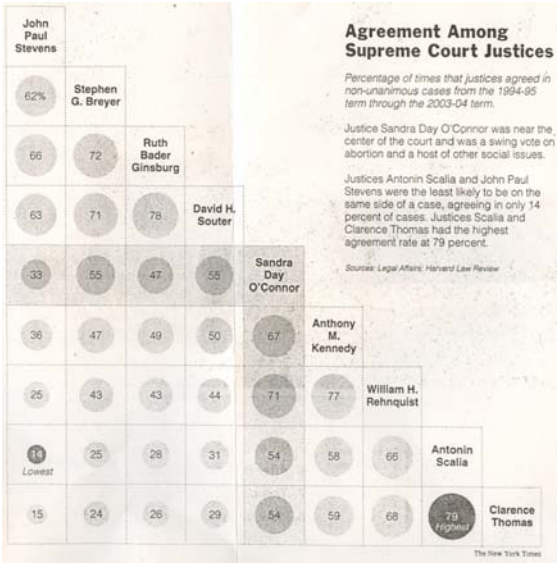



29%

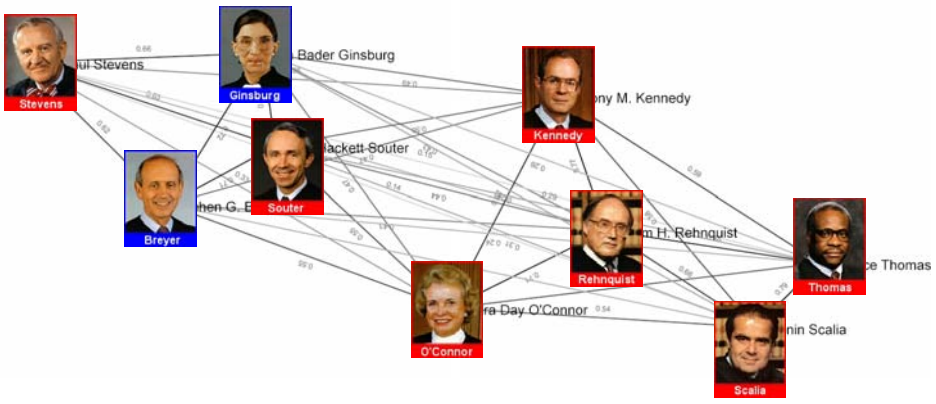
Total 5 to 4 Cases = 175

Source: Statistics harvested from the Harvard Law Review

# July 2, 2005 *New York Times*



Towards An Interactive Learning Environment




The End