

**Using *HistCite* to Map the Output of
Small World,
Watson-Crick 1953,
Cell Death and Differentiation,
P. Nicotera, and
Gene Flow**

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Abstract

The authors have developed a system called *HistCite*[™] which generates chronological maps of subject (topical) collections resulting from searches of the *ISI Web of Science*[®] or SCI/SSCI/AHCI on CD-ROM. *WoS* export files are created in which all cited references for source documents are captured. These bibliographic collections are processed by *HistCite* which generates chronological tables as well as historiographs which highlight the most-cited works in and outside the collection. Several topics including small world networks, gene flow, and the structure of DNA will be demonstrated. Real time dynamic genealogical historiographs will be shown. *HistCite* also includes a module for detecting and editing errors or variations in cited references. Export Files of 5,000 or more records are processed in minutes on a PC. Ideally the system will be used to help the searcher quickly identify the most significant work on a topic and enable the searcher to trace its year-by-year historical development.

The overall theme of this symposium is needs assessment in libraries. The *HistCite*[™] system resulted from a long-term needs assessment of users of bibliographic databases. On the one hand, there is the librarian's and user's need to identify the key works on a particular subject. On the other hand, scholars and editors desire rapid historical reviews of new topics. *HistCite* is designed to satisfy both of these requirements, whether for reference service, or in writing review articles or historical introductions to new manuscripts.

HISTORICAL INTRODUCTION

Even before the advent of the *Science Citation Index* in print the use of citation data to help write the history of science was discussed in the 1964 report on "The use of Citation Data in Writing the History of Science"¹ which included an historiograph sketching the history of DNA from Gregor Mendel in 1865 to Marshall Nirenberg in 1961 through various stages including Avery-McCleod-McCarty in 1944 through Watson-Crick in 1953. Flow charts of the papers were created manually based solely on the references cited in a set of core source papers identified in a book by Isaac Asimov on the genetic code. Then, in subsequent years I periodically speculated on the potential use of citation indexes for historiography.²

Similar maps were later created by Tony Cawkell.³ When I taught information retrieval at the University of Pennsylvania Moore School of Electrical Engineering, students were required to create similar topical historiographs. In all these mapping exercises it was explicitly assumed that scholars would use *ISI's* citation indexes to identify the needed citation links by manual searches. I believed that these historiographs would aid in studying contemporary history of science. Since history and bibliography were intimately linked the term "historio-bibliography" was coined.⁴

During the DNA mapping project, we often discussed the idea of writing computer programs that would create such maps directly from the electronic files of the *Science Citation Index*. We thought this would require random access to *ISI's* massive files so that cited and citing documents could be retrieved in real time. In the 1960s, however, low cost gigabyte memories were still a dream. The implementation of real time mapping had to wait for the time when computer memories were large and cheap enough to handle retrospective files covering many decades of literature. While on-line searches were possible in the 1970s, mapping in real time was still not feasible and because the PC had not yet come along. Only when the output of a completely linked large file of thousands of records could be handled by today's PCs did the creation of historiographs in real time become feasible.

There have been many different types of "mapping" exercises performed on a relatively small scale. In the past, co-citation clustering required main frame computers⁵ and in most cases still does. These ideas were later extended to creating small cluster maps on-line as in the *SciMap* system developed by Henry Small at *ISI*. In that system a starting paper is used to seed the creation of a co-citation cluster map⁶. In spite of the many mapping and visualization reports in the literature, none were applied to the creation of historiographs. Further, none of the many authors on co-citation mapping considered the potential significant relationship between historical displays and the need of reference librarians and users to evaluate the output of literature searches with *Science Citation Index (SCI)*, *Medline*, *Chemical Abstracts*, etc.

Until quite recently, we thought of creating historiographs primarily by seeding one or two primordial papers. The *Science Citation Index on CD-ROM* was used to trace forward in time papers that had cited the starting papers. This is the essence of the now traditional "cited reference search." Since the basic purpose of an historiograph is to display the chronological development of a topic or field year by year from the earliest papers forward in time we searched the annual *SCI* in the same way. Once we identified the initial group of citing papers, we then did further cited reference searches on those citing papers. This process is sometimes called citation chaining. We iterated this process for as many years of the literature as was necessary. This will be illustrated later when I discuss the work of Watson and Crick.

For each year of the literature searched there would be 0 to N papers retrieved. The full *SCI* Source record for each of the N papers would be captured including authors, titles, journal, volume page and years, and the list of cited references. If there are 20 cited references per source paper then there would be 20N cited references collected. Thus, if the collection involves 500 source papers, the uniquely cited references will total 5,000 to 10,000 items. If 1,000 different papers or books have been cited then the average frequency will be 10. However, the range of citation frequency would run from 1 to 1,000.

The *HistCite* system creates a series of tables and matrices which list all the 500 source documents in chronological order and shows their citation frequencies both within the collection and globally. The *HistCite* program also includes a variety of sort keys which create ranked directories of authors, journals, and citation frequencies.

***HISTCITE* PROGRAM**

In *HistCite*, we distinguish two types of frequency – LCS and GCS. The local citation score or frequency is the number of times an item is cited in the retrieved collection. The GCS is the global score, the number of cites in the entire *SCI/SSCI*.

The record for each source document contains both its LCS and GCS. Once *HistCite* sorts the papers by citation score, the user will select a group cited above an arbitrarily chosen threshold to be mapped. If there are 500 source papers then a 5% selection threshold would produce 25 core papers. These core papers should be of prime interest especially to a searcher who is not familiar with the subject matter. Ordinarily, one would examine this core list first in reviewing a new topic. The coordinates of these papers are used to create an historiograph of the topic which displays the papers and their citation links chronologically.

Identifying Core Literatures

As stated earlier, it was initially assumed we would begin with one primordial paper. However, it became apparent that one could feed in groups of papers by one or more authors – and by extension, larger clusters of papers by institution or by key word. Thus the output of any conventional search or a combination of citation and key word searches could be input to the system. Once the input bibliography is created, the core papers on the “topic” can be rapidly identified.

Visualization

The production of the various tables or lists from these procedures is separate from the problem of visualizing these data. Time does not permit me to go into the details of how these artifacts aid in the perception of the interrelationships between citing and cited papers. Using your PC screen, you can scroll a map of almost unlimited size. With *HistCite* you use mouse clicks and pop-up windows to navigate whatever map you create. However, in most situations 25 or [more] nodes

are easily visible on the ordinary PC screen. Thus a map involving several hundred nodal papers can be created, but it is best to first view a condensed version containing 25 to 50 of the core papers in the local or global collection. In this way, you can quickly perceive their historical connections.

Outer References

HistCite also produces frequency ranked tables of “outer references,” that is, cited papers and books that fall outside the starting retrieved collection. These are works which do not turn up in the original *WoS* search but, significantly, are cited frequently in the papers that are retrieved. You can examine these candidate references and decide whether to add them to the initial collection. For example, a highly cited book or patent might be cited which is not part of the original *SCI* source database. For each of these a source record would have to be created manually. Many of these items will have been published prior to the starting reference and may inform the earlier history.

For each outer reference, *HistCite* provides a hot link to the *WoS* and executes a “cited reference search.” By clicking on the hot link to the full source record, it can be added to the marked list of the collection. Once a new .txt file is created, the *HistCite* software is invoked to create a new set of tables. The size of the outer reference list can be specified by the user. Generally, I add those outer papers which are cited at the frequency threshold used in the mapping procedure.

Missing References

It is well known that authors cite references with many variant spellings or make errors in one or more parts of the reference such as volume or page. These incomplete or “missing” references are identified in a separate table. As part of the procedures invoked, the program will seek out and display the closest matched paper in the collection and suggest changes. In many references, the initial page of the document is not cited. In chemical papers the exact page where a specific chemical compound is discussed will be cited. The cited page number can be edited so that it can be included in the citation frequency score for the fully paginated reference. Fortunately the number of such errors or variations is quite manageable. The reader can choose to edit them or not. Most are singletons that ordinarily will not affect the overall ranking or mapping results. However, to study historical impact, I have found it useful to unify citations to books.

At present, the program accepts export records from either the *SCI* CD-ROM, the *Web of Science*, or *SciSearch* on Dialog. However, Dialog records do not include the GCS. Since the LCS is computed by *HistCite*, it is still possible to create a very useful map of the local collection!

In the examples which follow, the collections were created by searching the *Web of Science* using either a title word, cited reference, or a combination search. The resulting “marked lists” were downloaded in the WOS EXPORT format which is in plain ASCII text. The plain ASCII .txt file is then processed by the program. *HistCite* output is presented in html. The *HistCite* program can reside on the user’s hard drive or on a central server.

Figure 1: Selected List of Sample *HistCite* Collections

Over the past few years, we have created a large number of test collections on a variety of topics. Figure 1 contains a partial list of those topics.

The entire list of the collections can be accessed at my website

<http://garfield.library.upenn.edu/papers/sla062003.html>

Index of /Histcite

<http://garfield.library.upenn.edu/histcomp/>
[Guide to Databases Created by Histcite](#)

avery_watson-crick/	Mar 03	--	--	Citations for Watson-Crick '53 & Avery '44
bibliographic-coupling/	Aug 01	223	G1, G2	Papers that cite Kessler's Bibliographic Coupling or contain BC in title
BJN/	Aug 02	5843	---	Articles from <i>The British Journal of Nutrition</i> , 1947-2002
celldeathdiff 1994-2003/	Jun 03	1056	--	Papers published in Cell Death & Differentiation. (1036 from WOS, 20 1994 papers added manually.)
cochrane 1972-2001/	Oct 01	836	G1, G2	1972-2001 Citations to A.L.Cochrane's 'Effectiveness and Efficiency'
cocitation-small/	Nov 01	414	---	Papers that cite H Small/B Griffith or contain "Co-Citation" in Title
Cold Spring Harbor '53/	Jun 03	1742	G1, G2	Papers citing 1953 COLD SPRING HARBOR SYMP ON QUANT BIOL
drosophgenome/	Oct 02	1005	G1	Articles citing 'The Genome Sequence of Drosophila Melanogaster,' by M. Adams, <i>Science</i> 287, March 24, 2000
evidence_based_medicine/	Jan 03	873	G1, G2	Articles containing 'evidence based medicine' in title, 1992-2002
geneflow47-02/	Jun 02	3552	G1	A.I. Pudovkin - Geneflow 1947 - 2002
hotpapers/	Jul 02	---	---	Hotpapers covered in <i>The Scientist</i>
j_info_sci/	Jan 03	1306	G1, G2	Papers published in <i>Journal of Information Science</i> 1979-2002
kroto/	Oct 02	3244	G1	Papers citing HW Kroto's 1985 paper, "C-60 - BUCKMINSTERFULLERENE"
Nicotera P/	Jun 03	170	---	Papers by P. Nicotera in WoS
Nurse P/	Jun 03	10,153	G1	Papers by P. Nurse in <i>WoS</i> & the articles citing them
Rockefeller Univ/	Jun 02	750	---	Papers published by authors at Rockefeller University in 2002
small_world_new1967-2003/	Mar 03	424	G1	Papers that cite "Small World Problem" by Milgram S., 1967, PSYCHOL TODAY, or contain "Small World" in title.

Figure 2: *HistCite* Guide

On the website, there is a detailed guide (help screen) which explains each element.

HistCite Guide

Outer References: [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#)

Thu Jan 24 15:53:33 2002

Nodes: 782

Sorted by year, journal, volume, page.

Cited nodes	Nodes / Authors	GCS	LCS
0 1	1970 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 67(2):821-& LEVIN AS; SPITLER LE; STITES DP; FUDENBER.HH WISKOTT-ALDRICH SYNDROME, A GENETICALLY DETERMINED CELLULAR IMMUNOLOGIC DEFICIENCY - CLINICAL AND LABORATORY RESPONSES TO THERAPY WITH TRANSFER FACTOR	171	171
1 2	1971 AMERICAN JOURNAL OF MEDICINE 51(3):295-& FUDENBER HH GENETICALLY DETERMINED IMMUNE DEFICIENCY AS PREDISPOSING CAUSE OF AUTOIMMUNITY AND LYMPHOID NEOPLASIA	148	0
1 3	1971 AMERICAN JOURNAL OF PATHOLOGY 63(3):653-& SANTOS GW APPLICATION OF MARROW GRAFTS IN HUMAN DISEASE	8	0
1 4	1971 ANNALS OF INTERNAL MEDICINE 74(5):955-& KIRKPATR.CH; RICH RR; BENNETT JE CHRONIC MUCOCUTANEOUS CANDIDIASIS - MODEL-BUILDING IN CELLULAR IMMUNITY	315	0
1 5	1971 BULLETIN OF THE WORLD HEALTH ORGANIZATION 45(1):125-& [Anon] PRIMARY IMMUNODEFICIENCIES		0
1 6	1971 CALIFORNIA MEDICINE 115(4):42-& MARINKOV.VA CLINICAL USE OF TRANSFER FACTOR		0
1 7	1971 CANCER 28(1):115-& LEJTENYI MC; FREEDMAN SO; GOLD P	50	2

The COLORED boxes are components of the Historiograph Compilation.
Clicking on a box will describe in more detail about the specific component.

SMALL WORLD PROBLEM (STANLEY MILGRAM)

Figure 3: Cited Reference Search on Milgram's 1967 *Psychology Today* article.

[http://garfield.library.upenn.edu/papers/jasist54\(5\)400y2003.pdf](http://garfield.library.upenn.edu/papers/jasist54(5)400y2003.pdf)

In 1967, in *Psychology Today*,ⁱ Stanley Milgram published his primordial paper on the "Small World Problem." A simple Cited Reference search of the *SSCI/SCI* initially produced about 148 citing papers. Note that the cited page is page 61.

However, another ten papers cited page 60. It was an easy error to make because the "first" page of the article is a photograph. By adding this variant and others, we obtain a somewhat larger collection of citing papers.

ISI Web of **SCIENCE**[®] Powered by ISI Web of Knowledge_{SM}

i. Milgram S. "Small World Problem," *Psychology Today*, 1(1):61-67 (1967)

HOME

HELP

DATE & DB LIMITS

GENERAL SEARCH

CITED REF SEARCH

LOG OFF

Cited Reference Search

10 references matched query: Cited Year=1967; Cited Author=milgram s; Databases=SCI-EXPANDED, SSCI, A&HCI; Timespan=All Years

STEP 2: CITED REFERENCE SELECTION

The table lists all of the cited references that match your search request and the number of times each variation has been cited. Select all desired references (including variants) and then press Search.

[Set language and document type limits and sort option.](#)

SELECT PAGE

 or select specific references from list.

SEARCH

 to find articles that cite selected references.

References 1 -- 10

⏮ ⏪ ⏩ ⏭ [1] ⏮ ⏪ ⏩ ⏭

Hits	Cited Author	Cited Work	Volume	Page	Year
<input type="checkbox"/>	1 MILGRAM S	MEGAMOT	15	31	1967
<input type="checkbox"/>	9 MILGRAM S	PATTERNS PREJUDICE	1	3	1967
<input type="checkbox"/>	1 MILGRAM S	PATTERNS PREJUDICE	1	5	1967
<input type="checkbox"/>	3 MILGRAM S	POLITISCHE GESELLSCH		170	1967
<input type="checkbox"/>	10 MILGRAM S	PSYCHOL TODAY	2	60	1967
<input type="checkbox"/>	<u>148 MILGRAM S</u>	<u>PSYCHOL TODAY</u>	<u>1</u>	<u>61</u>	<u>1967</u>
<input type="checkbox"/>	2 MILGRAM S	PSYCHOL TODAY	1	62	1967
<input type="checkbox"/>	6 MILGRAM S	PSYCHOL TODAY MAY		61	1967
<input type="checkbox"/>	1 MILGRAM S	PSYCHOLOGY TODAY MAY			1967
<input type="checkbox"/>	1 MILGRAM S	READINGS SOCIAL PSYC			1967

References 1 -- 10

⏮ ⏪ ⏩ ⏭ [1] ⏮ ⏪ ⏩ ⏭

SELECT PAGE

 or select specific references from list.

SEARCH

 to find articles that cite selected references.

Figure 4: WoS General Search for “Small World” in Title

ISI Web of SCIENCE® Powered by ISI Web of Knowledge_{SM}

HOME

HELP

DATE & DB LIMITS

GENERAL SEARCH

CITED REF SEARCH

COMBINE SEARCHES

ADVANCED SEARCH

General Search Results--Summary

TI=(small world)
DocType=All document types; Language=All languages; Database(s)=SCI-EXPANDED, SSCI, A&HCI; Timespan=1945-2003

SUBMIT MARKS

MARK PAGE

MARK ALL

Page 33 (Articles 321 -- 327):

Latest date

SORT

[31 | 32 | 33]

Use the checkboxes to add individual articles to the Marked List. Be sure to click SUBMIT MARKS button before leaving page.

☐

VARMA BN
[SMALL WORLD OF KHANH-HAU - HENDRY,JB](#)
AM J SOCIOL 72 (4): 422-423 1967

☐

AUCHTER EL
[SMALL WORLD OF KHANH HAU - HENDRY,JB](#)
J DEV AREAS 1 (4): 547-549 1967

☐

MILGRAM S
[SMALL-WORLD PROBLEM](#)
PSYCHOL TODAY 1 (1): 61-67 1967

☐

BRANT CS
[THE SMALL WORLD OF HAU,KHAHN - HENDRY,JB](#)
AM ANTHROPOL 67 (1): 198-199 1965

☐

GITTINGER JP
[THE SMALL WORLD OF KHANH HAU - HENDRY,JB](#)
ANN AM ACAD POLIT SS 358 (MAR): 240-241 1965

☐

ROBINSON W
[ITS A SMALL WORLD](#)
AM J NURS 62 (11): 10-10 1962

SUBMIT MARKS

MARK PAGE

MARK ALL

Page 33 (Articles 321 -- 329):

319 documents matched your query of the 32,319,368 in the data limits you selected.

In addition to the cited reference search we also searched *WoS* for papers with the term “small world” in the title. This is illustrated in Figure 4. This added another 260 or so papers, bringing the total to 424 papers. A marked list was created and then saved as an ISI Export File. This .txt file was submitted to the *HistCite* program.

Figure 5: Chronological File of Papers citing S. Milgram's 1967 *Psychology Today* Paper, or using Small World in Title, 1962-2002

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#)

[HistCite Guide](#)

Papers citing "Small World Problem" by Milgram S., 1967, *Psychology Today*, V1, P61 and papers with "Small World" in the title from 1967 to present

Nodes: 424

Sorted by year, journal, volume, page.

Page 1:

#	Cited nodes	Nodes / Authors	GCS	LCS
1	0	1 1967 AMERICAN JOURNAL OF SOCIOLOGY 72(4):422-423 VARMA BN <i>Small World of Khanh-Hau - Hendry,JB</i>	2	1
2	1	2 1967 AMERICAN JOURNAL OF SOCIOLOGY 73(1):115-115 EVERS HD <i>Small World of Khanh-Hau - Comment</i>	0	0
3	0	3 1967 JOURNAL OF DEVELOPING AREAS 1(4):547-549 AUCHTER EL <i>Small World of Khanh Hau - Hendry,JB</i>	0	0
4	0	4 1967 PSYCHOLOGY TODAY 1(1):61-67 MILGRAM S <i>Small World Problem</i>	148	167
5	0	5 1969 FORTUNE 80(4):121-& ZALAZNICK S <i>Small World Of Big Washington Lawyers</i>	0	0
6	1	6 1969 SOCIOMETRY 32(4):425-443 TRAVERS J; MILGRAM S <i>Experimental Study Of Small World Problem</i>	64	43
7	1	7 1970 BRITISH JOURNAL OF SOCIAL PSYCHIATRY 4(2):83-87 HART JW <i>Sociometry of Poverty</i>	0	0
8	0	8 1970 ENGLISH JOURNAL 59(3):416-420 SOFFER RS <i>Its A Small World</i>	1	0
9	2	9 1970 JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY 15(2):101-& KORTE C; MILGRAM S <i>Acquaintance Networks between Racial Groups - Application of Small World Method</i>	38	31
10	2	10 1970 SOCIAL FORCES 49(2):259-+ WHITE HC <i>Search Parameters for Small World Problem</i>	22	14

The initial output of the *HistCite* system is the master chronological table. The first three papers in the table are by Varna, Evers, and Auchter. These are not relevant to the search but the fourth is the key paper by Milgram. Note that the Global Citation Score (GCS) is 148. The Local Citation Score (LCS) is 167. The 148 is the score noted in the *WoS* for citations to page 61. But we added an additional 19 for the variants noted earlier.

Figure 6: Most-cited papers from the starting bibliography ranked by Local Citation Score (LCS)

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#) [HistCite Guide](#)

Papers citing "Small World Problem" by Milgram S., 1967, *Psychology Today*, V1, P61, and papers with "Small World" in the title from 1967 to present

Nodes: 424
Sorted by LCS.
Page 1: 1



#	Cited nodes	Nodes / Authors	GCS	LCS
1	0	4 1967 PSYCHOLOGY TODAY 1(1):61-67 Milgram S <i>Small World Problem</i>	148	167
2	1	194 1998 NATURE 393(6684):440-442 Watts DJ; Strogatz SH <i>Collective Dynamics Of 'Small-World' Networks</i>	387	134
3	3	224 1999 SCIENCE 286(5439):509-512 Barabasi AL; Albert R <i>Emergence of scaling in random networks</i>	269	49
4	3	218 1999 PHYSICAL REVIEW E 60(6):7332-7342 Newman MEJ; Watts DJ <i>Scaling and percolation in the small-world network model</i>	74	47
5	4	219 1999 PHYSICAL REVIEW LETTERS 82(15):3180-3183 Barthelemy M; Amaral LAN <i>Small-world networks: Evidence for a crossover picture</i>	73	47
6	1	6 1969 SOCIOMETRY 32(4):425-443 Travers J; Milgram S <i>EXPERIMENTAL STUDY OF SMALL WORLD PROBLEM</i>	64	43
7	5	229 2000 EUROPEAN PHYSICAL JOURNAL B 13(3):547-560 Barrat A; Weigt M <i>On the properties of small-world network models</i>	58	39
8	2	9 1970 JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY 15(2):101-& Korte C; Milgram S <i>Acquaintance Networks Between Racial Groups - Application of Small World Method</i>	38	31
9	4	265 2000 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 97(21):11149-11152 Amaral LAN; Scala A; Barthelemy M; Stanley HE <i>Classes of small-world networks</i>	111	28
10	4	221 1999 PHYSICS LETTERS A 263(4-6):341-346 Newman MEJ; Watts DJ <i>Renormalization group analysis of the small-world network model</i>	40	27

In addition to the basic chronological "home" table several sorts can be called out. These are activated by clicking on the hot links. The first is the Local Citation Score (LCS) which is based on the citation frequency within the basic collection. The paper by Milgram has now moved up to position #1 and its LCS is 167. The second most-cited paper in LCS is by Watts and Strogatz.

Figure 7: Small World Collection ranked by Global Citation Score (GCS)

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#) [HistCite Guide](#)

Papers citing "Small World Problem" by Milgram S., 1967, *Psychology Today*, V1, P61 and papers with "Small World" in the title from 1967 to present

Nodes: 424

Sorted by GCS.

Page 1: 1



#	Cited nodes	Nodes / Authors	GCS	LCS
1	1	194 1998 NATURE 393(6684):440-442 Watts DJ; Strogatz SH <i>Collective dynamics of 'small-world' networks</i>	387	134
2	5	25 1976 AMERICAN JOURNAL OF SOCIOLOGY 81(4):730-780 White HC; Boorman SA; Breiger RI <i>Social-Structure From Multiple Networks .1. Blockmodels Of Roles And Positions</i>	339	7
3	3	224 1999 SCIENCE 286(5439):509-512 Barabasi AL; Albert R <i>Emergence of scaling in random networks</i>	269	49
4	6	249 2000 NATURE 406(6794):378-382 Albert R; Jeong H; Barabasi AL <i>Error and attack tolerance of complex networks</i>	154	20
5	0	4 1967 PSYCHOLOGY TODAY 1(1):61-67 Milgram S <i>Small World Problem</i>	148	167
6	13	300 2001 NATURE 410(6825):268-276 Strogatz SH <i>Exploring complex networks</i>	128	23
7	3	26 1976 AMERICAN JOURNAL OF SOCIOLOGY 81(6):1384-1446 Boorman SA; White HC <i>Social Structure from Multiple Networks .2. Role Structures</i>	117	4
8	2	64 1981 AMERICAN JOURNAL OF SOCIOLOGY 86(5):1015-1035 Feld SL <i>The Focused Organization of Social Ties</i>	111	4
9	4	265 2000 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 97(21):11149-11152 Amaral LAN; Scala A; Barthelemy M; Stanley HE <i>Classes of small-world networks</i>	111	28
10	2	30 1976 SOCIAL FORCES 55(1):93-122 Burt RS <i>Positions in Networks</i>	108	2

By clicking on GCS, the file is sorted by the global citation frequency, that is, how often each paper is cited in the entire *WoS* collection. Now the Watts paper moves up to position #1 and is followed by HC White et al. Milgram is now in the fifth position. By juxtaposing GCS and LCS, we become aware of the extent of the literature both within and outside the starting collection. In the more recent literature, physics papers begin to dominate what was formerly a topic of sociological interest.

Figure 8: Authors ranked by number of publications.

By clicking on the all-author hotlink, we find the most-published author on the Small World problem. Hotlinks also permit display of the authors by global or local citation score. Thus the most-cited authors, are distinguished from the most-published ones. The individual citation frequencies for these papers are totaled.

Ranked All-Author list

Total: 482

Sorted by **pubs**

#	Name	TGCS	TLCS	Pubs
1	[Anon]	0	0	14
2	Newman MEJ	336	171	12
3	Blumen A	66	31	9
4	Bernard HR	85	24	8
5	Killworth PD	85	24	8
6	Barabasi AL	560	101	6
7	Kim BJ	13	0	6
8	Watts DJ	528	233	6
9	Albert R	558	101	5
10	Amaral LAN	230	94	5
11	Kuperman M	30	16	5
12	McCarty C	59	11	5
13	Barthelemy M	197	87	4
14	Bochner S	23	10	4
15	Choi MY	6	0	4
16	Elgazzar AS	2	0	4
17	Jasch F	9	1	4
18	Jeong H	242	46	4
19	Kertesz J	15	0	4
20	Zanette DH	6	0	4
21	Abramson G	30	16	3
22	Ahmed E	3	1	3
23	Holme P	9	0	3
24	Hong H	6	0	3
25	Hunter JE	17	7	3
26	Jespersen S	47	28	3
27	Kochen M	4	1	3
28	Latora V	10	4	3
29	Marchiori M	10	4	3
30	Milgram S	250	221	3

Figure 9: Journals ranked by number of papers published

Figure 9 displays the journals which published on the Small World problem. The number of papers for each journal is shown on the right. This topic, originally mainly of interest to social network researchers, is now permeated by physics papers. Such drastic change in the history of this literature indicates that it might be better to split the historical exercise into the periods 1967-1997 and then 1998 to the present.

Ranked Journal list

Total: 253

Sorted by **pubs**

#	Title	Pubs
1	PHYSICAL REVIEW E	45
2	SOCIAL NETWORKS	13
3	PHYSICAL REVIEW LETTERS	10
4	AMERICAN JOURNAL OF SOCIOLOGY	9
5	NATURE	9
6	PHYSICA A	8
7	EUROPEAN PHYSICAL JOURNAL B	7
8	PNAS	7
9	EUROPHYSICS LETTERS	6
10	SOCIAL FORCES	6
11	NEW YORK TIMES BOOK REVIEW	5
12	SCIENCE	4
13	FORBES	4
14	AMERICAN SOCIOLOGICAL REVIEW	3
15	NATION	3
16	PHYSICAL REVIEW B	3
17	JOURNAL OF CHEMICAL PHYSICS	3
18	FORTUNE	3
19	INTERNATIONAL JOURNAL OF BIFURCATION AND CHAOS	3
20	TLS-THE TIMES LITERARY SUPPLEMENT	3
21	PHYSICS LETTERS A	3
22	NEW REPUBLIC	3
23	ENVIRONMENT AND PLANNING A	3
24	PMLA-PUBLICATIONS OF THE MODERN LANGUAGE ASSOCIATION OF AMERICA	2
25	AAA-ARBEITEN AUS ANGLISTIK UND AMERIKANISTIK	2
26	CONTEMPORARY SOCIOLOGY-A JOURNAL OF REVIEWS	2
27	LIBRARY TRENDS	2
28	NEW YORK REVIEW OF BOOKS	2
29	HISTOIRE	2
30	LANDSCAPE ARCHITECTURE	2
31	ACADEME-BULLETIN OF THE AAUP	2
32	TECHNOLOGY REVIEW	2
33	LIBRARY JOURNAL	2
34	KOLNER ZEITSCHRIFT FUR SOZIOLOGIE UND SOZIALPSYCHOLOGIE	2
35	JOURNAL OF SOCIAL ISSUES	2

Figure 10: Outer nodes – most cited works outside original collection

The “outer nodes” link lists the thousands of references that are cited in the main collection. These “outer” references include books as well as journal articles not included as sources in the *Web of Science*. They are sorted by citation frequency in the local network. The user can retrieve these items from *WoS* so that their full bibliographic data and GCS can be added to the initial collection. When the *HistCite* program is run again they will be integrated into the collection. A semi-automatic look-up of each item can be activated to *Web of Science* by clicking on *WOS*. A quick scan of these references will reveal some of the historical precedents to this topic, e.g., the work of Manfred Kochen, a mathematician qua information scientist who edited a book on the small world problem in 1989.

ISI Web of Science location:

Cited references outside of this network.

Total: 6719 (top 100 shown).

Sorted by **LCS**.

#	LCS	Reference
1	45	ALBERT R, 1999, NATURE, V401, P130 WoS
2	45	NEWMAN MEJ, 2001, PHYS REV E 2, V64 WoS
3	41	BOLLOBAS B, 1985, RANDOM GRAPHS WoS
4	39	GRANOVETTER MS, 1973, AM J SOCIOL, V78, P1360 WoS
5	30	WATTS DJ, 1999, SMALL WORLDS WoS
6	26	MOUKARZEL CF, 1999, PHYS REV E, V60, P6263 WoS
7	25	WASSERMAN S, 1994, SOCIAL NETWORK ANAL WoS
8	23	KOCHEN M, 1989, SMALL WORLD WoS
9	22	LAGOFERNANDEZ LF, 2000, PHYS REV LETT, V84, P2758 WoS
10	22	WATTS DJ, 1999, SMALL WORLDS DYNAMIC WoS
11	21	JEONG H, 2000, NATURE, V407, P651 WoS
12	21	ERDOS P, 1960, PUBL MATH I HUNG, V5, P17 WoS
13	19	REDNER S, 1998, EUR PHYS J B, V4, P131 WoS
14	15	GUARE J, 1990, 6 DEGREES SEPARATION WoS
15	14	FALOUTSOS M, 1999, COMP COMM R, V29, P251 WoS
16	13	POOL ID, 1978, SOC NETWORKS, V1, P5 WoS
17	12	DEMENEZES MA, 2000, EUROPHYS LETT, V50, P574 WoS
18	12	HUBERMAN BA, 1999, NATURE, V401, P131 WoS
19	11	BRODER A, 2000, COMPUT NETW, V33, P309 WoS
20	10	MITCHELL JC, 1969, SOCIAL NETWORKS URBA WoS
21	10	POOL ID, 1978, SOC NETWORKS, V1, P1 WoS
22	10	MOLLOY M, 1995, RANDOM STRUCT ALGOR, V6, P161 WoS
23	9	GRANOVETTER MS, 1974, GETTING JOB STUDY CO WoS
24	9	WILLIAMS RJ, 2000, NATURE, V404, P180 WoS
25	9	DOROGOVTSSEV SN, 2001, PHYS REV E 1, V63 WoS
26	9	CALLAWAY DS, 2000, PHYS REV LETT, V85, P5468 WoS
27	9	PASTORSATORRAS R, 2001, PHYS REV LETT, V86, P3200 WoS
28	8	ERDOS P, 1959, PUBL MATH-DEBRECEN, V6, P290 WoS
29	8	MOLLOY M, 1998, COMB PROBAB COMPUT, V7, P295 WoS
30	8	KURAMOTO Y, 1984, CHEM OSCILLATIONS WA WoS

Figure 11: Missing links

The system identifies questionable or “missing” citations where there is reason to believe there is an error or variation that prevents unification. This expert system permits the reader to correct errors of omission in year or volume or pagination. Once corrected, these items can be fed back into the file so as to complete the citation counts. In the example shown for Gould’s paper, he has cited a paper by Korte but has omitted the page number.

Potentially missed citations...

40 nodes have citations that may potentially refer to other nodes.

1 | [22](#) 1975 INTERNATIONAL SOCIAL SCIENCE JOURNAL 27(2):303-327

GOULD P

Mathematics in geography - Conceptual revolution or new tool



KORTE C, 1970, J PERSONALITY SOCIAL, V15 may refer to [9](#) KORTE-C-1970-V15-P101

2 | [95](#) 1985 SOCIAL NETWORKS 7(4):323-339

KOCHEN M

The structure of acquaintance nets and rates of societal development

KILLWORTH PD, 1978, SOCIAL NETWORKS, V1, P1959 may refer to [46](#) KILLWORTH-PD-1978-V1-P159

3 | [107](#) 1987 SOCIAL NETWORKS 9(2):153-169

HO E; KOCHEN M

Perceived acquaintanceship and interpersonal trust - The cases of Hong Kong and China

KILLWORTH PD, 1978, SOCIAL NETWORKS, V1, P195 may refer to [46](#) KILLWORTH-PD-1978-V1-P159

4 | [136](#) 1992 ADVANCES IN EXPERIMENTAL SOCIAL PSYCHOLOGY 25():277-329

BLASS T

The social-psychology Of Milgram, Stanley

MILGRAM S, 1967, PATTERNS PREJUDICE, V1, P3 may refer to [4](#) MILGRAM-S-1967-V1-P61

5 | [224](#) 1999 SCIENCE 286(5439):509-512

Barabasi AL; Albert R

Emergence of scaling in random networks

BARTHELEMY M, 1999, PHYS REV LETT, V82, P15 may refer to [219](#) BARTHELEMY-M-1999-V82-P3180

BARTHELEMY M, 1999, PHYS REV LETT, V82, P15 may refer to [220](#) BARTHELEMY-M-1999-V82-P5180

6 | [232](#) 2000 EUROPHYSICS LETTERS 50(1):1-7

Dorogovtsev SN; Mendes JFF

Exactly solvable small-world network

BARTHELEMY M, 1999, PHYS REV LETT, V82, PE5180 may refer to [219](#) BARTHELEMY-M-1999-V82-P3180

BARTHELEMY M, 1999, PHYS REV LETT, V82, PE5180 may refer to [220](#) BARTHELEMY-M-1999-V82-P5180

HERZEL H, 1998, FRACTALS, V6, P4 may refer to [188](#) HERZEL-H-1998-V6-P301

When we first assembled the data on the Milgram 1967 paper, all the occurrences of page 60 turned up provided we captured the citations in the original *WoS* search. We then edited all those records, by using a search and replace command.

Figure 12: Citation Matrix

In order to help the user better visualize the inter-relations between the thousands of cited papers in the network, the software creates a citation matrix which displays the nodal numbers for citing and cited works. This matrix can then become input for the creation of co-citation maps of other kinds of maps.

Small World Citation Matrix

Nodes: 424

Sorted by year, journal, volume, page.

Page 1: 1

cited nodes	Cited nodes	Nodes	GCS	LCS	citing nodes
	0	1 1967 VARMA BN	2	1 2	
1	1	2 1967 EVERS HD	0	0	
	0	3 1967 AUCHTER EL	0	0	
	0	4 1967 MILGRAM S	148	167	6 7 9 10 11 12 13 14 15 16 18 19 20 22 23 24 25 26 27 28 29 30 31 32 33 38 43 44 45 46 47 48 49 51 52 53 54 55 56 58 61 62 63 64 66 71 72 76 78 80 81 82 87 90 95 96 103 107 110 112 126 128 129 136 137 143 148 149 155 172 174 178 182 188 193 194 195 196 202 210 211 215 217 218 219 221 224 225 229 240 243 249 250 253 254 256 257 258 261 263 268 269 270 272 273 275 276 278 280 286 289 296 298 299 300 301 302 305 308 309 310 311 313 317 319 322 323 324 326 328 329 333 334 337 342 344 345 346 347 350 353 357 359 368 369 370 373 374 383 385 387 389 400 403 407 408 409 411 412 413 414 416 417 420 421 423 424
	0	5 1969 ZALAZNICK S	0	0	
4	1	6 1969 TRAVERS J	64	43	9 10 11 13 16 18 19 21 23 24 27 28 29 33 38 43 44 45 46 47 48 49 51 53 54 55 56 61 66 76 78 80 82 96 103 136 148 196 269 270 326 417 418
4	1	7 1970 HART JW	0	0	
	0	8 1970 SOFFER RS	1	0	
4 6	2	9 1970 KORTE C	38	31	13 18 19 23 24 27 28 29 32 33 38 44 45 46 47 48 49 51 54 55 56 61 76 78 82 136 182 202 243 385 417
4 6	2	10 1970 WHITE HC	22	14	18 23 24 25 26 30 44 45 51 55 72 202 276 323
4 6	2	11 1971 JACOBSON D	8	0	
4	1	12 1972 LEVINE JH	93	3	16 25 149
4 6 9	3	13 1972 HUNTER JE	1	1	18
4	1	14 1972 GRIFFITH BC	106	0	
4	1	15 1972 MULLINS NC	8	1	25

Figure 13: Historiograph of Small World Key Papers, 1967-2002

Figure 13 is a map created on the Small World problem based on the data compiled by the HistCite program. The table briefly identifies each of the 15 most-cited papers in the local collection. The size of the circles are proportional to the citation frequency. Node #4, the paper by Milgram, has been cited 167 times while the much more recent paper by Watts, #194, has been cited locally 134 times. The large number of circles in the more recent years demonstrates how this field has mushroomed. And the Watts paper would be even more prominent if we created a map based on GCS.

HISTORIOGRAPH OF SMALL WORLD LCS PAPERS 1967-2002

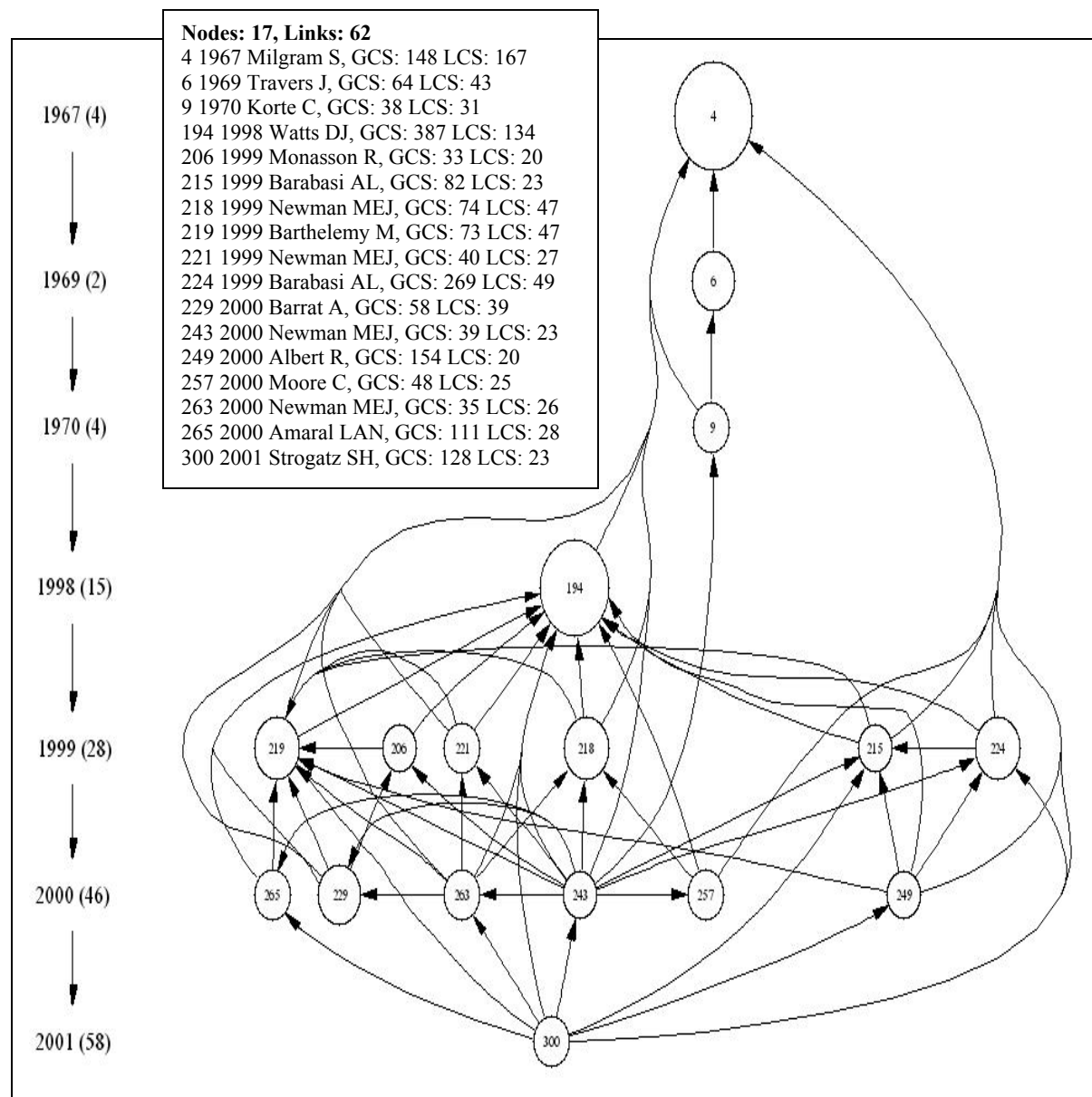


Figure 14: Source Record for Milgram S, Psychology Today.

4

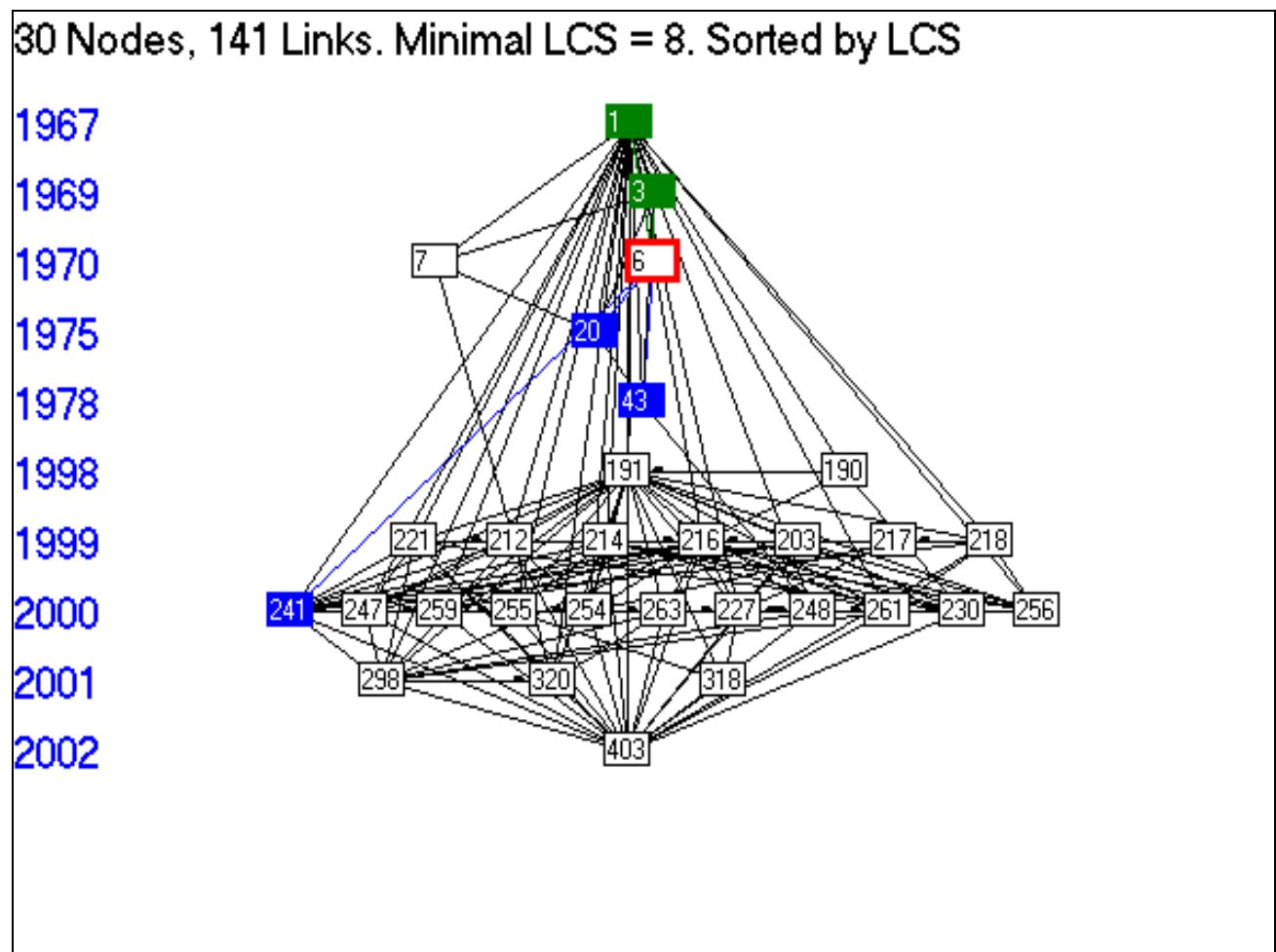
Author(s)	MILGRAM S
Title	SMALL-WORLD PROBLEM
Journal	PSYCHOLOGY TODAY 1(1):61-67
Date	1967
Type	
Address	
Abstract	
GCS	148
LCS	167
cites	0
CR[3]	HARARY F, 1965, STRUCTURAL MODELS IN KEMENY JG, 1962, MATH MODELS SOCIAL S RAPOPORT A, 1963, HDB MATH PSYCHOLOGY, V2, PCH14

And when you are online you can click on each node to view the complete source record.

Figure 15: 2nd Small World Graph based on LCS

Figure 15 is an alternative method of displaying the information on this topic. If you were operating it on your PC, you could click on one node at a time and it would be highlighted in red. The green nodes are cited by node #30 and the blue are citing nodes. Cited papers are in green and citing papers are in blue. The next version of this software will permit use of circles which are proportional in size to citation frequency.

MAP OF 30 MOST-CITED PAPERS ON “SMALL WORLD” IN GLOBAL *WOS*



WATSON-CRICK 1953 DNA PAPER

Now I would briefly like to show you the use of *HistCite* in a truly historical mapping exercise. We are celebrating the 50th anniversary of the Watson-Crick discovery of the Double Helix structure of DNA. That 1953 paper was used to conduct a cited reference of the *SCI*. Since time is short, I am not going to dwell on the details of that search. In Figures 16, 17, 18, and 19, I simply want to show you the result of mapping the five years from 1953 to 1958.

Figure 16: Citations to Watson-Crick

In Figure 16, we have the usual HistCite table for the papers that cite Watson-Crick, 1953, but have added a few of the key outer references for Avery and Hershey.

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#) [HistCite Guide](#)

Articles from 1953-1958 citing Watson and Crick's 1953 paper, "Molecular Structure of DNA" and selected outer references

Nodes: 210

Sorted by year, journal, volume, page.

Page 1: 1

#	Cited nodes	Nodes / Authors	GCS	LCS
1	0	1 1944 JOURNAL OF EXPERIMENTAL MEDICINE 79():137-157 AVERY OT; MACLEON CM; MCCARTY M <i>Studies on the Chemical Nature of the Substance Inducing Transformation of Pseumococcal Types. Induction of Transformation by a Deoxyribonucleic Acid Fraction Isolated from Pneumococcus Type III</i>	0	23
2	0	2 1952 JOURNAL OF GENERAL PHYSIOLOGY 36(1):39-56 HERSHEY AD; CHASE M <i>Independent Functions of Viral Protein and Nucleic Acid in Growth of Bacteriophage</i>	747	23
3	2	3 1953 ACTA CRYSTALLOGRAPHICA 6(8-9):673-677 FRANKLIN RE; GOSLING RG <i>The Structure of Sodium Thymonucleate Fibres .1. The Influence of Water Content</i>	14	11
4	3	4 1953 ACTA CRYSTALLOGRAPHICA 6(8-9):678-685 FRANKLIN RE; GOSLING RG <i>The Structure of Sodium Thymonucleate Fibres .2. The Cylindrically Symmetrical Patterson Function</i>	10	8
5	1	5 1953 ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS 46(1):12-17 SMITH CL <i>The Breakdown of Desoxyribonucleic Acid Under Deuteron and Electron Bombardment</i>	5	1
6	2	6 1953 BIOCHEMICAL JOURNAL 55(5):774-782 WYATT GR; COHEN SS <i>The Bases of the Nucleic Acids of Some Bacterial and Animal Viruses - The Occurrence of 5-Hydroxymethylcytosine</i>	57	8
7	3	7 1953 COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY 18():123-131 WATSON JD; CRICK FHC <i>The Structure of Dna</i>	61	21
8	1	8 1953 COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY 8():133-134 WYATT GR <i>The Quantitative Composition of Deoxypentose Nucleic Acids As Related To the Newly Proposed Structure</i>	9	4
9	2	9 1953 COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY 18():171-183 LARK KG; ADAMS MH <i>The Stability of Phages As a Function of the Ionic Environment</i>	13	2

Figure 17: Chained Citations to Watson-Crick

In Figure 17, we have the table for the 975 papers that were retrieved by virtue of chaining citations to the 210 papers that cited Watson-Crick. In other words, these are second generation citations to the citing papers in Figure 16.

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#) [HistCite Guide](#)

Articles citing Watson and Crick's 1953 paper, "Molecular Structure of DNA", the articles citing them (1953-1958), and selected outer references

Nodes: 975

Sorted by year, journal, volume, page.

Page 1: 1 [2](#)

#	Cited nodes	Nodes / Authors	GCS	LCS
1	0	1 1938 JOURNAL OF BIOLOGICAL CHEMISTRY 124():425- SEVAG MG <i>[unknown]</i>	216	37
2	1	2 1944 JOURNAL OF EXPERIMENTAL MEDICINE 79():137-157 AVERY OT; MACLEON CM; MCCARTY M <i>Studies on the Chemical Nature of the Substance Inducing Transformation of Pseumococcal Types. Induction of Transformation by a Deoxyribonucleic Acid Fraction Isolated from Pneumococcus Type III</i>	331	43
3	0	3 1945 JOURNAL OF BIOLOGICAL CHEMISTRY 161(1):83-89 SCHMIDT G; THANNHAUSER SJ <i>A Method for the Determination of Desoxyribonucleic Acid, Ribonucleic Acid, and Phosphoproteins in Animal Tissues</i>	696	34
4	1	4 1945 JOURNAL OF BIOLOGICAL CHEMISTRY 161(1):293-303 SCHNEIDER WC <i>Phosphorus Compounds in Animal Tissues .1. Extraction and Estimation of Desoxypentose Nucleic Acid and of Pentose Nucleic Acid</i>	952	30
5	2	5 1946 JOURNAL OF GENERAL PHYSIOLOGY 30(2):117-& MIRSKY AE; POLLISTER AW <i>Chromosin, a Desoxyribose Nucleoprotein Complex of the Cell Nucleus</i>	323	35
6	0	6 1947 JOURNAL OF THE CHEMICAL SOCIETY (SEP):1131-1141 GULLAND JM; JORDAN DO; TAYLOR HFW <i>Deoxypentose Nucleic Acids .2. Electrometric Titration of the Acidic and the Basic Groups of the Deoxypentose Nucleic Acid of Calf Thymus</i>	70	31
7	3	7 1951 BIOCHEMICAL JOURNAL 48(5):584-590 WYATT GR <i>The Purine and Pyrimidine Composition of Deoxypentose Nucleic Acids</i>	276	63
8	0	8 1951 JOURNAL OF BIOLOGICAL CHEMISTRY 189(2):597-605 MARSHAK A; VOGEL HJ <i>Microdetermination of Purines and Pyrimidines in Biological Materials</i>	136	30
9	0	9 1951 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 37(4):205-211 PAULING L; COREY RB; BRANSON HR <i>The Structure of Proteins - 2 Hydrogen-Bonded Helical Configurations of the Polypeptide Chain</i>	185	26
10	1	10 1952 BIOCHEMICAL JOURNAL 52(5):558-565 MARKHAM R; SMITH JD <i>The Structure of Ribonucleic Acids .2. The Smaller Products of Ribonuclease Digestion</i>	104	28
11	0	11 1952 JOURNAL OF GENERAL PHYSIOLOGY 36(1):39-56 HERSHEY AD; CHASE M <i>Independent Functions of Viral Protein and Nucleic Acid in Growth of Bacteriophage</i>	206	

Figure 18: Watson-Crick – year-by-year historiography

In Figure 18, we have the year-by-year map of the 22 most-cited papers in the chained indexed file. Notice that in 1953 there were nine highly-cited papers. And in 1954, there are five. Using the typical reference citation, that is, only author, volume, page, and year, it is not possible to differentiate the month-by-month progression, after the April, 1953 Watson and Crick paper. However, the *HistCite* system can take into account the cover dates of the journals involved if they are included.

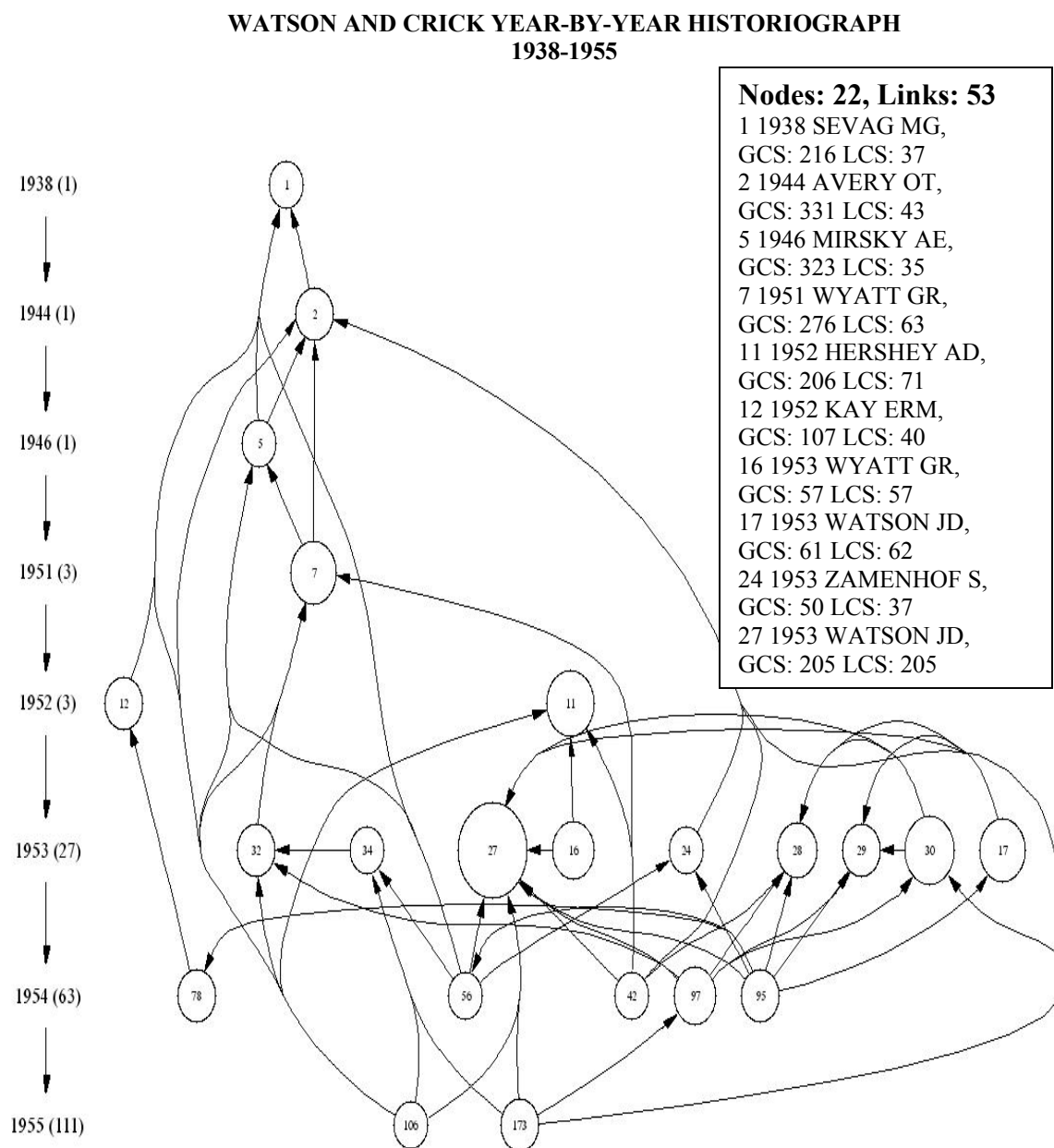


Figure 19: Watson-Crick Month-by-Month historiograph 1953

In Figure 19, we see how the historiography changes not just year-to-year but month-by-month. Unfortunately, *WoS* does not contain cover dates until 1985 or there about. So we had to manually insert in the export files the cover dates for the few dozen papers involved in this example.

WATSON AND CRICK MONTH-BY-MONTH HISTORIOGRAPH FOR 1953

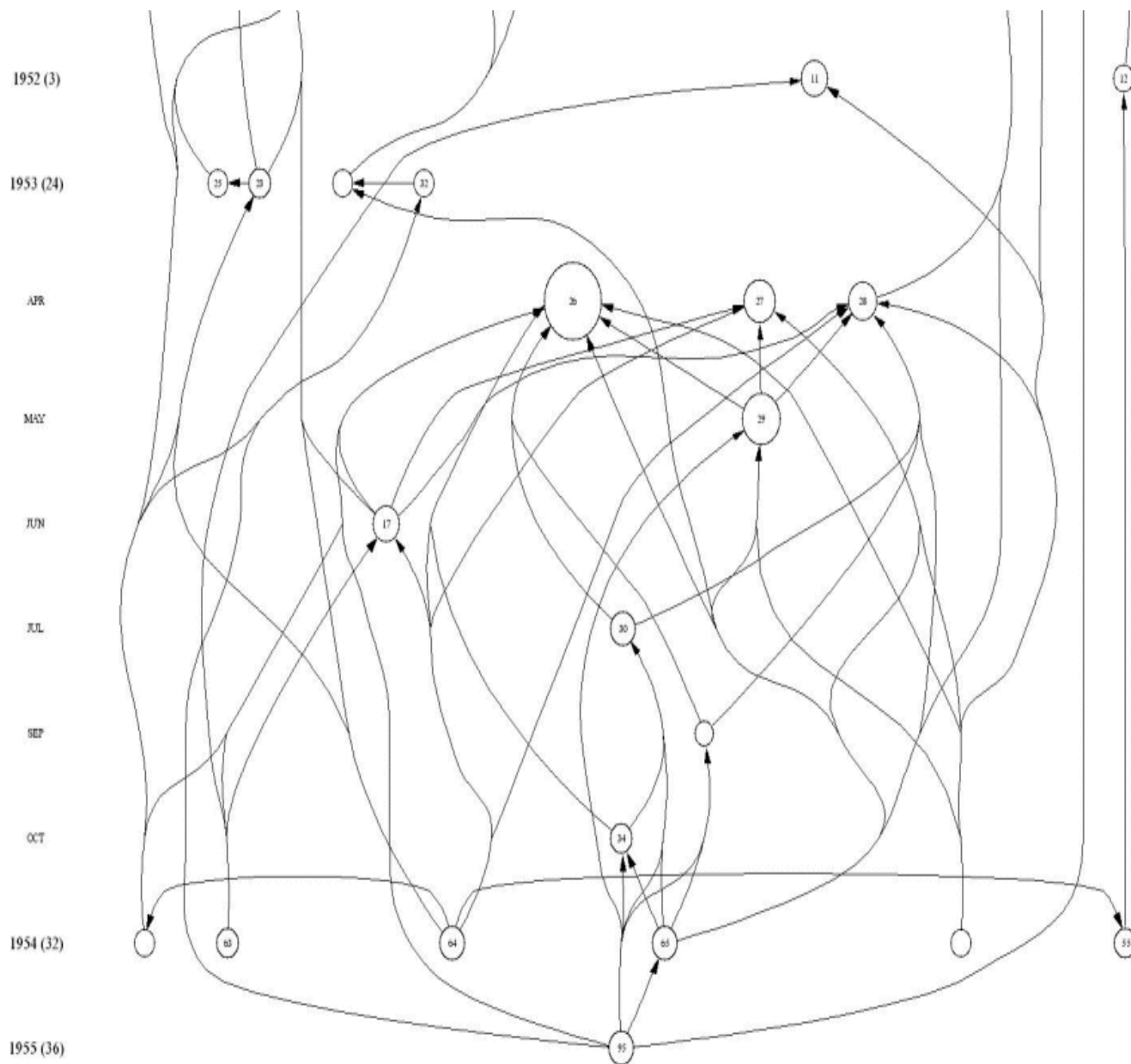
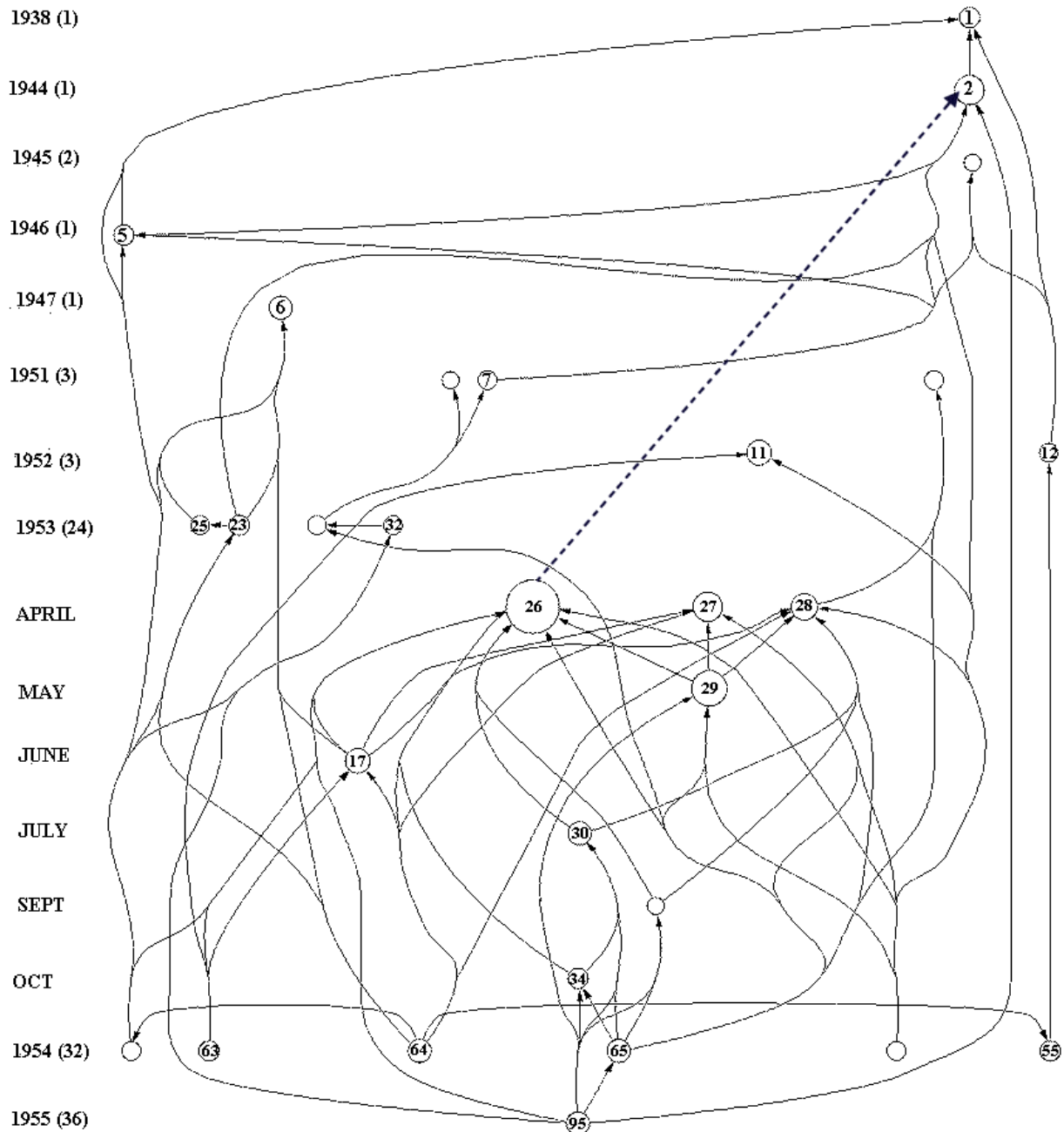


Figure 20: Watson-Crick Historiograph 1953 with arrow from Watson-Crick to Avery

In a recent interview,⁸ James Watson apologized for not having cited Avery in the primordial *Nature* paper on the DNA helical structure. But as we have seen, this omission on his part made little difference in the algorithmic mapping of the development of DNA science. But in view of Watson's comment, I have added a dotted line from Watson-Crick to Avery indicating that key link. However, to obtain a more accurate picture of Avery between 1944 and 1945, we would have to create a citation index for the 1944 literature. There is some controversy as to how much the significance of the Avery work was appreciated by the scientific community at that time.^{9,10,11,12,13,14}

WATSON-CRICK AND AVERY



We have described a tool which permits the user to manage the voluminous references produced in a comprehensive search of the literature. For those who are new to the subject, the mere juxtaposition of the most-cited papers for each five- or ten-year period of the literature will help identify the key literature to be used first. For those who are knowledgeable in the field, the system will help jog the memory to recall the key works which were associated with the development of the field. While the relevance of citing works may be apparent, the collective bibliographic coupling and co-citation of papers in and outside the basic bibliography should provide a comprehensive structure for completing a synoptic history of the topic.

CELL DEATH

Several years ago, Gerry Melino and I used the *SCI* to perform various citation analyses of the cell death field.¹⁵ That paper is available at:

<http://www.garfield.library.upenn.edu/papers/celldeathv4p352v1997.pdf>

In the intervening five-year period, the field has grown enormously. In 2000, there were 5,700 papers that included the terms “cell death” or “apoptosis” in their titles. In 2001, there were 6,175 but in 2002 this dropped back to 5,100. In the first six months of 2003, there were about 3,000. If we were to expand the search to include terms in abstracts, these figures all would almost treble. We will face a formidable task to update that study.

For the purpose of today’s discussion, I will limit my remarks to a brief review of the *HistCite* files we have created for *Cell Death and Differentiation*. In Figure 21, you see the first entries for the first year of *CDD* in 1994. In this example in Figure 21, all papers published in the journal *Cell Death and Differentiation* are listed. Note that the chronological sort key includes not only volume, page and year, but also issue number.

The WOS output file is normally arranged in reverse chronological order. The ISI production procedure is, of necessity, often asynchronous with the cover dates. Thus a December 2000 article may appear in WOS in January 2001. Also, timing variations occur when ISI adds back issues to its cumulative files. So it is not possible to rely on the WOS, at present, to produce listings in perfect chronological arrangement, even for a single journal.

While the *HistCite* program will usually produce a perfect chronological sort for a single journal's records, it is not always possible to do this for a collection covering articles from many journals. Since volume numbers vary from journal to journal the usual sort by volume, page, and year will not produce a perfect chronological sort. However, if the monthly or weekly dates are included in the original *WOS* records, as was done for the Watson-Crick example in Figure 19, then the file can be sorted properly by date. It is also important to notice that the 1994 *Cell Death and Differentiation* papers included in this figure are not yet included as sources in *WoS*. They were created manually in order to complete the *HistCite* file.

Figure 21: HistCite of papers published in *Cell Death and Differentiation*, 1994-2003

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#) [HistCite Guide](#)

Papers from *Cell Death and Differentiation* from 1994 to May 2003

Nodes: 1056

Sorted by **year, journal, volume, page**.

Page 1: 1 [2](#) [3](#)

#	Cited nodes	Nodes / Authors	GCS	LCS
1	0	1 1994 CELL DEATH AND DIFFERENTIATION 1(2):-iv OSBORNE BA <i>Intracellular regulators of death</i>	0	0
2	1	2 1994 CELL DEATH AND DIFFERENTIATION 1(1):iv-iv FESUS L <i>DNA fragmentation</i>	2	0
3	0	3 1994 CELL DEATH AND DIFFERENTIATION 1(2):- THIELE CJ; MELINO G <i>Death and Differentiation in Erice</i>	0	0
4	0	4 1994 CELL DEATH AND DIFFERENTIATION 1(1):-68 COTTER TG; MELINO G <i>The high-tech aspect of death</i>	0	0
5	0	5 1994 CELL DEATH AND DIFFERENTIATION 1(1):1-6 PEITSCH MC; POLZAR B; TSCHOPP J; MANNHERZ HG <i>About the involvement of deoxyribonuclease I in apoptosis</i>	31	9
6	1	6 1994 CELL DEATH AND DIFFERENTIATION 1(1):7-9 EASTMAN A <i>Deoxyribonuclease II in apoptosis & the significance of intracellular acidification</i>	32	8
7	0	7 1994 CELL DEATH AND DIFFERENTIATION 1(1):11-17 HUGHES JR; CIDLOWSKI JA <i>Apoptotic DNA degradation: evidence for novel enzymes</i>	31	0
8	0	8 1994 CELL DEATH AND DIFFERENTIATION 1(1):19-31 POLAKOWSKA RR; HAAKE AR <i>Apoptosis: the skin from a new perspective</i>	54	3
9	0	9 1994 CELL DEATH AND DIFFERENTIATION 1(1):33-37 HIBNER U; COUTINHO A <i>Signal antonymy: a mechanism for apoptosis induction</i>	12	0
10	0	10 1994 CELL DEATH AND DIFFERENTIATION 1(1):39-47 YONISH ROUACH; BORDE J; GOTTELAND M; MISHAL Z; VIRON A; MAY E <i>Induction of apoptosis by transiently transfected metabolically stable WT P53 in transformed cell lines</i>	31	0

Figure 22: Cell Death and Differentiation sorted by GCS

In Figure 22, we have sorted this file by Global Citation Score and learned thereby that Nicholson's paper in 1999 is the most-cited.

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#) [Graphs](#) [HistCite Guide](#)

Cell Death and Differentiation Papers, 1994 to May 2003

Nodes: 1056

Sorted by **GCS**.

Page 1: 1 [2](#) [3](#)



#	Cited nodes	Nodes / Authors	GCS	LCS
1	4	476 1999 CELL DEATH AND DIFFERENTIATION 6(11):1028-1042 Nicholson DW <i>Caspase structure, proteolytic substrates, and function during apoptotic cell death</i>	301	29
2	0	363 1999 CELL DEATH AND DIFFERENTIATION 6(2):99-104 Porter AG; Janicke RU <i>Emerging roles of caspase-3 in apoptosis</i>	176	6
3	0	342 1998 CELL DEATH AND DIFFERENTIATION 5(12):1004-1016 Srinivasan A; Roth KA; Sayers RO; Shindler KS; Wong AN; Fritz LC; Tomaselli KJ <i>In situ immunodetection of activated caspase-3 in apoptotic neurons in the developing nervous system</i>	165	5
4	0	288 1998 CELL DEATH AND DIFFERENTIATION 5(7):551-562 Fadok VA; Bratton DL; Frasch SC; Warner ML; Henson PM <i>Role of phosphatidylserine in recognition of apoptotic cells by phagocytes</i>	129	14
5	0	88 1996 CELL DEATH AND DIFFERENTIATION 3(3):255-267 Kumar S; Lavin MF <i>The ICE family of cysteine proteases as effectors of cell death</i>	127	21
6	1	289 1998 CELL DEATH AND DIFFERENTIATION 5(7):563-568 Ren Y; Savill J <i>Apoptosis: The importance of being eaten</i>	125	7
7	0	265 1998 CELL DEATH AND DIFFERENTIATION 5(5):372-380 Schendel SL; Montal M; Reed JC <i>Bcl-2 family proteins as ion-channels</i>	121	6
8	3	340 1998 CELL DEATH AND DIFFERENTIATION 5(12):997-1000 Stroh C; Schulze-Osthoff K <i>Death by a thousand cuts: an ever increasing list of caspase substrates</i>	121	10
9	0	253 1998 CELL DEATH AND DIFFERENTIATION 5(4):271-288 Rasper DM; Vaillancourt JP; Hadano S; Houtzager VM; Seiden I; Keen SLC; Tawa P; Xanthoudakis S; Nasir J; Martindale D; Koop BF; Peterson Ep; Thornberry Na; Huang Jq; Macpherson Dp; Black Sc; Hornung F; Lenardo MJ; Hayden MR; Roy S; Nicholson DW <i>Cell death attenuation by 'Usurpin', a mammalian DED-caspase homologue that precludes caspase-8 recruitment and activation by the CD-95 (Fas, APO-1) receptor complex</i>	118	6
10	0	482 1999 CELL DEATH AND DIFFERENTIATION 6(11):1081-1086 Ekert PG; Silke J; Vaux DL <i>Caspase inhibitors</i>	114	10

Figure 23: Paper #476 by Nicholson

In Figure 23, we see the full source record for the Nocholson paper.

476

Author(s)	Nicholson DW
Title	Caspase structure, proteolytic substrates, and function during apoptotic cell death
Journal	CELL DEATH AND DIFFERENTIATION 6(11):1028-1042
Date	1999 NOV
Type	Review
Address	Merck Frosst Canada & Co, Merck Frosst Ctr Therapeut Res, POB 1005, Pointe Claire, PQ H9R 4P8, Canada Merck Frosst Canada & Co, Merck Frosst Ctr Therapeut Res, Pointe Claire, PQ H9R 4P8, Canada
Abstract	Caspases play an essential role during apoptotic cell death. These enzymes define a new class of cysteine proteases and comprise a multi-gene family with more than a dozen distinct mammalian family members. The discrete and highly limited subset of cellular polypeptides that are cleaved by these proteases is sufficient to account for the majority of cellular and morphological events that occur during cell death. In some cases, caspases also play a contributory role in escalating the propensity for apoptosis, and in doing so may exacerbate disease pathogenesis.
GCS	301
LCS	29
cites	4
CR[214]	<p>ADAMKLAGE S, 1998, J IMMUNOL, V161, P5687 AHMAD M, 1997, CANCER RES, V57, P615 ALNEMRI ES, 1996, CELL, V87, P171 AN B, 1996, CANCER RES, V56, P438 ANDRADE F, 1998, IMMUNITY, V8, P451 ATSUMI G, 1998, J BIOL CHEM, V273, P1380 BARKETT M, 1997, J BIOL CHEM, V272, P29419 BARNES NY, 1998, J NEUROSCI, V18, P5869 BARR PJ, 1994, BIO-TECHNOL, V12, P487 BEYAERT R, 1997, J BIOL CHEM, V272, P11694 BLACK SC, 1998, J MOL CELL CARDIOL, V30, P733 BOLDIN MP, 1996, CELL, V85, P803 BRANCOLINI C, 1998, CELL DEATH DIFFER, V5, P1042 BRANCOLINI C, 1995, EMBO J, V14, P5179 BRANCOLINI C, 1997, J CELL BIOL, V139, P759 BRAUN JS, 1999, NAT MED, V5, P298 BROCKSTEDT E, 1998, J BIOL CHEM, V273, P28057 BROCKSTEDT E, 1998, J BIOL CHEM, V273, P33884 BROWN SB, 1997, BIOCHEM J, V323, P233 BROWNE SJ, 1998, CELL DEATH DIFFER, V5, P206 BUCKLEY CD, 1999, NATURE, V397, P534 BUENDIA B, 1999, J CELL SCI, V112, P1743 BUMP NJ, 1995, SCIENCE, V269, P1885 CARDONE MH, 1997, CELL, V90, P315 CASCIOLARROSEN L, 1996, J EXP MED, V183, P1957 CASCIOLARROSEN LA, 1994, J BIOL CHEM, V269, P30757 CASCIOLARROSEN LA, 1995, J EXP MED, V182, P1625</p>

Figure 24: Outer References for *Cell Death and Differentiation* sorted by LCS

In Figure 24, we see the ranked list of outer references which includes at the top the papers by P Li in 1997 and the classic paper by J.F.R. Kerr in 1972, which has been cited in over 5,500 papers, a further reflection of the growth of this field. Immediately follow Kerr is the 1980 paper by A. H. Wyllie, which has been cited in 4,700 papers. His 1980 paper in *Nature* (#18) has been cited about 3,100 times. These examples illustrate how the outer references in a *HistCite* file essentially recapitulate the history of the topic.

WORK OF PIERLUIGI NICOTERA

ISI Web of Science location:

Cited references outside of this network

Total: 28426 (top 100 shown).

Outer References

Sorted by **LCS**.

#	LCS	Reference
1	102	LI P, 1997, CELL, V91, P479 WoS
2	91	KERR JFR, 1972, BRIT J CANCER, V26, P239 WoS
3	83	WYLLIE AH, 1980, INT REV CYTOL, V68, P251 WoS
4	74	NICHOLSON DW, 1995, NATURE, V376, P37 WoS
5	74	KLUCK RM, 1997, SCIENCE, V275, P1132 WoS
6	74	MUZIO M, 1996, CELL, V85, P817 WoS
7	73	YANG J, 1997, SCIENCE, V275, P1129 WoS
8	70	GREEN DR, 1998, SCIENCE, V281, P1309 WoS
9	67	THOMPSON CB, 1995, SCIENCE, V267, P1456 WoS
10	63	ZOU H, 1997, CELL, V90, P405 WoS
11	63	BOLDIN MP, 1996, CELL, V85, P803 WoS
12	61	LIU XS, 1996, CELL, V86, P147 WoS
13	59	YUAN JY, 1993, CELL, V75, P641 WoS
14	58	LI HL, 1998, CELL, V94, P491 WoS
15	57	COHEN GM, 1997, BIOCHEM J 1, V326, P1 WoS
16	54	ENARI M, 1998, NATURE, V391, P43 WoS
17	53	LUO X, 1998, CELL, V94, P481 WoS
18	52	WYLLIE AH, 1980, NATURE, V284, P555 WoS
19	52	ALNEMRI ES, 1996, CELL, V87, P171 WoS
20	50	OLTVAI ZN, 1993, CELL, V74, P609 WoS
21	49	ELLIS RE, 1991, ANN REV CELL BIOL, V7, P663 WoS
22	48	THORNBERRY NA, 1998, SCIENCE, V281, P1312 WoS
23	48	TEWARI M, 1995, CELL, V81, P801 WoS
24	44	STELLER H, 1995, SCIENCE, V267, P1445 WoS
25	44	GAVRIELI Y, 1992, J CELL BIOL, V119, P493 WoS
26	44	BOSSYWETZEL E, 1998, EMBO J, V17, P37 WoS
27	44	NAGATA S, 1997, CELL, V88, P355 WoS
28	43	BOISE LH, 1993, CELL, V74, P597 WoS
29	43	RAFF MC, 1992, NATURE, V356, P397 WoS
30	43	NICOLETTI I, 1991, J IMMUNOL METHODS, V139, P271 WoS

Figure 25: Nicotera papers sorted chronologically

In Figure 25, we have the file of papers published by Pierluigi Nicotera. His 170 co-authored papers have been widely cited as can be seen in the next slide.

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#)

[HistCite Guide](#)

Papers by P NICOTERA in ISI Web of Science

Nodes: 170

Sorted by year, journal, volume, page.

Page 1: 1

CHRONOLOGICAL

#	Cited nodes	Nodes / Authors	GCS	LCS
1	0	1 1984 ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS 235(2):343-350 DIMONTE D; BELLOMO G; THOR H; NICOTERA P; ORRENIUS S <i>Menadione-Induced Cyto-Toxicity Is Associated with Protein Thiol Oxidation and Alteration in Intracellular CA-2+ Homeostasis</i>	302	10
2	0	2 1984 EUROPEAN JOURNAL OF BIOCHEMISTRY 144(1):19-23 BELLOMO G; NICOTERA P; ORRENIUS S <i>Alterations in Intracellular Calcium Compartmentation Following Inhibition of Calcium Efflux From Isolated Hepatocytes</i>	38	6
3	0	3 1985 FEBS LETTERS 181(1):149-153 NICOTERA P; MOORE M; MIRABELLI F; BELLOMO G; ORRENIUS S <i>Inhibition of Hepatocyte Plasma-Membrane CA-2+-Atpase Activity By Menadione Metabolism and Its Restoration by THIOLS</i>	153	9
4	1	4 1985 FEBS LETTERS 187(1):121-125 NICOTERA P; BALDI C; SVENSSON SA; LARSSON R; BELLOMO G; ORRENIUS S <i>Glutathione S-Conjugates Stimulate ATP Hydrolysis in the Plasma-Membrane Fraction of Rat Hepatocytes</i>	26	1
5	0	5 1985 JOURNAL OF BIOLOGICAL CHEMISTRY 260(4):1999-2002 NICOTERA P; MOORE M; BELLOMO G; MIRABELLI F; ORRENIUS S <i>Demonstration and Partial Characterization of Glutathione Disulfide-Stimulated Atpase Activity in the Plasma-Membrane Fraction from Rat Hepatocytes</i>	82	6
6	1	6 1986 FEBS LETTERS 209(1):139-144 NICOTERA P; HARTZELL P; DAVIS G; ORRENIUS S <i>The Formation of Plasma-Membrane Blebs in Hepatocytes Exposed To Agents That Increase Cytosolic CA2+ Is Mediated by the Activation of a Nonlysosomal Proteolytic System</i>	180	8
7	4	7 1986 JOURNAL OF BIOLOGICAL CHEMISTRY 261(31):14628-14635 NICOTERA P; HARTZELL P; BALDI C; SVENSSON SA; BELLOMO G; ORRENIUS S <i>Cystamine Induces Toxicity in Hepatocytes Through Elevation of Cytosolic CA-2+ & Stimulation of aNonlysosomal Proteolytic System</i>	227	27
8	1	8 1986 KLINISCHE WOCHENSCHRIFT 64():138-141 ORRENIUS S; NICOTERA P <i>Studies of CA-2+-Mediated Toxicity in Hepatocytes</i>	16	0
9	3	9 1987 ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS 259(2):283-295 MOORE GA; ROSSI L; NICOTERA P; ORRENIUS S; OBRIEN PJ <i>Quinone Toxicity in Hepatocytes - Studies on Mitochondrial CA- 2+ Release Induced By Benzoquinone Derivatives</i>	31	1
10	5	10 1987 ARCHIVES OF TOXICOLOGY ():11-19 ORRENIUS S; NICOTERA P <i>On the Role of Calcium in Chemical Toxicity</i>	0	0

Figure 26: Nicotera papers sorted by GCS

In Figure 26, the papers are ranked by GCS. I have selected the top two papers to illustrate another feature of the *WoS* search system. One can identify a research sub-specialty though co-citation analysis.

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#)

[HistCite Guide](#)

Papers by P NICOTERA Ranked by Global Citation Score

Nodes: 170

Sorted by **GCS**.

Page 1: 1



#	Cited nodes	Nodes / Authors	GCS	LCS
1	1	75 1995 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 92(16):7162-7166 BONFOCO E; KRAINC D; ANKARCRONA M; NICOTERA P; LIPTON SA <i>Apoptosis and Necrosis - 2 Distinct Events Induced, Respectively, by Mild and Intense Insults with N-Methyl-D- Aspartate or Nitric-Oxide Superoxide in Cortical Cell-Cultures</i>	786	10
2	7	72 1995 NEURON 15(4):961-973 ANKARCRONA M; DYPBUKT JM; BONFOCO E; ZHIVOTOVSKY B; ORRENIUS S; LIPTON SA; NICOTERA P <i>Glutamate-Induced Neuronal Death - A Succession Of Necrosis Or Apoptosis Depending On Mitochondrial-Function</i>	715	33
3	7	27 1989 TRENDS IN PHARMACOLOGICAL SCIENCES 10(7):281-285 ORRENIUS S; MCCONKEY DJ; BELLOMO G; NICOTERA P <i>Role Of CA-2+ in Toxic Cell Killing</i>	682	7
4	6	24 1989 FASEB JOURNAL 3(7):1843-1849 MCCONKEY DJ; HARTZELL P; NICOTERA P; ORRENIUS S <i>Calcium-Activated DNA Fragmentation Kills Immature Thymocytes</i>	524	12
5	2	18 1989 ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS 269(1):365-370 MCCONKEY DJ; NICOTERA P; HARTZELL P; BELLOMO G; WYLLIE AH; ORRENIUS S <i>Glucocorticoids Activate a Suicide Process in Thymocytes through an Elevation of Cytosolic CA-2+ Concentration</i>	507	15
6	2	97 1997 JOURNAL OF EXPERIMENTAL MEDICINE 185(8):1481-1486 LEIST M; SINGLE B; CASTOLDI AF; KUHNLE S; NICOTERA P <i>Intracellular adenosine triphosphate (ATP) concentration: A switch in the decision between apoptosis and necrosis</i>	505	30
7	16	41 1992 ANNUAL REVIEW OF PHARMACOLOGY AND TOXICOLOGY 32():449-470 NICOTERA P; BELLOMO G; ORRENIUS S <i>Calcium-Mediated Mechanisms In Chemically-Induced Cell-Death</i>	392	20
8	0	1 1984 ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS 235(2):343-350 DIMONTE D; BELLOMO G; THOR H; NICOTERA P; ORRENIUS S <i>Menadione-Induced Cyto-Toxicity Is Associated With Protein Thiol Oxidation And Alteration In Intracellular CA-2+ Homeostasis</i>	302	10
9	5	25 1989 JOURNAL OF BIOLOGICAL CHEMISTRY 264(11):6398-6403 JONES DP; MCCONKEY DJ; NICOTERA P; ORRENIUS S <i>Calcium-Activated DNA Fragmentation in Rat-Liver Nuclei</i>	266	19
10	0	26 1989 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 86(2):453-457 NICOTERA P; MCCONKEY DJ; JONES DP; ORRENIUS S <i>ATP Stimulates CA-2+ Uptake and Increases the Free CA-2+ Concentration in Isolated Rat-Liver Nuclei</i>	235	19

Figure 27: Combined search in *WoS* on these 2 1995 papers by Nicotera

Figure 27 illustrates the combined search feature which permits boolean searching of sets. Thus, the two sets of papers citing Nicotera's two 1995 papers are combined. In set #3 we have the 182 papers that have co-cited them.

Co-Citation Search of Two Nicotera 1995 Papers

ISI Web of SCIENCE®
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HOME
 HELP
 DATE & DB LIMITS
 GENERAL SEARCH
 CITED REF SEARCH
 ADVANCED SEARCH

Combine Searches

Enter two or more search set numbers (e.g., #1) combined with Boolean operators (AND, OR, NOT).
 For example: #2 NOT #1 [more examples](#)

Current Selections:
 Database(s)=SCI-EXPANDED, SSCI, A&HCI
 Timespan=1945-2003

Set	Results	<input type="button" value="OPEN HISTORY"/> <input type="button" value="SAVE HISTORY"/> Search History	Delete Sets
#3	182	#1 AND #2 <i>DocType=All document types; Language=All languages; Database(s)=SCI-EXPANDED, SSCI, A&HCI; Timespan=1945-2003</i>	<input type="checkbox"/>
#2	723	Cited Author=NICOTERA P AND Cited Year=1995 <i>DocType=All document types; Language=All languages; Database(s)=SCI-EXPANDED, SSCI, A&HCI; Timespan=1945-2003</i>	View Lookup Selections <input type="checkbox"/>
#1	787	Cited Author=NICOTERA P AND Cited Year=1995 <i>DocType=All document types; Language=All languages; Database(s)=SCI-EXPANDED, SSCI, A&HCI; Timespan=1945-2003</i>	View Lookup Selections <input type="checkbox"/>

Field Tag Key:
TS=Topic **AU**=Author **AD**=Address
TI=Title **SO**=Source

☒

Figure 28: Recent papers co-citing papers by Nicotera in 1995

In Figure 28, there is a list of some recent papers on this topic identified by the search.

Recent Papers Co-Citing Two Nicotera 1995 Papers

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HOME

HELP

DATE & DB LIMITS

GENERAL SEARCH

CITED REF SEARCH

COMBINE SEARCHES

ADVANCED SEARCH

Combine Searches Results--Summary

#1 AND #2
DocType=All document types; Language=All languages; Database(s)=SCI-EXPANDED, SSCI, A&HCI; Timespan=1945-2003

SUBMIT MARKS

MARK PAGE

MARK ALL

Page 1 (Articles 1 -- 10):

Latest date

SORT

◀

◀◀

◀

[1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10]

▶

▶▶

▶

Use the checkboxes to add individual articles to the Marked List. Be sure to click SUBMIT MARKS button before leaving page.

☐

Roy M, Sapolsky RM
[The exacerbation of hippocampal excitotoxicity by glucocorticoids is not mediated by apoptosis](#)
NEUROENDOCRINOLOGY 77 (1): 24-31 JAN 2003

☐

Lopez E, Figueroa S, Oset-Gasque MJ, et al.
[Apoptosis and necrosis: two distinct events induced by cadmium in cortical neurons in culture](#)
BRIT J PHARMACOL 138 (5): 901-911 MAR 2003

☐

Sinclair C, Reavy H, Grieve A, et al.
[Inherent desensitisation-preventing properties of a novel, subtype-selective AMPA receptor agonist, \(S\)-CPW 399, as a possible explanation for its excitotoxic action in cultured cerebellar granule cells](#)
NEUROCHEM INT 42 (6): 499-510 MAY 2003

☐

Cock HR
[The role of mitochondria and oxidative stress in neuronal damage after brief and prolonged seizures](#)
PROG BRAIN RES 135: 187-196 2002

☐

Hansson MJ, Persson T, Friberg H, et al.
[Powerful cyclosporin inhibition of calcium-induced permeability transition in brain mitochondria](#)
BRAIN RES 960 (1-2): 99-111 JAN 17 2003

☐

Cascio C, Guarneri R, Russo D, et al.
[A caspase-3-dependent pathway is predominantly activated by the excitotoxin pregnenolone sulfate and requires early and late cytochrome c release and cell-specific caspase-2 activation in the retinal cell death](#)
J NEUROCHEM 83 (6): 1358-1371 DEC 2002

Gene Flow

Figure 29: Chronological table of papers on gene flow from 1974 to 2003

As a final illustration of a keyword search, consider the topic of “gene flow.” This is of considerable interest to Alexander I. Pudovkin, who together with Vladimir Istomin and myself developed *HistCite*. Instead of a cited reference search, we conducted a typical title word search in *WoS*. Between 1974 and 2001, 620 papers were published on this topic.

Figure 29 shows a portion of the full chronological collection.

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#)

GeneFlow Papers - 1974 to August 2001

See the Historiograph of the 29 most cited papers in LCS by clicking [here](#)

Nodes: 620

HistCite Chronological Display

Sorted by year, journal, volume, page.

Cited nodes	Nodes / Authors	GCS	LCS
0 1	1974 GENETICS 78(3):961-965 SPIETH PT <i>Gene Flow and Genetic Differentiation</i>	43	9
0 2	1975 AMERICAN NATURALIST 109(969):597-601 SLATKIN M; MARUYAMA T <i>Influence of Gene Flow on Genetic Distance</i>	21	6
0 3	1975 AMERICAN NATURALIST 109(970):659-676 MAY RM; ENDLER JA; MCMURTRIE RE <i>Gene Frequency Clines in Presence of Selection Opposed by Gene Flow</i>	88	15
0 4	1975 AUK 92(3):493-510 COOKE F; MACINNES CD; PREVETT JP <i>Gene Flow Between Breeding Populations f Lesser Snow Geese</i>	71	3
0 5	1975 GENETICS 80(2):349-361 MCKENZIE JA <i>Gene Flow and Selection in a Natural Population of Drosophila- Melanogaster</i>	17	0
0 6	1975 GENETICS 81(4):787-802 SLATKIN M <i>Gene Flow and Selection in a 2-Locus System</i>	52	3
0 7	1975 HEREDITY 34(JUN):407-415 BRUSSARD PF; VAWTER AT <i>Population Structure, Gene Flow and Natural Selection in Populations of Euphydryas-Phaeton</i>	9	0
0 8	1975 JOURNAL OF MOLECULAR EVOLUTION 5(3):177-185 ADAMS RP <i>Gene Flow Versus Selection Pressure and Ancestral Differentiation in Composition of Species - Analysis of Populational Variation of Juniperus-Ashei Buch Using Terpenoid Data</i>	21	0
0 9	1976 GENETICS 83(3):S64-S64 RODELL CF <i>Some Demographic Considerations of Gene Flow</i>		0

Figure 30: Gene flow collection sorted by Local Citation Score (LCS)

When you click on LCS, the papers by Slatkin move to the top. This is not a surprising result as he is the leader in this field. 29 of these were used to create an historiograph. Only a portion of the 29 papers cited 10 or more times is shown.

Bottom of Form

[Outer References](#) [Missing Links?](#) [Journal list](#) [All-Author list](#) [Citation Matrix](#)

Gene Flow Papers – 1974 to August 2001

See the Historiograph of the 29 most cited papers in LCS by clicking [here](#)

Nodes: 620

Sorted by LCS.



Cited nodes	Nodes / Authors	GCS	LCS
11	71 1985 ANNUAL REVIEW OF ECOLOGY AND SYSTEMATICS 16():393-430 SLATKIN M <i>Gene Flow in Natural Populations</i>	554	111
4	121 1987 SCIENCE 236(4803):787-792 SLATKIN M <i>Gene Flow and the Geographic Structure of Natural Populations</i>	646	104
2	76 1985 EVOLUTION 39(1):53-65 SLATKIN M <i>Rare Alleles as Indicators of Gene Flow</i>	536	100
4	153 1989 EVOLUTION 43(7):1349-1368 SLATKIN M; BARTON NH <i>A Comparison of 3 Indirect Methods for Estimating Average Levels of Gene Flow</i>	401	82
0	37 1981 GENETICS 99(2):323-335 SLATKIN M <i>Estimating Levels of Gene Flow in Natural Populations</i>	220	53
0	29 1980 NATURE 284(5755):450-451 SCHAAL BA <i>Measurement of Gene Flow in Lupinus-Texensis</i>	165	39
4	31 1981 ANNALS OF THE MISSOURI BOTANICAL GARDEN 68(2):233-253 LEVIN DA <i>Dispersal Versus Gene Flow in Plants</i>	190	37
5	112 1987 EVOLUTION 41(2):385-400 WAPLES RS <i>A Multispecies Approach to the Analysis of Gene Flow in Marine Shore Fishes</i>	198	30
4	64 1984 GENETICS 106(2):293-308 LARSON A; WAKE DB; YANEV KP <i>Measuring Gene Flow Among Populations Having High-Levels of Genetic Fragmentation</i>	119	28
0	16 1977 THEORETICAL POPULATION BIOLOGY 12(3):253-262 SLATKIN M <i>gene flow and genetic drift in a species subject to frequent local extinctions</i>	162	25
3	156 1989 GENETICS 123(3):603-613 SLATKIN M; MADDISON WP <i>A Cladistic Measure of Gene Flow Inferred from the Phylogenies of Alleles</i>	171	22

Figure 31: Computer generated historiograph of “gene flow” most-cited papers.

The genealogical graphical presentation is seen in Figure 31. Note that each rectangular node is hot linked to a full source entry .

GENE FLOW – 29 Most Cited LCS Papers

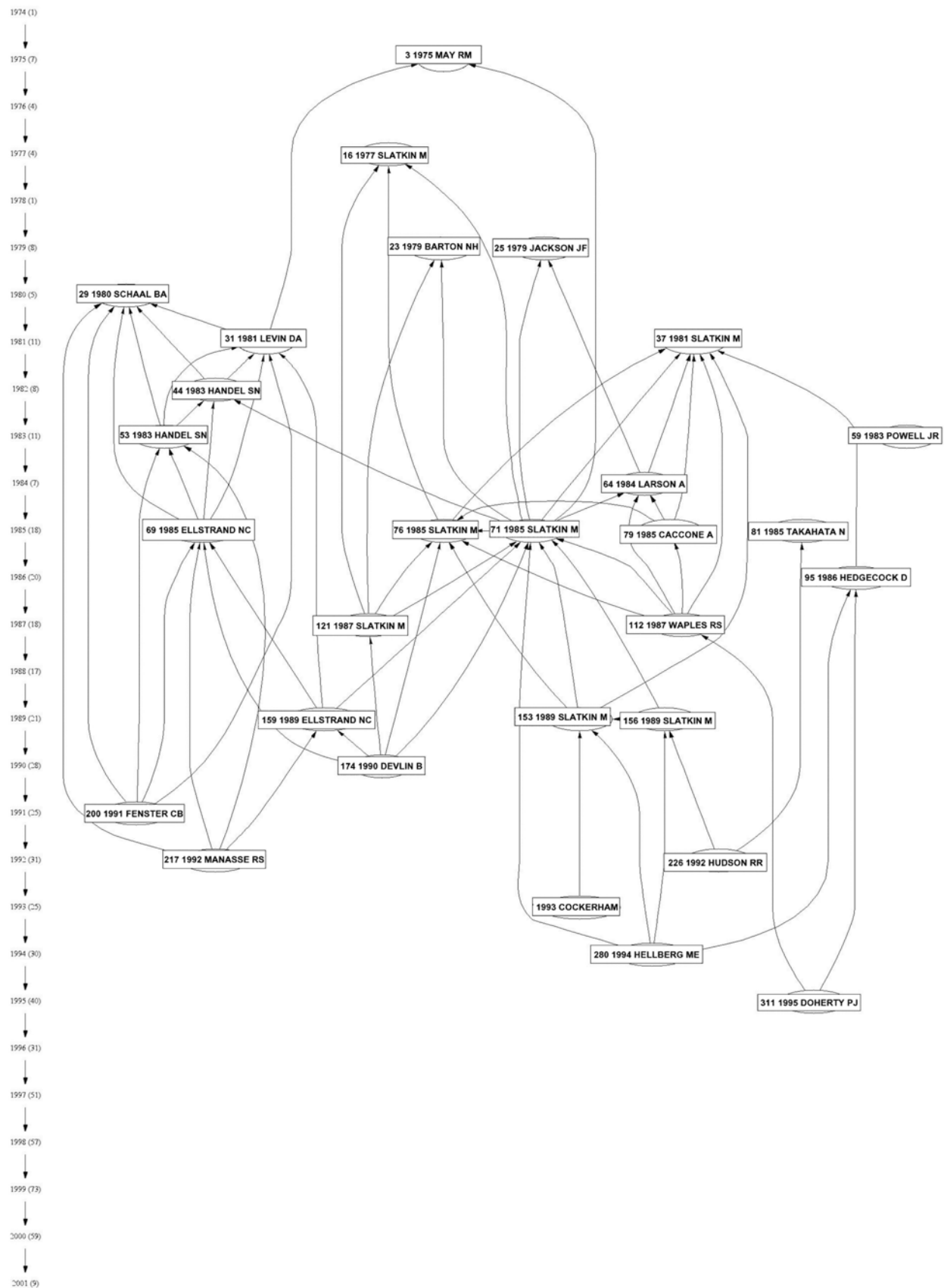


Figure 32: Full source entry for node #3, paper by R. M. May, *American Naturalist*, 1975.

Node #3 at the top of Figure 32 is the full source entry for Richard May's 1975 paper in the *American Naturalist*.

3

Author(s)	MAY RM; ENDLER JA; MCMURTRIE RE
Title	GENE FREQUENCY CLINES IN PRESENCE OF SELECTION OPPOSED BY GENE FLOW
Journal	AMERICAN NATURALIST 109(970):659-676
Year	1975
Type	Article
Address	PRINCETON UNIV,BIOL DEPT,PRINCETON,NJ 08540
Abstract	
WoS CS	88
LCS	15
cites	0
CR[17]	BARBER HN, 1965, HEREDITY, V20, P551 BARBER HN, 1957, NATURE, V179, P1267 BISHOP J, 1972, J ANIM ECOL, V4, P209 CROW JF, 1970, INTRO POPULATION GEN ENDLER JA, 1973, SCIENCE, V179, P243 ENDLER JA, 1976, SUBSPECIES SPECIES C FISHER RA, 1937, ANN EUGEN, V7, P355 FISHER RA, 1950, BIOMETRICS, V6, P353 HALDANE JBS, 1948, J GENET, V48, P277 HANSON WD, 1966, BIOMETRICS, V22, P453 JAIN SK, 1966, HEREDITY, V21, P407 KETTLEWELL HBD, 1969, HEREDITY, V24, P1 KETTLEWELL HBD, 1969, HEREDITY, V24, P15 KETTLEWELL HBD, 1961, HEREDITY, V16, P403 KIMURA M, 1958, 9 NAT I GEN ANN REP, P84 ROUGHGARDEN J, 1974, AM NAT, V108, P649 SLATKIN M, 1973, GENETICS, V75, P733

Figure 33: Gene flow, 1974-2001, collection with each paper represented by a circle proportional to citation frequency

In Figure 33, the same set of 29 LCS papers is shown in another format. Each document is represented by a circle whose area is proportional to its citation frequency.

1975 (7)

1977 (4)

1980 (5)

1981 (11)

1984 (7)

1985 (18)

1986 (20)

1987 (18)

1989 (21)

1992 (31)

1993 (25)

3

16

29

31

69

156

121

76

71

64

79

95

112

159

226

153

257

3 1975 MAY RM, GCS: 88 LCS: 15
16 1977 SLATKIN M, GCS: 162 LCS: 25
29 1980 SCHAAL BA, GCS: 165 LCS: 39
31 1981 LEVIN DA, GCS: 190 LCS: 37
37 1981 SLATKIN M, GCS: 220 LCS: 53
64 1984 LARSON A, GCS: 119 LCS: 28
69 1985 ELLSTRAND NC, GCS: 105 LCS: 20
71 1985 SLATKIN M, GCS: 554 LCS: 111
76 1985 SLATKIN M, GCS: 536 LCS: 100
79 1985 CACCONE A, GCS: 41 LCS: 18
95 1986 HEDGECK D, GCS: 127 LCS: 15
112 1987 WAPLES RS, GCS: 198 LCS: 30
121 1987 SLATKIN M, GCS: 646 LCS: 104
153 1989 SLATKIN M, GCS: 401 LCS: 82
156 1989 SLATKIN M, GCS: 171 LCS: 22
159 1989 ELLSTRAND NC, GCS: 67 LCS: 16
226 1992 HUDSON RR, GCS: 121 LCS: 18
257 1993 COCKERHAM CC, GCS: 77 LCS: 20

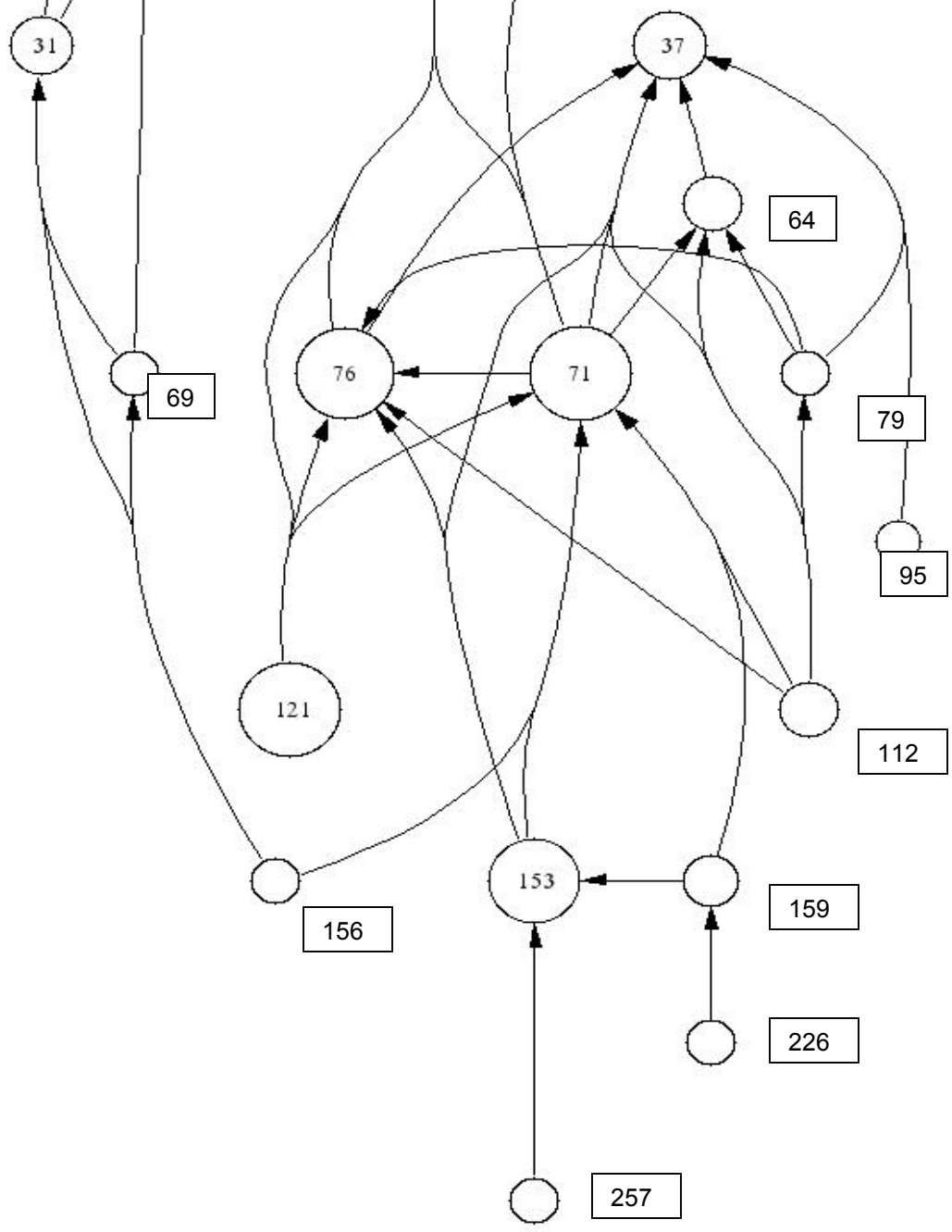
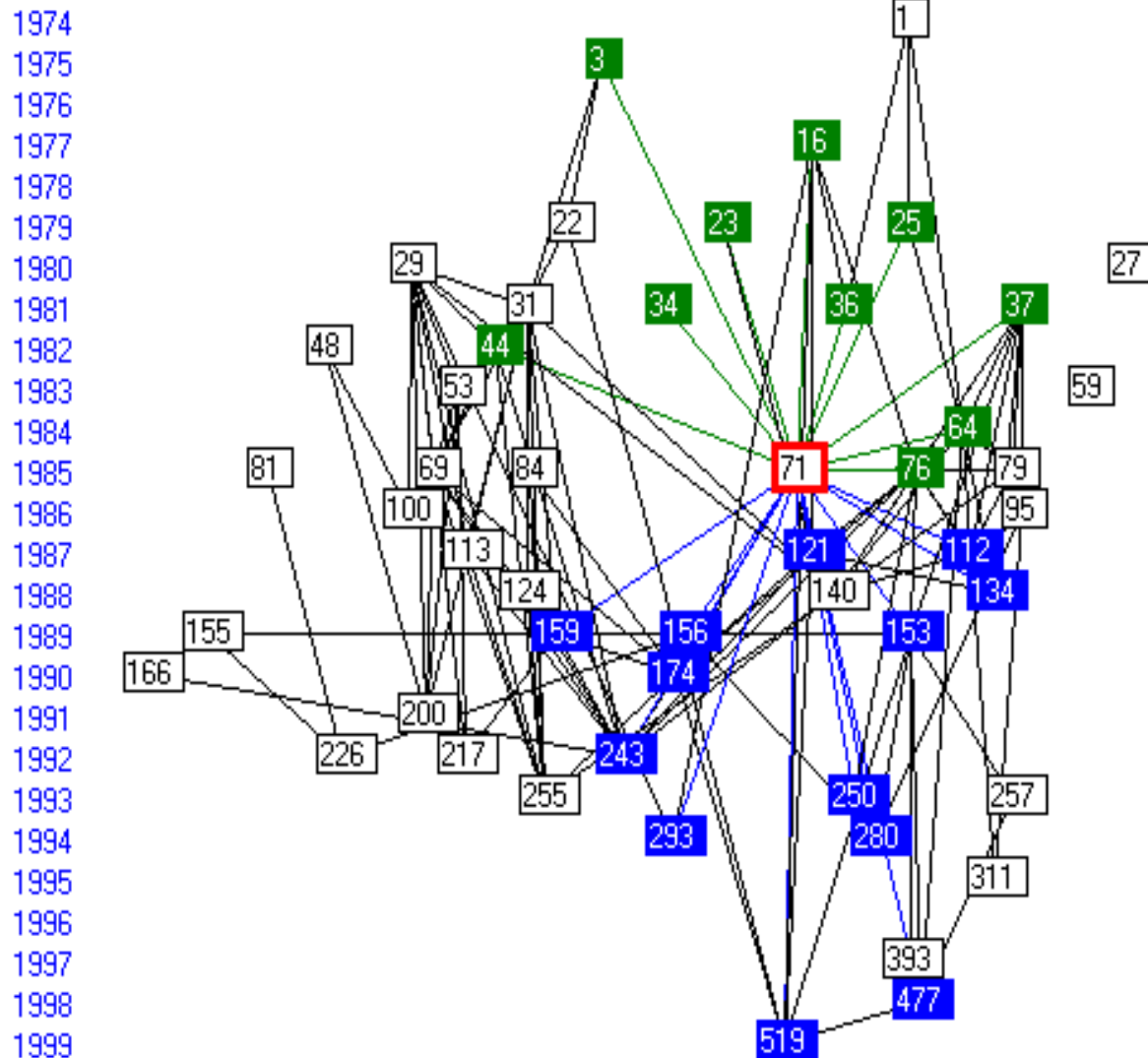


Figure 34: Gene Flow 1974 to August, 2001 in alternate format for PC use

This last figure provides yet another format. It is necessary to see this dynamically since it is possible to navigate the network by moving the cursor from node to node. In this case, node #71 is in white and the lines show links in two directions – cited and citing.

GENE FLOW: 1974 TO AUGUST 2001

50 Nodes, 138 Links. Minimal LCS = 7. Sorted by LCS



Anyone who is seriously interested in this topic should refer to

<http://garfield.library.upenn.edu/histcomp/geneflow47-02/>

where Pudovkin has compiled 3,552 references on this topic published from 1947 to 2002..

For further information on *HistCite*, see our paper on “Why Do We Need Algorithmic Historiography?” published in a special issue of the *Journal of the American Society for Information Science and Technology* on “Visualization of Scientific Paradigms.”¹⁶

Figure 35: PAPERS BY P. NICOTERA – RANKED TITLE WORDS LISTING

In conclusion, let me emphasize that *HistCite* is a work in progress. We recently added a vocabulary feature which provides an analysis of the title words used in the collection which provides clues for expanding the *WoS* search.

PAPERS BY P NICOTERA

RANKED TITLE WORDS LISTING

Words dictionary

Total No.: 586

Sorted by: **frequency**

Top 25 shown

Num	Word	raw / freq. %
1	APOPTOSIS	74 / 5.572
2	CA	33 / 2.485
3	NEURONAL	25 / 1.883
4	DEATH	24 / 1.807
5	CELL	24 / 1.807
6	ROLE	17 / 1.280
7	CELLS	17 / 1.280
8	NECROSIS	15 / 1.130
9	CALCIUM	14 / 1.054
10	ACTIVATION	12 / 0.904
11	TOXICITY	11 / 0.828
12	NITRIC	11 / 0.828
13	MECHANISMS	11 / 0.828
14	INTRACELLULAR	11 / 0.828
15	HEPATOCYTES	11 / 0.828
16	EXCITOTOXICITY	10 / 0.753
17	ATP	10 / 0.753
18	OXIDE	9 / 0.678
19	NUCLEAR	9 / 0.678
20	INDUCED	9 / 0.678
21	TRIGGERED	8 / 0.602
22	RAT	8 / 0.602
23	NO	8 / 0.602
24	NEURONS	8 / 0.602
25	MICE	8 / 0.602

Figure 36: PAPERS BY P. NICOTERA -- RANKED TITLE WORD PAIRS

Depending upon the size of the files involved, it may be more useful to view the permutations of title word pairs. This is reminiscent of the printed SCI's Permuted Subject Index. .

PAPERS BY P NICOTERA

TITLE WORD PAIRS

Word pairs dictionary

Total No.: 939

Sorted by: **frequency**

Top 25 Shown.

Num	<u>pair</u>	<u>raw / freq. %</u>
1	<u>APOPTOSIS & NEURONAL</u>	16 / 1.382
2	<u>CELL & DEATH</u>	14 / 1.209
3	<u>APOPTOSIS & NECROSIS</u>	12 / 1.036
4	<u>NITRIC & OXIDE</u>	8 / 0.691
5	<u>CEREBELLAR & GRANULE</u>	5 / 0.432
6	<u>CELL & KILLING</u>	5 / 0.432
7	<u>CA & CYTOSOLIC</u>	5 / 0.432
8	<u>APOPTOSIS & TRIGGERED</u>	5 / 0.432
9	<u>HEPATOCYTES & TOXICITY</u>	4 / 0.345
10	<u>DNA & FRAGMENTATION</u>	4 / 0.345
11	<u>CELLS & PC</u>	4 / 0.345
12	<u>CELL & NEURONAL</u>	4 / 0.345
13	<u>CA & ROLE</u>	4 / 0.345
14	<u>CA & CONCENTRATION</u>	4 / 0.345
15	<u>AUTOCRINE & EXCITOTOXICITY</u>	4 / 0.345
16	<u>APOPTOSIS & INDUCED</u>	4 / 0.345
17	<u>POLYMERASE & RIBOSE</u>	3 / 0.259
18	<u>OXIDATIVE & STRESS</u>	3 / 0.259
19	<u>NUCLEI & RAT-LIVER</u>	3 / 0.259
20	<u>NITRIC & TRIGGERED</u>	3 / 0.259
21	<u>INTRACELLULAR & ROLE</u>	3 / 0.259
22	<u>HEPATOCYTES & RAT</u>	3 / 0.259
23	<u>GRANULE & NEURONS</u>	3 / 0.259
24	<u>GLUTAMATE-INDUCED & NEURONAL</u>	3 / 0.259
25	<u>GENICULATE & NUCLEUS</u>	3 / 0.259

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