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“The *Index Catalogue* and Historical Shifts in Medical Knowledge, & Word Usage Patterns”

**ABSTRACT**

Faithful aggregated accounts of the advancement of science are invaluable for those setting scientific policy as well as scholars of the history of science. As science develops the scholarly community’s determination of the accepted knowledge undergoes shifts. Within medicine these shifts include our understanding of what can cause disease and what defines specific disease entities. Shifts in accepted medical knowledge are captured in the medical literature. The Index Catalogue of the Library of the Surgeon General’s Office, United States Army, published from 1880 -1961, is an extremely large index to medical literature. The newly digitized form of this index, referred to as the IndexCat, allows us a way to generate faithful accounts of the development of medical science during the late nineteenth- and early twentieth-centuries. My data looks at shifts within the IndexCat surrounding three disease entities: syphilis, Huntington’s chorea, and beriberi, and their interactions with two disease causation theories: germ and hereditary, from 1880-1930. Temporal changes in the prominent subject heading words and title words within the literature of these diseases and disease theories corroborate qualitative accounts of this same literature, which reports the complex and sometimes oblique process of knowledge accretion. Although preliminary, my results indicate that the IndexCat is a valuable tool for studying the development of medical knowledge.

**INTRODUCTION**

Accurate descriptions of the way in which science has developed are extremely valuable to decision makers and scholars of the history of science. So far attempts to generate accurate descriptions have not been completely successful (Fleck 1979, Law & Whittaker 1992, Zitt 1991). Zitt states that the “study of long term changes in the scientific and technological arenas poses particular theoretical and practical problems” (Zitt 1991). Historians have traditionally undertaken this task using qualitative methods. These methods provide detailed insight into a region of science; however they require extensive amounts of time, effort, and subjective interpretation. More recently bibliometricians have undertaken the task using quantitative methods that can be fast and much less subjective. However they are limited by the dataset that is employed, which until recently has contained too few records, and span of years to truly capture the development of a scientific discipline. The newly digitized IndexCat overcomes the limitations of the previous quantitative studies with its over 2 million records and their publication dates ranging from the 1400s to the 1950s. The IndexCat is an index to the Library of the Surgeon General’s Office’s collection, the largest U.S. medical library by 1895. This paper reports on research exploring the IndexCat’s viability as a tool for the quantitative analysis of the history of science.

This research is based on the idea that theory drives thinking and word usage within a topic. In this case the theories driving thinking and word usage are two disease causation theories: germ theory and hereditary theory. The topics are three specific disease entities:

syphilis, Huntington's chorea, and beriberi. These theories biased the scholarly community's perception of *what* was interesting to think about, to research, and to write about relative to these disease entities. In addition, these theories guided the scholarly community on *how* to think about these disease entities in regard to what words to use to communicate their thoughts. The following model may help visualize this point.

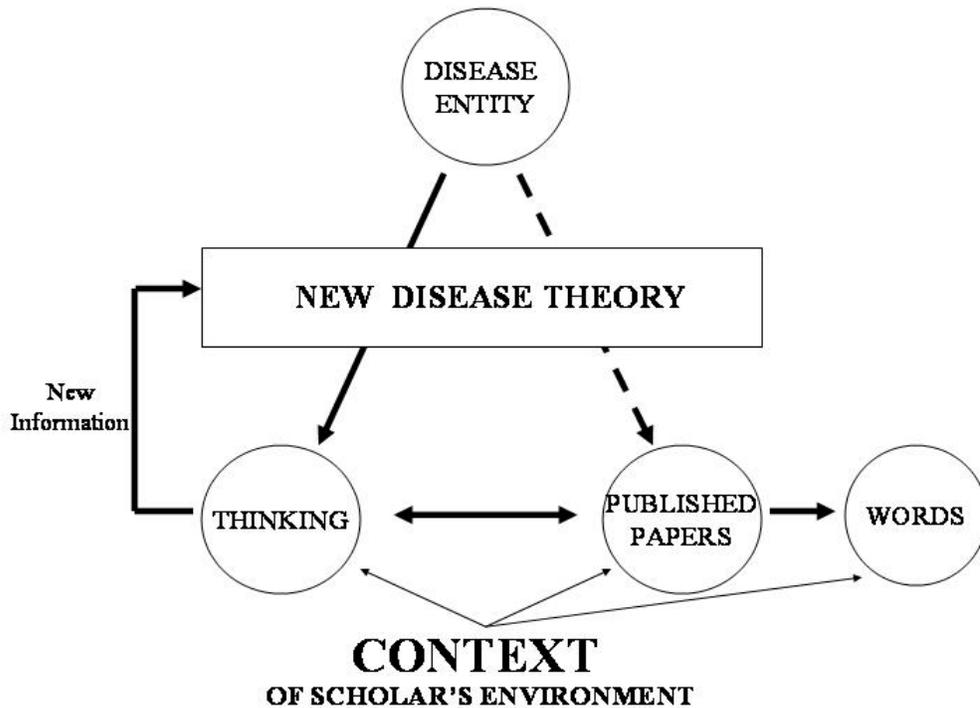


Figure 1.) Process model of theory driving thinking and word usage

On the left side of the triangle the current understanding of a disease entity, as interpreted through the lens of the available theories, directly impacts the thinking about that disease. While on the right side of the triangle the disease entity, viewed with the current theories, impacts the papers published and the words used to communicate about that disease. The bottom leg of the triangle illustrates that this thinking and writing influence each other. The thinking about the disease entity directly impacts what disease papers are written and what words are used in those papers. Conversely, the published papers directly impact what the scholarly community is thinking. This process takes place within the context of a scholar's environment and is modified with new information as scholars think about the disease entity. Keep in mind that new theories are constantly popping up and that our understanding of particular diseases is not static.

This study ties together three research questions involving IndexCat's indexed documents with publication dates of 1880-1930. The first question is: what is the change in the occurrence of our two disease causation theories? The second question is: what is the change in the co-occurrence of these theories with our three diseases? The third question is: what kinds of word patterns occur with maturing disease understanding?

The rest of this paper is organized in the following manner. Next is a discussion of the related literature and a description of the IndexCat. Then the research methods are presented. This is followed by the results and a summary.

## **RELATED WORK**

The idea that theory directs thinking and word usage within research activities draws upon Ludwik Fleck's book on the sociology of scientific facts (Fleck 1979, Coniglione 1997). Fleck argues that facts are generated under the influence of the thought styles shared among scientists. He illustrates this point by tracing the variations in the concept of syphilis from the 15<sup>th</sup> century to the 19<sup>th</sup> century as it was shaped by mystical, empirical, and etiological thought styles. Thought styles influenced how scientists understood and wrote about a topic. One could extend this idea to say that thought styles also influence the terms that indexers select to describe a topic. My work furthers Fleck's by demonstrating the influence of two medical thought styles; both different than those used by Fleck.

The second important theme of this research is the idea that word usage patterns accompany the maturation of an emerging topic. This idea draws upon F.W. Lancaster's work tracking an emerging topic across databases (Lancaster & Lee 1985) and Terrence Brooks' work on the evolving subject indexing of the AIDS literature during the 1980s (Bierbaum, Brooks & Brooks 1992). Lancaster monitored the epidemiological diffusion of "acid rain" within digital databases over a fourteen year period in the 1970s and 80s. My data reveal a growth in the emergence and use of germ theory and hereditary theory. The data also demonstrate the sprawl in thinking that occurs at the edges of thought styles and the idea that a scientific fact, as defined by Fleck, is not the result of a single experiment, but "built up from earlier knowledge, from many successful and unsuccessful experiments" (Fleck 1979: 98).

Brooks recorded patterns in the subject headings used with the emerging AIDS literature of the 1980s. As the medical community's understanding of AIDS evolved, the subject indexing reflects that evolution. Brooks' data shows a temporal shift in focus from *characterizing* AIDS to *transmitting* and *controlling* the disease and finally to *diagnosing* the disease. Similar to Brooks' work, the data presented here records word patterns associated with the evolution in understanding of syphilis from 1860-1930. The subject heading phrases associated with the syphilis literature indicate a temporal shift in focus from *characterization* to *specific manifestations* and *causes*, and lastly to *diagnosis* of the disease. The data show similar patterns in the titles of this same literature.

## **IndexCat – General characteristics:**

The IndexCat is phenomenal for its number of records, range of publication dates, international inclusiveness, and subject scope. It is the largest medical bibliographic reference tool with well over two million records. It indexes documents published from the early 1400s to the mid-1900s, written in over 40 languages, and published all over the world. The IndexCat is an index to the documents held in the Library of the Surgeon General's Office, the predecessor to the National Library of Medicine. By 1895 the library was the largest medical library in the country and its collection development policy was to collect "everything of significance ever

written on a given bioscientific topic.” (Chapman 1994: 169). Scholars consider the index one of the U.S.’s top four contributions to medicine (Rogers & Adams 1950). The IndexCat was published from 1880–1961 in five Series. Each Series has numerous volumes that each indexes a few letters of the alphabet. The first three Series were produced under a consistent set of standards and therefore this research is limited to those Series.

**IndexCat – Subject scheme:**

There are roughly fifty thousand main subject headings in the first three Series. IndexCat’s main headings were “derived from the classification used by the Royal College of Physicians of London” (Miles 1982). In 1887 the Royal College of Physicians of London had a classification system with thirty main classes encompassing scientific disciplines, named diseases, body parts, human body systems, and attributes of diseases.

The main headings are split into more specific concepts with the use of sub-entries. Within the main subject heading *Syphilis* in Series 1-3 there are 80 distinct sub-entries at the first level of hierarchy. Types of sub-entries used with the heading *Syphilis* include the concepts of body parts, signs and symptoms, phases of the disease, relationships of the disease to society, general medical characteristics, and bibliographic form. Across series there are changes in how subject headings are subdivided. These changes result from alterations in the: amount of specificity in subject analysis, accepted medical knowledge, representation of a concept, and word form or punctuation (Table 1).

Type of Change	Series 1	Series 2 and Series 3
Specificity	(Constitutional)	(Secondary); (Tertiary)
	(Treatment of) with salvarsan (“606”)	(Treatment of) with salvarsan
Knowledge	[null set]	(Blood-pressure in); (Serodiagnosis of)
Representation of concept	(Pathology and theories of)	(Causes and pathology of)
	(Communication of)	(Transmission of)
	(Treatment of) with salvarsan (“606”) [Fatal cases]	(Treatment of) with salvarsan (Death from)
Word form and punctuation	(Treatment of) with mercury [Fumigations]	(Treatment of) with mercurials -- Fumigation

Table 1.) Change in sub-entries of *Syphilis* from Series 1 to Series 3.

**METHODOLOGY**

A database of the first three Series<sup>1</sup> of the digitized IndexCat was created in Access. The data for all three research questions are the result of database queries that are grouped by the decade of the item’s publication date and limited to English language material. The queries were

constructed as a string of truncated words with a logical “or” between them. The \* symbol is a truncation mark and retrieves an unlimited number of characters. For example, the character string: *germ\**, *germ \** [Note: in the first string there is a space following the “\*” and in the second string there is a space between the “m” and the “\*”.] will search for *germs* and *germ theory*, but not for *Germans*.

The first research question utilized the title field, as opposed to the subject field, to maximize the potential for finding theory words over the whole range of publication dates in my study: from the time the theory emerged in the literature to the time of the theory’s widespread acceptance. Subject heading schemes have a lag between the time a new concept occurs in a paper and the time a new heading is created and indexes a paper.

Three separate sets of character strings were used to query for germ theory: a set that encompasses a narrow meaning of the germ theory, a set that encompasses a broad meaning of the germ theory, and an intermediate set that falls between the broad and narrow sets. The reason for using three was to test the sensitivity of this bibliometric method on a search string that a potential average researcher might select. The character strings used to query the database for the two disease causation theories are listed below (Table 2).

Query	Meaning	Specificity	Query String
Germ Theory	Narrow meaning		bacil*, bacteri*, germ *, germs *
	Intermediate meaning		bacil*, bacteri*, germ *, germs *, contagio*, infect*, inflama*, inoculat*
	Broad meaning		bacil*, bacteri*, germ *, germs *, contagio*, infect*, inflama*, inoculat*, pallida*, parasit*, spiroch*, treponema*, virus*
Hereditary Theory			hereditary*, inherit*, eugenic*, genetic*, Mendel*, genealog*, congenital*

Table 2) Title word search queries for the two theories.

The second research question involved querying the database for co-occurrences of theory words in the title fields and disease words in the subject heading fields (Table 3). Theories were searched for within the title fields, as in the first research question. Diseases were searched for within the subject heading field to maximize the potential for finding all the papers about the three diseases. Subject headings allow for the retrieval of

<sup>1</sup> Series One, composed of sixteen volumes, was published from 1880-1895. Series Two, composed of twenty-one volumes, was published from 1896-1916. Series Three, composed of ten volumes, was published from 1918-1932. all the documents about a general topic, regardless of whether the topic is specified in the document’s title. Also, the IndexCat’s subject scheme has a high level of specificity for all of the various disease entities know in the nineteenth century (Chapman 1994, Miles 1985). This specificity makes it easy to retrieve documents on syphilis and chorea; both have a long recorded history by the 1860s. They are searched with the following strings respectively: *syphilis\** and *chorea\**. Beriberi was not as well understood until later in the twentieth century and

consequently it must be searched with numerous subject headings. The search terms for beriberi include: *beriberi\**, *beri beri\**, *deficiency disease\**, *kakke\**, *neuritis (multiple\**, and *poliomyelitis (acute anterior, epiderm\**. The last two sets of character strings are added because beriberi causes a form of multiple neuritis as well as an acute anterior epidermal poliomyelitis, and therefore these headings need to be searched to retrieve all the documents on beriberi.

Query Meaning	Query String
Germ & syphilis	<b>title words:</b> bacil*, bacteri*, germ *, germs * <b>subject word:</b> syphilis*
Germ & chorea	<b>title words:</b> bacil*, bacteri*, germ *, germs * <b>subject word:</b> chorea*
Germ & beriberi	<b>title words:</b> bacil*, bacteri*, germ *, germs * <b>subject words:</b> beriberi*, beri beri*, deficiency disease*, kakke*, neuritis (multiple*, and poliomyelitis (acute anterior, epiderm*
Hereditary & syphilis	<b>title words:</b> hereditary*, inherit*, eugenic*, genetic*, Mendel*, genealog*, congenital* <b>subject word:</b> syphilis*
Hereditary & chorea	<b>title words:</b> hereditary*, inherit*, eugenic*, genetic*, Mendel*, genealog*, congenital* <b>subject word:</b> chorea*
Hereditary & beriberi	<b>title words:</b> hereditary*, inherit*, eugenic*, genetic*, Mendel*, genealog*, congenital* <b>subject words:</b> beriberi*, beri beri*, deficiency disease*, kakke*, neuritis (multiple*, and poliomyelitis (acute anterior, epiderm*

Table 3) Title word co-occurring with subject word queries for each theory with each disease.

The third research question was explored by querying the database for substantive title words, other than the theory title words used in the second research questions, occurring in records indexed with the subject word *Syphilis*. Individual title words were lemmatized, which is a normalization process that transforms adjectival forms of words into noun forms, plural nouns into singular nouns, and transforms various verb tenses into the present tense verb form. For example the title words “treating” and “treated” were lemmatized to “treatment.” Next, the words were arbitrarily limited to those ranked first to tenth within one or more publication decade. Ranking is a normalization process that transforms the irregular variations inherent in raw counts into a set of values relative to each other. Note that words with identical frequencies were assigned the same rank. Out of the remaining words, a few were selected for their subjectively determined value.

## **RESULTS**

### **Research Question One**

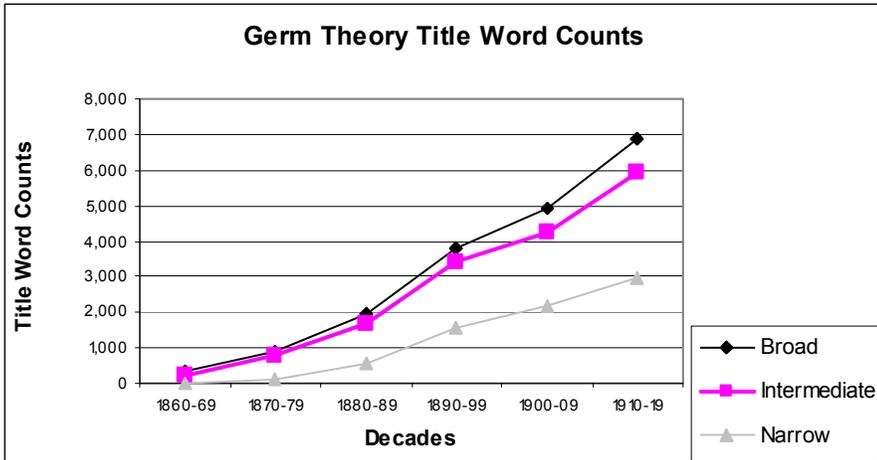


Figure 2.) Graph of germ theory title word counts.

Figure 2 demonstrates the change in the presence of germ theory title words over time. The three lines represent the three levels of inclusiveness of the three germ theory queries (Table 2). No matter which query string is used, there is strong evidence of the emerging germ theory within the IndexCat. The slope of all three lines increases after the decade of the 1870s, meaning that papers with a publication date starting in 1880 contain more germ theory title words than those with a publication date prior to 1880. This shift corresponds with the year 1878, when Robert Koch published his seminal paper on wound infection which elucidated the germ theory of disease causation (Ackerknecht 1982). Even using the narrow meaning of germ theory there is a total of over 8,000 germ title words retrieved. These germ title words suggest that over one percent of the “distinct English language” records contain germ theory title words.

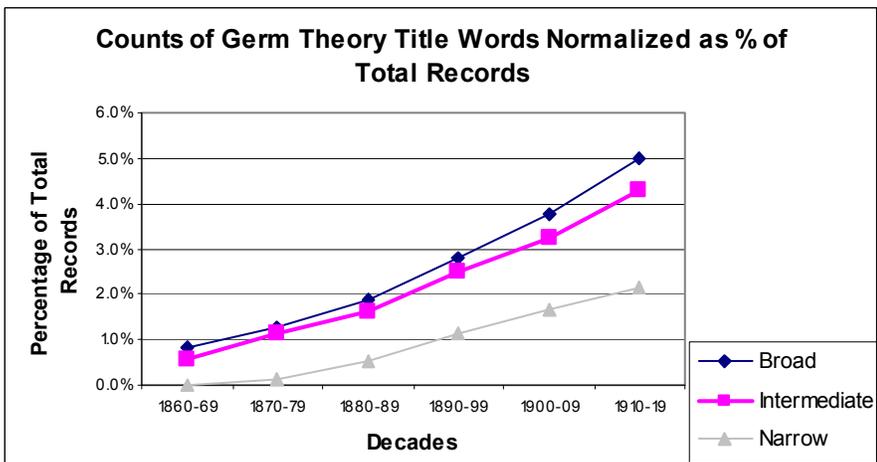


Figure 3.) Graph of germ theory title word counts normalized

Figure 3 demonstrates that the increase in germ theory title words (Fig. 2) is independent of the overall growth of the medical literature. Figure 3 takes the raw counts from Figure 2 and controls for possible variations in collection size within the IndexCat. Although the slopes of the

lines in Figure 3 are more gradual than in Figure 2 there is still a definite increase in germ theory title words after 1878 and lasting through 1919. This corroborates the literature that says the theory of germ causation gained acceptance during the late 1880s and early 1890s (Ackerknecht 1982).

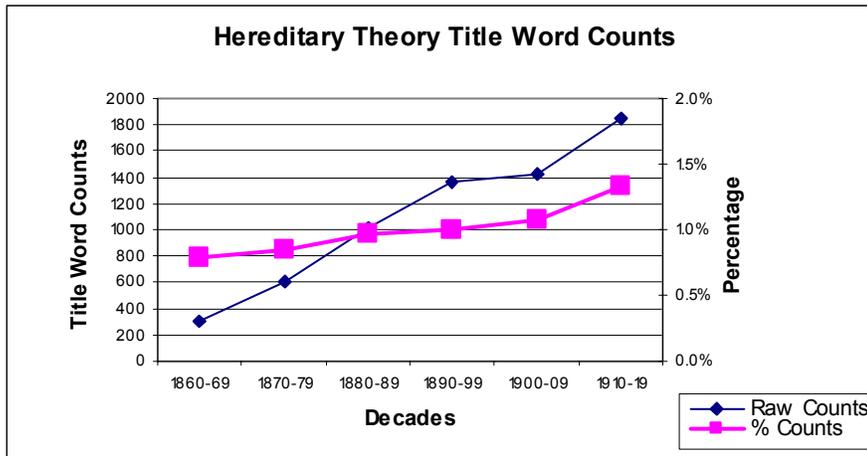


Figure 4.) Graph of hereditary theory title word counts and normalized counts

Figure 4 shows that there is evidence of the emerging hereditary theory within the IndexCat and the counts are independent of the overall growth of the literature indexed in the IndexCat. There are over 7,000 hereditary title words in the database, which represents one percent of the distinct, English language records in the database. The slope of the line in Figure 4 has a sharp peak after the decade of the 1900s, the decade when Mendel’s classic 1866 paper on genetic inheritance was rediscovered and applied to human disease by Archibald Garrod (Olby 1993, Ackerknecht 1982). This peak comes after gradually increasing counts from 1860-1919, corroborating historical accounts of this time about the interest in heredity and the relative importance of nature and nurture in human disease (Olby 1993, Waller 2002). Therefore, both of the disease theory query constructs (germ and hereditary) are evident in the titles indexed within the IndexCat. Each construct is present in over 1% of the English language titles. The chronological distribution of records within each retrieval set corresponds to the emergence times of these theories as identified by medical historians.

**Research Question Two**

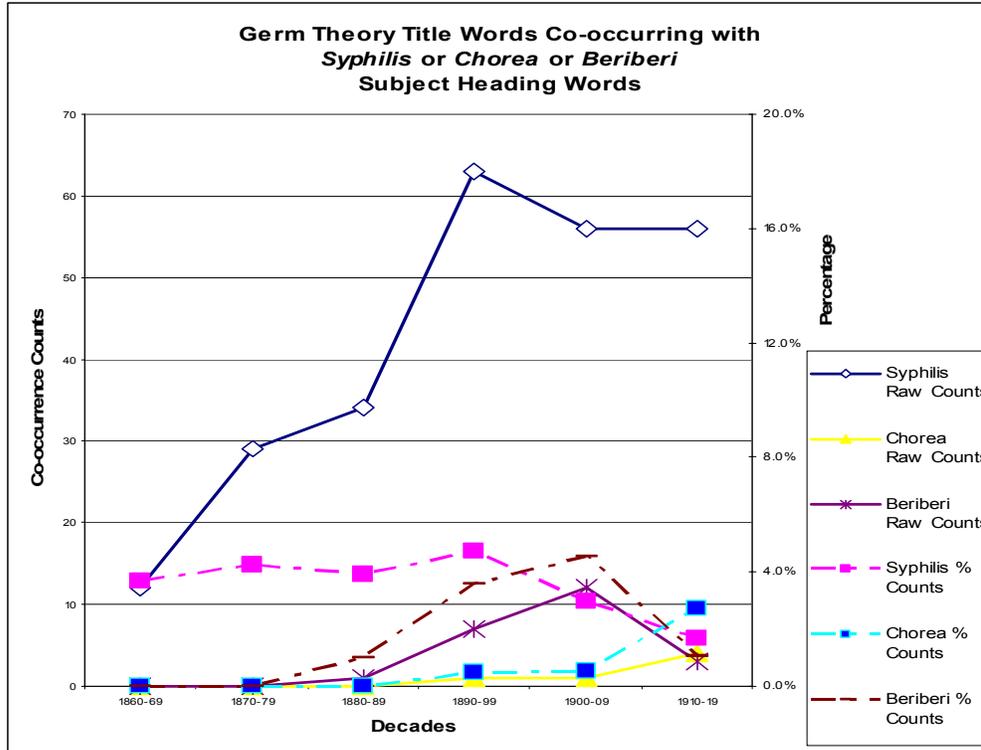


Figure 5.) Germ theory co-occurring with syphilis, chorea, and beriberi.

The Germ theory presents a messy picture of the application of a disease causation theory to three diseases: essentially not co-occurring with Huntington’s chorea, co-occurring robustly with syphilis, and co-occurring inconsistently with beriberi. Its 6 co-occurrence counts with Huntington’s chorea mark it as essentially not co-occurring with this disease (Figure 5). Germ theory’s co-occurrence with syphilis is an example of a successful use of a theory. Germ theory co-occurs robustly with syphilis, although relative to the overall counts of syphilis in the IndexCat these co-occurrences are a steady, small percentage from 1860-1929 (Figure 5).

In Figure 5 the raw counts of syphilis co-occurring with germ theory are highest in the 1890s with a value of 63, which equals 5% of all the syphilis papers for the 1890s. This rise in counts follows Koch’s 1878 classic paper on the germ theory. Although the counts of germ theory with syphilis increase over time, the total number of syphilis papers increases at an even faster rate: from 325 papers in the 1860s to 3349 papers in the 1910s. Therefore, with time, the papers with the topic of syphilis and germ theory are a smaller percentage of the total syphilis papers. The data indicate that there is a steady, low level of interest in syphilis together with germs during the time of my study. This shows the complexity of the history of medicine. On the one hand the identification of syphilis as “germ-caused” represents a break-through in theoretical understanding. On the other hand, the application of this understanding to effective treatment had to await the advent of antibiotics.

The 23 unevenly distributed counts of germ theory with beriberi is an example of theoretical sprawl associated with a powerful theory (Figure 5). The germ theory was so successful in explaining disease that there was a “gold rush” to use the theory on yet

unexplained, urgent diseases of the time, such as beriberi (Lusky 2003). Recorded accounts tell us that prior to Casimir Funk's key paper in 1912, which revealed the deficiency aspect of beriberi, scientists labored to find its germ cause (Carpenter 2000). In 1900-1909 germ theory co-occurs with beriberi with a count of 12, representing 4% of all the beriberi papers from 1900-1909. By the 1920s the counts drop off to 3, or 1%. Germ theory with beriberi occurs less frequently and is a smaller part of all the beriberi papers published in the 1920s. Perhaps the parallel drop in raw and percentage counts is indicative of the shift away from the germ theory. This is an area for further study.

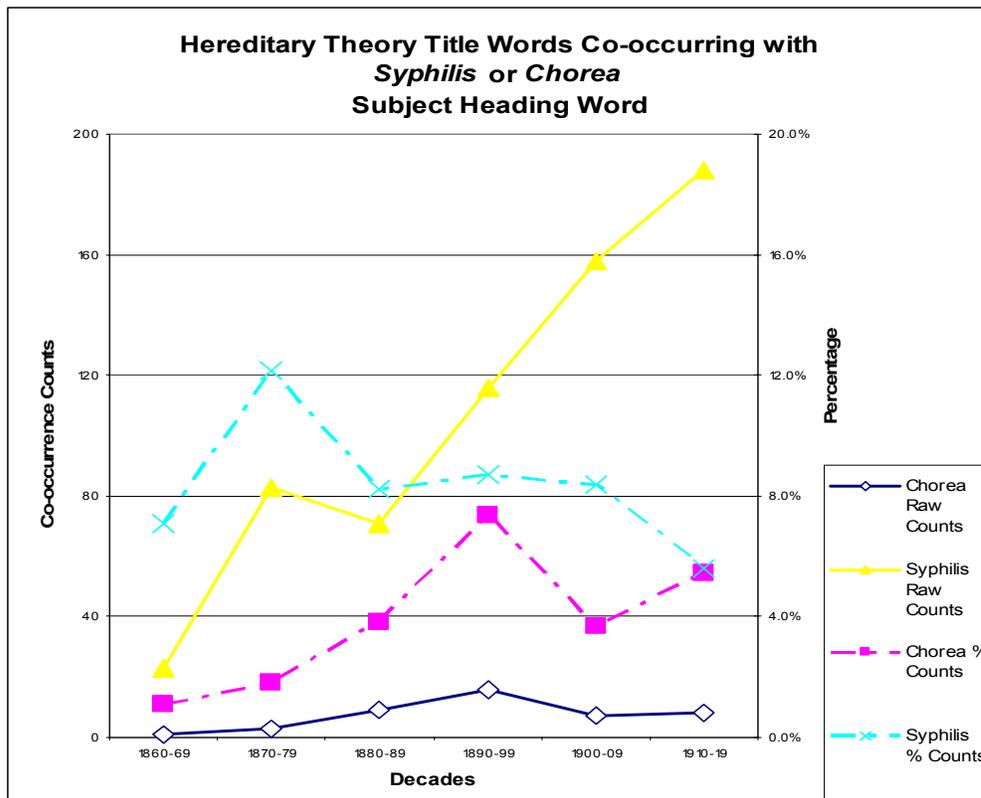


Figure 6.) Hereditary theory co-occurring with syphilis and chorea.

Hereditary theory is an example of a theory not overly delineated, but with successful applications. Hereditary theory has zero co-occurrence with beriberi, occurs successfully with Huntington's chorea, and variably with syphilis. Its successful co-occurrence with Huntington's chorea is seen in Figure 6 not only by where the raw counts peak but also by how the raw counts mimic the percentage counts. The raw counts start with a value of 1 in the 1860s, gradually peak with a count of 16 in the 1890s, and drop after that. The percentage counts are at their highest in 1890s with a value of 7%.

Chorea's co-occurrences with hereditary theory, presented in Figure 6 fits with the fact that George Huntington published his key paper on the disease in 1872 outlining the familial link in the disease. After 1899 there are fewer papers that combine the topics of chorea with hereditary theory, and the fewer papers that do exist are a smaller percentage of all the papers

published on chorea after 1899 as compared to the previous two decades. This drop could be evidence that although scientists are still quiet interested in chorea after 1899, there is a die-off of interest in hereditary theory with chorea. Alternatively, this could be a type of “obliteration by incorporation:” hereditary theory becomes so much a part of the understanding of Huntington’s chorea that it is not necessary to explicitly mention, or at least within the titles (Merton 1968).

Syphilis’s co-occurrence with hereditary theory is an example of a cross-bleeding between two theories, germ and hereditary, as they vie to explain a disease’s clinical observations (Figures 6). The percentage counts are especially informative. In the decade of the 1870s there are 83 co-occurrence counts equaling 12% of the documents. After 1878 the slopes of the two lines diverge. By the 1910s the raw counts peak at 188 and percentage counts drop to a low of 6%. Although in the 1910s the two topics co-occur more frequently, these co-occurrences are a smaller percentage of the total papers as compared to the previous five decades.

Figure 6 supports the idea that, from 1860-1919, there is a shift in understanding in the role of heredity with syphilis. Because of existing historical accounts (Olby 1993, Quetel 1990, Waller 2002) we know that around the turn of the century there was a lot of confusion between the congenital and hereditary aspects of disease in general and with syphilis in particular. Armed with this knowledge we could interpret the downward turning line of percentage counts in Figure 6 as a reflection of the unsuccessful application of hereditary theory to syphilis.

Diminution of values in these graphs does not absolutely show either an accepted theory or a rejected theory. The simultaneous drop in both lines within the graph of hereditary theory co-occurring with chorea hints at the incorporation of the theory into the then accepted understanding of the disease. This pattern is in strong contrast to the trajectory of the two lines plotting the co-occurrence of hereditary theory with syphilis. Perhaps the falling line of percentage counts in consideration with the rising line of raw counts indicates that over time the hereditary theory takes up a smaller part of the syphilis literature and is less accepted as an explanation of the disease. However, conclusions on theory acceptance or rejection require the historian to perform more detailed analysis of the situation. My research simply raises the possibility that there are different patterns that can guide the historian. Further research is needed.

**Research Question Three**

SERIES	CATEGORY	HIGH RANKING	Ser 1	Ser 2	Ser 3
		SUB-ENTRY WORDS	RANK	RANK	RANK
One	Characterization	<b>Cases and statistics of</b>	8	*	*
		<b>Communication of#</b>	3	@	@
		<b>Complications and sequelae of#</b>	5	19	7
		<b>Publications in and subsequent#</b>	4	46	@
Two	Causative agents, or Manifestations, or	<b>Extragenital chancres in</b>	@	7	@
		<b>Eye in</b>	*	9	23

	Transmission	<b>Manifestations#</b>	@	6	12
		<b>Parasite of#</b>	*	4	6
		<b>Tertiary#</b>	7	5	10
		<b>Transmission of#</b>	@	8	18
Three	Diagnosis, or Experimental	<b>Diagnosis#</b>	10	11	5
		<b>Experimental#</b>	*	12	8
		<b>Primary#</b>	6	*	4
		<b>Serodiagnosis of#</b>	@	3	2

Table 4.) Prominent subject sub-entries used with Syphilis. \* = not used with syphilis in this Series. "@" = not used with any heading in this Series. Series 1 was published from 1880-1895, Series 2 from 1896-1916, and Series 3 from 1817-1932.

YEARS	CATEGORY	TITLE WORDS	HIGH RANKING							
			1850s	1860s	1870s	1880s	1890s	1900s	1910s	1920s
1850-79	Characterization	<b>congenital</b>	*	17	5	9	17	14	21	13
		<b>disease</b>	2	2	2	3	6	9	22	41
		<b>hereditar#</b>	12	5	4	6	7	5	34	47
		<b>mercury</b>	7	4	12	13	9	6	23	17
1880-99	Manifestations, or Site of infection	<b>brain</b>	14	16	9	4	4	10	14	43
		<b>chancr#</b>	*	14	20	5	3	8	38	40
		<b>gumma</b>	*	*	11	7	5	7	32	50
1900-29	Diagnosis, or  The germ, or Research	<b>diagnos#</b>	14	13	27	13	13	4	7	9
		<b>pallida# / spirochaeta# / treponema#</b>	*	*	*	*	*	3	11	11
		<b>reaction</b>	*	*	*	*	*	26	6	3
		<b>salvarsan</b>	*	*	*	*	*	*	3	38
		<b>study</b>	*	*	28	30	41	37	2	6
		<b>test</b>	*	*	*	*	*	40	10	5
		<b>wassermann</b>	*	*	*	*	*	30	5	4

Table 5.) Prominent title words used with Syphilis. \* = not used with syphilis in this Series

Table 4 demonstrates a shift in subject indexing associated with the syphilis literature. Series One has more headings having to do with general *characterizations* of the disease, Series Two has more headings on the specific *manifestations* and *transmission* of the disease, and Series Three has more headings relating to *diagnosis* and *experiments* with the disease. Table 5 displays a shift in the title words used with the syphilis literature from 1860-1929 revealing a similar pattern. From 1860-1879 there are more title words having to do with general *characterizations* of the disease, 1880-1899 has more titles on specific *manifestations* of the disease, and 1900-1929 have more words relating to *diagnosis* and *research* on the disease. This pattern is not too different from what Brooks found with the indexing of the AIDS literature in the 1980s. These word patterns inform us about what was of concern to the medical community relative to syphilis from 1860-1929 and hint that there are repeatable patterns of word usage associated with the maturation of disease understanding. More research could help inform this discussion.

## **SUMMARY**

The newly digitized IndexCat provides many new and exciting opportunities for research. Its total number of documents indexed, span of decades represented in the publication dates of the indexed documents, international inclusiveness, and breadth of subject indexing far exceeds any other medical bibliographic tool. The work presented here found the IndexCat to be a viable dataset for bibliometric research. This bibliometric analysis of the co-occurrence of subject heading words and title words within the IndexCat demonstrate the associations among the developing theories of disease causation and the developing understandings of specific diseases. These associations reflect current historical accounts of the research on specific diseases. The IndexCat facilitates meaningful bibliographic analysis of historical, medical literature; enhances existing historical accounts; and allows for a wider view of medical history not easily available previously.

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