

Dissemination and Retrieval of Information in Microbiology
and Chemotherapy by Citation Indexing*

by

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A citation index is an organized collection of the linkages that have been established in the literature between past, present or even future papers. These linkages are historical and bibliographic relationships expressed by reference citations. The Science Citation Index (SCI) shows where any specific publication has been cited by subsequent papers. It enables the scientist to explore the pathways between these related elements of evolving knowledge. He may begin his exploration by entering the system at any known event he chooses, whether by familiarity or by accidental discovery. For example, if a microbiologist were to enter the SCI system with Darling's classical 1906 paper on pseudotubercles in the lungs, (1) or DeMonbreun's 1934 paper concerning "The Cultivation and Cultural Characteristics of Darling's Histoplasma Capsulatum," (2) he would be led to a September 1965 paper by Sturim, Kouchoukos, and Ahlvin on "Gastrointestinal Manifestations of Disseminated Histoplasmosis" (3) or to other papers on various aspects of this subject, including treatment.

Consider another example. Many of you will recall the meningitis outbreak which occurred in California at Fort Ord. Mass sulfadiazine prophylaxis failed to stem the outbreak of meningococcal meningitis among recruits.

The concept of sulfonamide prophylaxis in a recruit camp environment began with the work by D. M. Kuhns et al. reported in the Journal of the American Medical Association in 1943. (4)

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However, to find the most recent opinion on this preventive therapy, one simply checks the 1965 SCI and finds a study by J. R. Gauld, et al. (5) on the "Epidemiology of Meningococcal Meningitis at Fort Ord" in the American Journal of Epidemiology. This paper studies the Fort Ord population and contains the statement that mass prophylaxis with sulfadiazine is contra-indicated as long as resistant strains of meningococcus are present. This recent work virtually reverses the original Kuhns' philosophy which is still being taught in medical schools today.

The difficulties in using classical descriptor techniques in indexing microbiological papers is particularly noticeable. The semantic and nomenclature problems of a rapidly evolving topic are almost impossible to deal with by descriptor systems even if expense is not considered. For example, a typical one word entry such as "amphotericin" or a group of words such as "Studies on the Use of Amphotericin-B and Related Compounds in the Treatment of Clinical Mycoses" may be inadequate for a particular search. Additional descriptors such as "blastomycoses" might be more helpful and specific.

However, using additional descriptors involves financial and semantic problems which severely limit such detailed word indexing. More important--a new compound may be as yet unestablished and thus provide no subject heading under which to search. However, even a paper containing an unnamed or unidentified natural substance can be indexed by bibliographic citations because they reflect the total body of knowledge or concepts which it embraces.

If the microbiologist begins with one old reference which holds his interest, he will be led by citation indexing to all subsequent articles, letters, etc., which cite this single work. The citation index leads him to information which may not be found under the "expected" headings in conventional subject indexes.

Consider another example. A microbiologist interested in streptomycin resistance may begin with several references on this subject. If he began with the work by Miller and Bohnhoff (6) on "Two Streptomycin-Resistant Variants of *Meningococcus*" in the Journal of Bacteriology, or that of H. B. Newcombe (7) "A Comparison of Spontaneous and Induced Mutations of *Escherichia coli* to Streptomycin-Resistance and Dependence" Journal of Cellular and Comparative Physiology, he would be led to work by S. Lie (8) which contains "Studies on the Streptomycin Resistance System of *Neisseria meningitidis*" in the Acta Pathologica et Microbiologica Scandinavica. In this study, the mutation characteristic of streptomycin resistance in meningococci and *E. coli* is compared. Transformation is investigated through the preparation of bacterial DNA by Marmur's procedure for the isolation of DNA from micro-organisms (9). For anyone interested in material on the use of this technique, there are over 200 such papers listed in the SCI for 1964 and 1965 alone. If this sounds trivial, I suggest you attempt a similar search by conventional methods. I might add that in our ASCA*system, all such papers which are turned up are further "qualified" by showing which other profile papers are cited.

Many papers on a subject important to the microbiologist appear in journals outside the scope of the biological indexes, such as Biological Abstracts. Methods of establishing standardized animal assays of typhoid vaccine have been investigated for years. If we begin with one test, the bacteremia test of Lipp and Ihm, reported (10) in 1958, the SCI leads to an article by J. Spaun and K. Uemura in the Bulletin of the World Health Organization for 1964 (11) which notes progress on an international collaborative study on this subject. This study points out, inter alia, that none of the assay procedures available in animals reflect the potency of typhoid vaccine in man.

The use of new clinical agents follows a predictive course which allows the SCI to be used to outstanding advantage when following the progress of new agents.

Papers could appear in this sequence:

Category

1. Synthesis or isolation
2. Antibiotic screening and Sensitivity Studies
3. Animal Studies including toxicity and experimental infection
4. Initial human pharmacological studies or human experimental use
5. Initial clinical trials
6. Widespread clinical use
7. Reports of common side effects and rare toxic manifestations
8. New clinical indications

Classically, papers in category No. 2 will cite No. 1, and Nos. 3-5 will commonly cite prior papers in the sequence. Citation of all earlier papers may be less common in the Nos. 6-8 series, although they will commonly cite papers in a similar category. For example, reports on agranulocytosis due to an antibiotic (No. 7) may cite earlier clinical reports of toxic manifestations (No. 7) or animal studies on toxicity (No. 3).

To follow an antibiotic agent prior to the time it is known in the literature under an established subject heading is rather difficult, due to the vagaries of conventional subject indexing. With citation indexing, one uses an unambiguous citation to identify the "subject matter" for each specific category shown above according to the type of information desired at the moment.

Let's trace the sequence of events for candididin, an antifungal antibiotic derived from a strain of Streptomyces griseus at Rutgers by Lechevalier, Waksman and others in 1953. It has had little clinical use.

H. Lechevalier et al. (12) reported the first synthesis and isolation of candicidin in 1953. They also discussed screening and sensitivity studies. This work was subsequently cited by A. M. Kligman and P. S. Lewis when reporting on "In vitro and in vivo Activity of Candicidin on Pathogenic Fungi" that same year in Proceedings of the Society for Experimental Biology and Medicine (13). Both the paper by Lechevalier and the one by Kligman and Lewis were subsequently cited by J. L. Fox in 1955, who reported the first clinical use of candicidin.

Fox used the compound in a case of monilial (*Candida albicans*) vulvovaginitis. He successfully treated the case over several months. This disease is common, may be chronic and without symptoms except for discharge. It may disappear spontaneously; however, in this case Fox felt that candicidin was active against this acute irritating episode. Subsequent cultures were negative.

All three of the previously cited papers were subsequently cited by L. A. Dick in another clinical evaluation of candicidin (15) done ten years later. According to the author, this is the first paper concerning the use of candicidin as a topical antimonilial agent, a point which is not at all self-evident from the title of this paper. Eighty per cent of the patients treated were either cured or showed excellent results.

The choice of starting references is most generally made by the scientist. A logical jumping off point is his own published work or that of related investigators. It is presumed that the investigator has in his files or in his memory such starting points.

For instance, a veterinary scientist newly interested in coccidiosis, a protozoan disease causing contagious enteritis in penned animals, especially chickens, may recall a March 1949 symposium on coccidiosis at the New York Academy of Science. By using one or more of the papers in that published symposium, he can determine more recent developments reported 15 years afterwards. For example, the paper by A. O. Foster on "The economic losses due to coccidiosis" (16) is cited by D. L. Pearson et al. in a paper on "Trials of Candidate Bovine Coccidiostats: Efficacy

of Amprolium, Lincomycin, Sulfamethazine, Chloroquine Sulfate and Di-Phenthane-70" in the American Journal of Veterinary Research (17) in 1965.

When there is no choice of a starting reference, a textbook can be consulted. The same veterinarian could, for instance, be concerned with the problem of Staphylococcic mastitis, an infection and abscess of the breast in dairy cattle, which is resistant to antibiotics and which usually requires surgery with drainage or commonly, amputation. With no knowledge of a specific paper on the subject, he might consult Blood and Henderson's Veterinary Medicine, 1963 (18).

In this text he is informed that antibiotics are ineffective, that strain-specific vaccines are impractical, but that bacterin vaccines from whole staphylococcic cells and their toxoids offer promise.

The name Slanetz appears in the bibliography of the appropriate section of the book. In the SCI, the works by Slanetz are cited, but not the specific reference mentioned in the text. However, the works cited embrace the same time period. Indeed, a 1965 up-to-date source, by Slanetz himself, is found entitled: "Evaluation of Cell-Toxoid Vaccines for the Vaccination of Dairy Cattle Against Staphylococcic Mastitis." (19) This current 1965 work cites two of Slanetz' earlier papers from 1959 and 1963, as well as three papers by other authors.

These examples can be matched by dozens of others. The most important added information I can provide is simply to say that the same principles apply in the ASCA system and can be used in a dramatic and effective way to keep individuals constantly up-dated on subjects of current interest. A personalized profile of questions entered into ASCA results in weekly computer reports which describe those current works most likely to be related to the subject of interest. A wide variety of different types of questions are available with ASCA which provide complementary criteria for systematically selecting pertinent material.

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EPIDEMIOLOGY OF MENINGOCOCCAL MENINGITIS
AT FORT ORD

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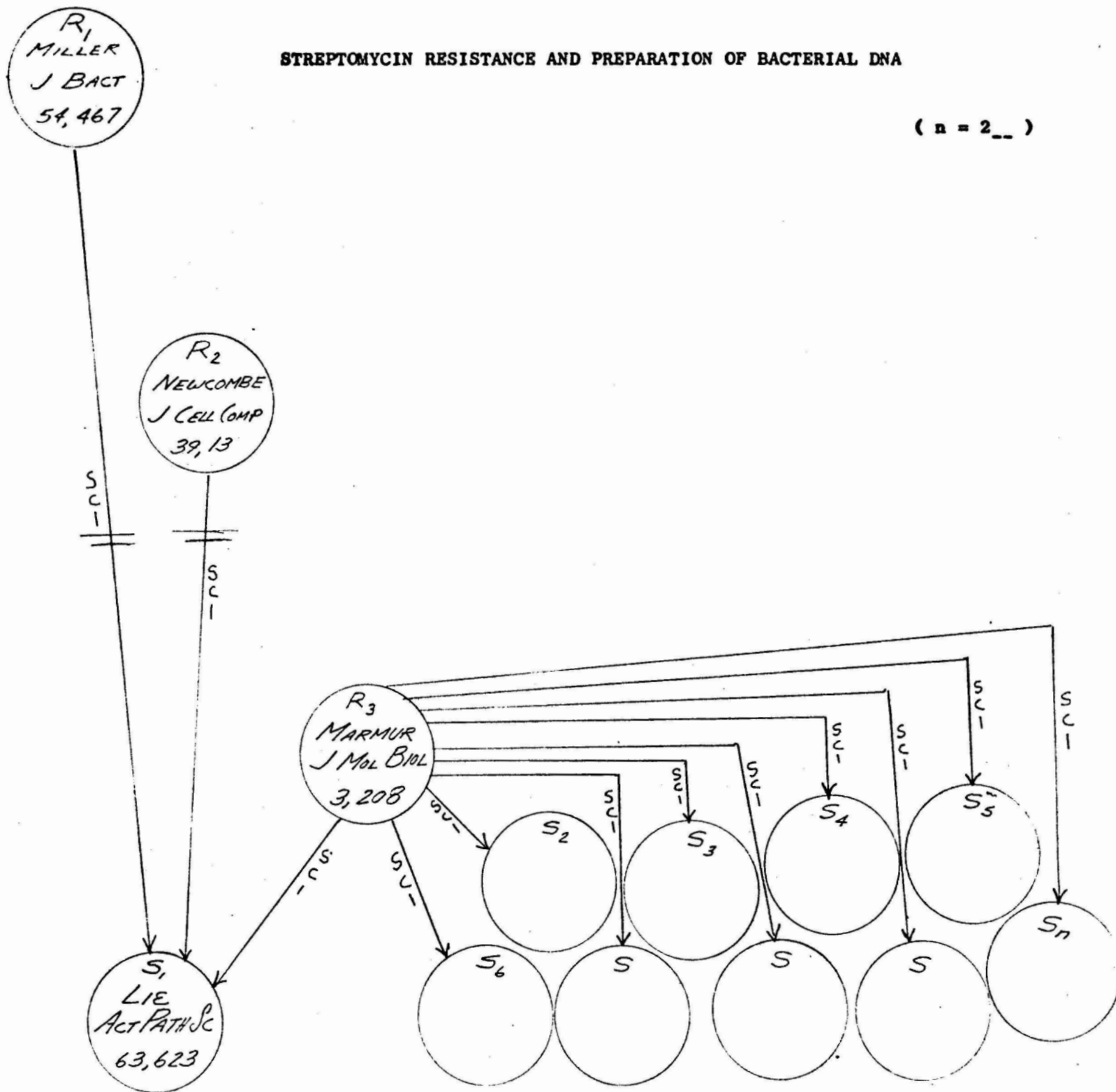
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STREPTOMYCIN RESISTANCE AND PREPARATION OF BACTERIAL DNA

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A Report on International Collaborative Laboratory Studies

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