

**CHARACTERISTICS AND AVAILABILITY OF JOURNAL LITERATURE
USED BY BIOMEDICAL RESEARCHERS IN SOUTH AFRICA**



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**Dissertation presented for the degree of Doctor of Philosophy
at the University of Stellenbosch**

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December 1991

Declaration

I the undersigned hereby declare that the work contained in this dissertation is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

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ABSTRACT

The management of especially academic libraries need to justify the expenditure on staff, equipment and materials to the top management at universities which are in the throes of economically stringent times. Document delivery is seen as one of the core functions an academic information service performs and thus an appropriate target for objective assessment. The present project focuses on the document delivery capability of the academic medical libraries in South Africa. A dual research protocol is employed. Firstly the characteristics of the journal literature used by the South African biomedical researchers are analysed and described. The availability of these publications are subsequently investigated. The journal articles published in 1989 by the target group provides the source data for the project. These articles, augmented by a representative sample of the references cited, are analysed according to established bibliometric criteria. The resulting description of characteristics is significant in its comparability with similar international studies. Subsequently, an empirical document delivery test is conducted at all seven the academic medical libraries in South Africa to establish the availability quotient of the identified journal citations. A hypothetical national average is also calculated. A high availability rate was found at all the test libraries. Academic libraries are at present forced to cancel journal subscriptions. It is crucially important that such cancellations should be handled on a rational basis thereby limiting the damage to what is collectively considered a national asset. This is only possible through national cooperation under the auspices of the CUP. This study was intended as an indicator of the current state of availability of biomedical journal literature in South Africa. It is recommended that the same methodology be used for follow-up studies to control these results and to monitor future availability trends.

OPSOMMING

Die bestuur van veral akademiese biblioteke is onder toenemende druk om die hoë bedryfskoste van inligtingsdienste aan hul topbestuur te regverdig. Die evaluering van dienste word dus 'n prioriteit. Dokumentlewering word gesien as een van die kernfunksies wat 'n akademiese inligtingsdiens verrig. Dit is terselfdertyd baie geskik vir objektiewe meting. In hierdie projek word spesifiek ondersoek ingestel na die aard en beskikbaarheid van die tydskriflektuur wat deur biomediese navorsers in Suid-Afrika gebruik word. Dit geskied deur 'n tweerlei navorsingsprotokol. Enersyds word die eienskappe van die tydskriflektuur wat deur Suid-Afrikaanse biomediese navorsers gebruik word ontleed en beskryf, andersyds word die beskikbaarheid van hierdie publikasies ondersoek. Die tydskrifartikels wat in 1989 deur die teikengroep gepubliseer is, word as uitgangspunt gebruik. Hierdie artikels asook 'n verteenwoordigende monster van die verwysings daarin vermeld, word volgens aanvaarde bibliometriese kriteria ontleed. Die beskrywing van die eienskappe van hierdie publikasies is insiggewend in die vergelykbaarheid daarvan met soortgelyke internasionale studies. Vervolgens word die beskikbaarheidskwosient van biomediese navorsingstydskrifte by al sewe Suid-Afrikaanse akademiese mediese biblioteke bepaal en 'n hipotetiese nasionale gemiddelde word bereken. Die beskikbaarheidsvlak van die items is hoog by al die mediese biblioteke waar die empiriese dokumentleweringstoets afgelê is. Akademiese biblioteke word genoep om tydskrifte weens geldtekort te kanselleer. Dit kan hierdie gunstige toedrag van sake nadelig beïnvloed. Dit is dus gebiedend noodsaaklik dat die skade aan die nasionale voorraad beperk word deur die rasionalisering van tydskrifvoorraad. Dit kan alleen geskied deur onderlinge samewerking tussen veral die mediese biblioteke, onder leiding van die KUH. 'n Oogmerk van hierdie studie was om as indikator van die huidige beskikbaarheid van biomediese joernale in Suid-Afrika te dien. Opvolgstudies met dieselfde metodologie is wenslik om die resultate te kontroleer en verdere neigings ten opsigte van die beskikbaarheid van biomediese navorsingsjoernale te monitor.

ACKNOWLEDGEMENTS

I am indebted to the following :

- * My supervisor, Dr SF Rossouw, Group Executive: Information of the Medical Research Council, for his invaluable assistance, constructive criticism and encouragement;
- * Prof PGJ Overduin, Head of the Department of Library and Information Science of the University of Stellenbosch;
- * Dr T van W Kotze, of the MRC Institute of Biostatistics, who was responsible for the SAS computation and assistance with the interpretation of the statistical analysis of the results;
- * Mrs H Groenewald, of the MRC Institute for Biomedical Communication for graphic work;
- * The Medical Research Council Information Group for research support in the form of literature searches, access to the SAMED database, assistance with graphic work, computation, statistical analysis;
- * The University of Stellenbosch for substantial research funds, especially from the *Harry Crossley Fund*;
- * The University of Cape Town for additional research funds and special study leave;
- * My colleagues at the libraries of the University of Cape Town, University of Stellenbosch, as well as at all the medical libraries I visited for assistance and support;
- * Mr S Coetzer for the physical production of the manuscript.

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LIST OF ABBREVIATIONS

BA	: Biological Abstracts
BIOSIS	: Biological Sciences Information Service
CA	: Chemical Abstracts
CAS	: Chemical Abstracting Service
CASLINE	: Chemical Abstracts Online
CI	: Capability Index
DDT	: Document Delivery Test
EM	: Excerpta Medica
EMBASE	: Online version of Excerpta Medica
IBC	: Institute for Biomedical Communication
IM	: Index Medicus
ISI	: Institute for Scientific Information
LISA	: Library and Information Science Abstracts
MASA	: Medical Association of Southern Africa
MEDLINE	: Online Index Medicus
MRC	: Medical Research Council
PISAL	: Periodicals in Southern African Libraries
RSA	: Republic of South Africa
SA	: South Africa
SABINET	: South African Bibliographical Information Network
SAS	: Statistical Application Software
SCI	: Science Citation Index
SCISEARCH	: Online version of Science Citation Index
SSCI	: Social Sciences Citation Index
UK	: United Kingdom
USA	: United States of America

1 INTRODUCTION

1.1 Statement of the problem

1.2 Research objectives

1.3 Research methodology

1.3.1 Literature search

1.3.2 Citation analysis

1.3.3 Evaluation of document delivery

1.3.4 Gathering of the data

1.3.5 Data management

1.3.6 Interpretation of the data

1.4 Conclusion

1.5 Glossary

1 INTRODUCTION

Biomedical research in South Africa

South Africa is considered the most prominent African country in medical research and within some specialized fields, even among the leaders in the world (Rossouw, 1979). Indeed, according to Sunter (1985, *cited by Prozesky, 1990*), medical research is the only subject area in which South Africa can claim First World status.

Institutionalized medical research in South Africa goes back to 1908 when the Onderstepoort Veterinary Research Institute was founded. In 1912, the SA Institute for Medical Research was established as a result of the need for research in the mining industry. The Council for Scientific and Industrial Research (CSIR) which came into being in 1946, provided for medical research through the *Committee for Research into Medical Sciences*. The most significant event for the promotion of medical research in South Africa was the establishment by an Act of Parliament of the South African Medical Research Council (MRC) in 1969.

The MRC's main task is to improve the health of the population of South Africa by scientific research. The first two goals in the mission statement of the MRC clearly formulate their responsibility and aims regarding research:

...MRC strives towards

- * an initiating, guiding and coordinating role in the area of biomedical research
- * the determination of research priorities on a continuous basis and the optimal allocation of resources

The MRC has two main research programmes. The first concerns joint research and the second institute research. Joint research is carried out in partnership with universities and other medically related institutions. Joint efforts take the form of project research, whereby individual researchers are given grants for a three year period per project, or of research units which undertake research programmes of longer duration. In 1987 the MRC supported 179 researchers and 29 research units. Currently (1991) the MRC supports 490 projects and 29 research units (Palan, 1991). Secondly, institute or own research is carried out by the staff of the various institutes within the MRC. These research projects address long-term, extensive research needs of national importance.

The medical faculties augment the MRC's top quality research manpower (Medical Research Council, 1991). This is clearly illustrated in the 1991 distribution of research workers in receipt of MRC funding to joint research (Fig 1.1).

The first South African Faculty of Medicine was founded at the University of Cape Town in 1912. The need for trained medical personnel grew and in response there are now seven faculties in RSA (excluding Transkei), given in the order of establishment dates :

University of Cape Town - 1912

University of the Witwatersrand (Johannesburg) - 1922

University of Pretoria - 1943

University of Natal (Durban) - 1951

University of Stellenbosch (Tygerberg) - 1957

University of the Orange Free State (Bloemfontein) - 1971

Medunsa (Medical University of SA, outside Pretoria) - 1980

A relatively small portion of the national budget is allocated to research in general. Medical research maintains a prominent position in the national research profile of South Africa. Funds for medical research comes from the MRC, the universities, private and public foundations and industry.

One of the quantitative methods of measuring research activity in a region or discipline is by counting the number of scientific publications in the period under review. An international investigation considered publications located in the *Science Citation Index* database during the five years 1976 to 1981, as the national 'output' of the 32 different countries identified in their study. These publications were allocated to the country stated in the first author's address or institutional affiliation. Each article was categorized according to subject (Braun, Glänzel & Schubert, 1985). In the case of South Africa, the number of papers of clinical and biomedical research represented half of all research publications that emanated from the country (Fig 1.2).

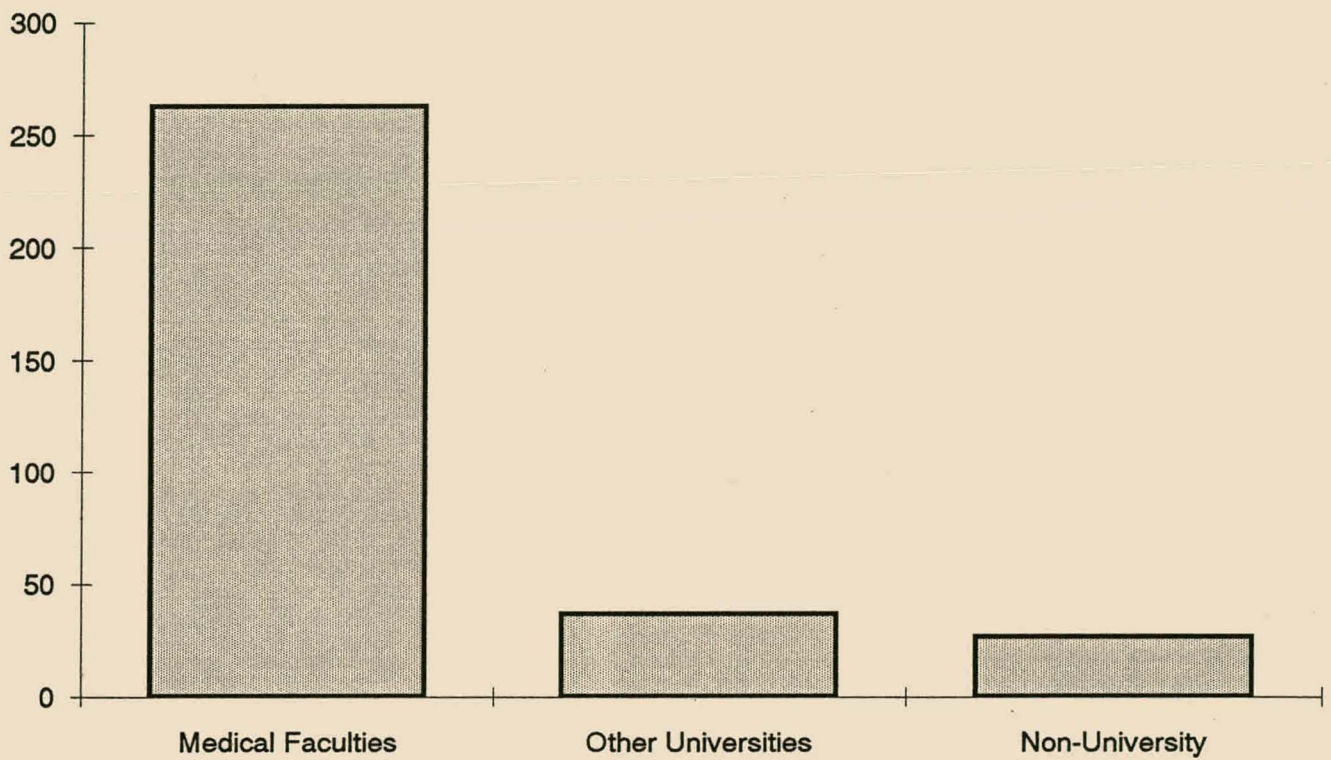


Fig 1.1

*Distribution of biomedical research workers according to institution
(excluding full-time MRC staff at own institutes)*

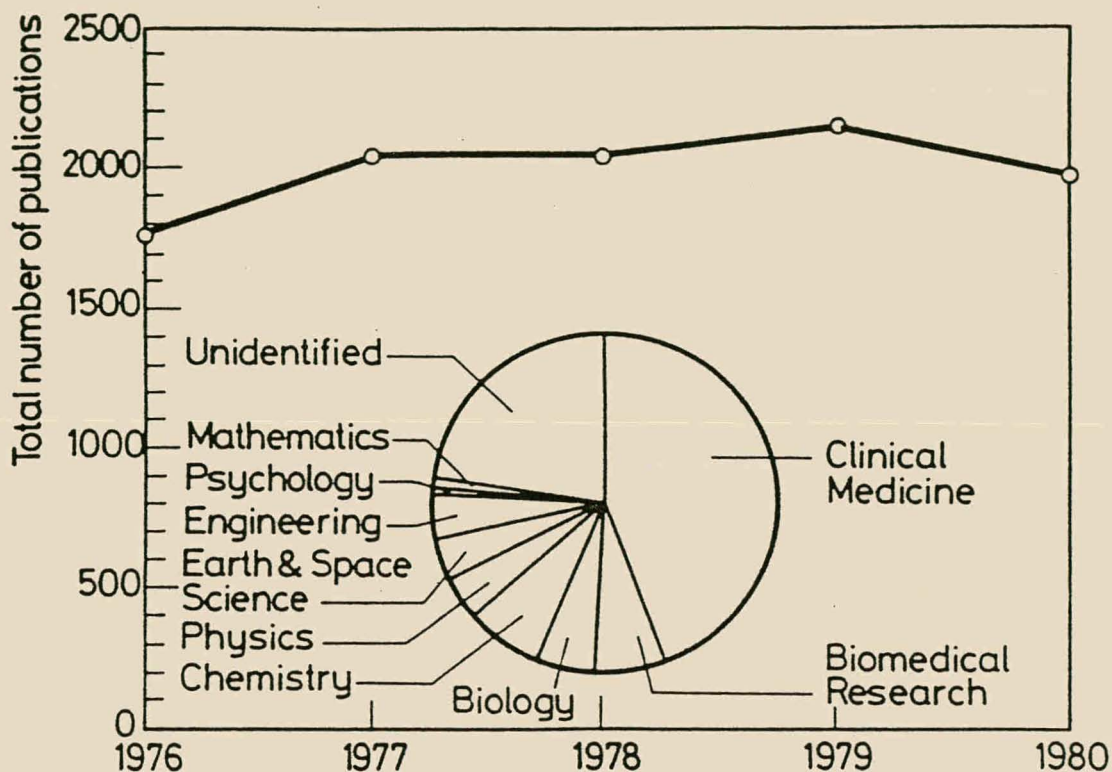


Fig 1.2 *Analysis of articles published internationally by South African researchers according to subject area (1976 - 1980)*

Source: Braun, et al., 1985

Biomedical research communication in South Africa

Medical researchers in this country are, in addition to clinical research and community health issues, also concerned with basic medical problems which have a universal application. The results of their studies appear in scientific journals of the highest repute and few international congresses are without participants from this country (Beighton, 1978).

Masson (1969, 1970a, 1970b) undertook a comprehensive survey of the generation, communication and use of scientific information in South Africa. In the course of the investigation particulars of the then 3 000 strong scientific research community were generated by age, gender, discipline, qualification and employment (Masson, 1969). In that survey, medical research workers numbered 114. The medical group earned substantially more than those in other fields; they were in possession of higher qualifications and had the highest median age (39), some five years older than the national average for a scientist.

The results of Masson's survey of research activity showed that medical research workers were by far the most prolific authors of the South African scientists studied. The group of 114 included 13 individuals (9%), who each claimed 40 or more publications in foreign journals. They had the highest average number of papers per scientist as well as the lowest number of "non-publishers". Medical researchers favoured publication in overseas journals, although publishing more papers in local journals than representatives from the other disciplines.

In 1988 there were 140 "Medical scientists" amongst all the persons registered in health and supplementary services (South Africa. Central Statistical Services, 1990). The criterion for inclusion in this category is not provided. In addition, a figure of 20 947 is given for "Medical practitioners (including specialists)", as well as 5 960 "Specialists (medical)" - it is not clear whether the latter figure is the "(including specialists)" portion referred to in the first category or not. The statistic is thus regarded with an element of scepticism.

Registered medical practitioners may belong to the *Medical Association of South Africa (MASA)*. The Association is a voluntary organization which originated as a branch of the British Medical Association, but became independent in 1946. The main objectives are :

1. To maintain and protect the honour and interests of the medical profession.
2. To hold or arrange meetings of members of the Association and the profession generally.
3. To circulate information by means of a journal.
4. To promote the medical and allied sciences.

The Association's contribution to biomedical communication includes the publication of the *South African Medical Journal*, arrangement of scientific congresses and the provision of grants to university libraries.

Apart from the internationally recognized research journal the *South African Medical Journal*, (Garfield, 1986; Pouris, 1989), several other medical journals are published in South Africa, e.g. *South African Journal for Continuing Medical Education (CME)*, *South African Journal of Surgery*, *Geneeskunde*, *Leech*, *Journal of Forensic Medicine*, *Journal of Clinical Nutrition*.

Since 1976, MASA has initiated many market surveys among all registered medically qualified persons, members and non-members of MASA (Reynolds, 1991, *pers comm*). The objective of these surveys (conducted by independent market researchers) is to determine the information needs of members of the medical fraternity and information about their preferences, for instance for types of publications. The information obtained in this manner serves to improve the information package offered by MASA, which, in turn may enlarge the circulation of their publications. These reports are examples of what librarians call "grey literature" and are not freely available. The fact that MASA feels the need to conduct such exercises at great expense is a positive indicator of the vital state of biomedical communication in South Africa.

Role of the IBC

In 1975 the *Institute for Medical Literature* was founded as one of the institutes of the MRC. It became operational in 1976, with the brief to provide an effective national service which would give biomedical research workers throughout the country equal access to an up-to-date-information retrieval facility. The Institute did not only achieve this very ambitious objective, but became a national centre of excellence, taking a leading role in furthering online training expertise to information workers in non-medical academic and industry libraries. The name of the Institute was broadened to *Institute for Biomedical Communication (IBC)* in 1986, reflecting an increasingly dynamic role on the national information scene.

The role of the IBC was never intended to duplicate the responsibilities of the libraries attached to the (now) seven medical faculties in the country. The provision of basic document delivery services rests with these medical libraries.

Information needs of biomedical researchers

It would be a rare librarianship study of this nature that did not, at very least, acknowledge the importance of the concepts *need*, *want*, *demand* and *use*. Essentially, these aspects have been exhaustively researched (the literature contains probably thousands of user and usage studies, as well as many review articles on the subject, e.g. Barber, 1966; Herner & Herner, 1967; Paisley, 1968; Urquhart, 1968; Voos, 1969; Wood, 1971; Kunz 1977; Hensley & Nelson, 1979; Dervin & Nilan, 1986; Rohde, 1986).

Urquhart (1968:2) formulated his "first library law" :

"A library exists to meet the needs of its users as economically as possible".

He further contends "a research worker requires information on his subject irrespective of where the publications containing it are found".

Basically, a researcher needs documents containing the information to do research; the user may or may not be aware of these *needs*; when a user is conscious of information needs, they become *wants*, which, in turn, if articulated or expressed, become *demands*; a satisfied demand leads to *use*, which may satisfy the original need! The fascinating philosophical discourse on these concepts, as recently pursued by Green (1911), is not at issue in this study. The only aspect focused on will be manifestations of documented *use*, or in terms of the statements above, satisfied known want. The biomedical research fraternity is therefore represented by those in their ranks that succeed in publishing the results of their research in the journals of science. For the purposes of the present study, the non-publishing members are excluded. The concept *use* will be restricted to the citations the sample group provided in their own published journal articles. Masson's study showed that in South Africa, medical scientists tend to publish a greater number of articles *per capita* than do scientists in other disciplines (Masson, 1970a). The competition for research funds is keen. The proven ability to have publications accepted in especially prestige peer-reviewed journals is an accepted norm of the value of scientific ability.

In South Africa, Lor (1978) studied the information needs of the general practitioner. Previously, Masson (1969, 1970a, 1970b) investigated the South African research scientist in which the medical component was identified. Haag's study (1989) of the barriers impeding users' access to information included medical researchers in the purposive sample. Numerous international studies are relevant to the information needs of scientists, including biomedical researchers.

These user studies become generally applicable if one can establish the comparability of the information use of the South African group with the international biomedical fraternity. To date, no attempt has been made to identify and describe the journals used by biomedical researchers in South Africa, nor to establish how readily available these publications are to the end-user through the national network of especially academic medical libraries.

1.1 STATEMENT OF THE PROBLEM

The medical research fraternity in South Africa is mainly located at the universities with medical faculties. Consequently, their documentary information needs are primarily served by those libraries attached to the faculties in question. Collectively, these libraries control a national resource of documents containing recorded information.

The concept information encompasses much more than that which is recorded in whatever physical or bibliographical format. Previous analyses of type of publication cited by scientists in general and medical scientists in particular (Fussler, 1949; Orr, Abdian & Leeds, 1964; Price, 1965; Kelland, 1989), give rise to the expectation that most of the information required by South African biomedical scientists for the purposes of their research articles would be published in research journals. This assumption will be put to the test as part of the empirical research.

The value of information in the research process is accepted as a premise, as is the preliminary assumption that research journals are the vehicles of the most significant quantity of published information in the sphere of biomedicine. The quality of the provision of identified journal articles, i.e. document delivery, requires assessment. The ability of the medical libraries to provide the document either from its own stock or to obtain it from elsewhere is at issue.

It is accepted that very little is known of the way in which South African biomedical researchers use published information, or of the nature and attributes that characterize the papers they publish in South Africa and abroad. A basic understanding of the structure of and processes involved in scientific communication provides an essential framework for the professional planning and management of library services. Specifically, knowledge acquired through a local study can serve to validate comparisons with results of international information science research.

Biomedical literature

The phrase "biomedical literature" is in itself problematic, as different interpretations are attached to it. Frequently, clinical medicine is detached from those biological sciences with a medical component. For the purposes of this investigation, the approach used by Orr & Leeds (1964) is followed. They argued that the basic choice is between biomedical literature in terms of the subject matter of documents, or on the basis of the scientists that use or generate the documents. Conventional definitions are subject based and would include all documents classified as relating to the large and varied scientific population engaged in "health related" research. Even if the members of this community could be classified neatly by subject or discipline, the scientific documents they find useful, cannot. The biomedical literature as conventionally defined constitutes a part, but not all, of a larger document universe useful to this population.

Characteristics of journal literature

In this dissertation, the terms *characteristics* and *attributes* are used interchangeably to signify qualities that can be identified to describe or distinguish elements of the constructed universe of journal literature or components thereof.

Availability of documents

The term *availability* appears frequently in the literature pertaining to document delivery capability of library and information systems. Kantor (1976) defined *availability* as a measure of the extent to which the needs of patrons for specific documents are promptly satisfied, whereas Hall (1985) simply calls it the likelihood that users will find material on the shelf when they need them. Material can therefore be considered available when the library or system has acquired an item, processed it and the user finds it at the location indicated in/on the catalogue record (Steynberg, 1989:373).

The research problem has two facets

1. The identification of attributes of the journal literature produced and used by South African biomedical researchers.
2. Assessment of the availability of research journal literature in South African medical libraries.

1.2 Research objectives

The universe of biomedical literature is added to on a continuous basis, some would claim that it grows at an exponential rate. One of the main aims of this investigation is thus the creation of a framework of biomedical literature in which the problem formulated above can be addressed. Such an approach requires the identification, exploitation and measurement of certain set parameters within this framework or structure. Possible changes or trends that may occur over time, could then be detected at the infra- and superstructural levels.

A procedure of direct monitoring of the use of research literature by the South African biomedical community, as an ongoing concern, would be very difficult, as well as prohibitively expensive in manpower. Therefore, an indirect approach based on a representative sample within the ambit of the entire body of published information in this field is preferred. A well structured experimental design would by no means diminish the validity or impact of such an undertaking and would have the added advantage of significant time-cost benefits.

A two-pronged approach was therefore devised as outlined in the statement of the problem. The infrastructural approach focuses on traits associated with published articles within journals whilst the superstructural investigation concentrates on gross assessment of availability of such journal articles both within and between locations. An expanded exposition of the state of the problem is as follows :

1. Select appropriate methodology to elucidate both aspects of the research problem.
2. Identify the attributes that characterize research articles published by South African biomedical researchers.
3. Identify the attributes that characterize research articles cited by South African biomedical researchers.
4. Compare these findings with each other and with similar international studies.
5. Investigate the availability at all seven medical libraries of a representative sample of journals required by researchers .
6. Relate the results to international standards
7. Identify shortcomings in the national infrastructure for the provision of research journals.
8. Recommend further research as a result of findings of this study.

1.3 Research methodology

Chen (1978:268) provided an acceptable definition of *methodology*: "the processes, techniques, or approaches employed in the solution of a problem". The objectives of the investigation are to solve the problems identified in the research statement. An attempt was made to determine the most appropriate approaches to meet those objectives.

In the present case, the problem consists of two objectives, which were translated into two separate but related, indeed interactive, facets, a *Citation analysis study* and a *Document Delivery Test*.

Some of the techniques used in the investigation apply to both aspects of the study, whereas some other methods were designed specifically to elucidate a particular aspect.

Limitations of the project :

1. The study was restricted to the *journal article component* of the information needs of research workers.
2. The term *use* referred only to references found in the bibliographies or footnotes of publication, thereby implying use by the author(s).
3. The term *biomedical* was used to include clinical as well as basic biomedical and life sciences research.

Choice of target group

1. The medical research fraternity is a large, identifiable group who produce sufficient publications for analysis.
2. There are seven well established, relatively self-sufficient medical libraries primarily responsible for the document delivery needs of the target group.

The researcher's background in an academic library service to agricultural scientists established a familiarity with biological literature sources. She is not responsible for a medical library and can therefore claim complete impartiality.

1.3.1 Literature search

In library and information sciences research, as is the case with other social sciences, it is seldom possible to conduct a literature search that is limited to a neatly specific topic. In the present case, a fairly wide area was covered to form a large reference framework within which specific aspects were accentuated. The exploration of published sources included as general terms of reference :

- * Research methods
- * Evaluation of library services
- * Citation analysis

More directed literature searching focused on the nature of *biomedical research journals* and on *document availability* studies. The identification of useful literature was approached in the conventional manner and is described in Chapter 2.

1.3.2 Citation analysis study

In Chapter 3 a number of attributes of journal articles are identified and described. The rationale for the choice of elements was based on previous bibliometric and scientometric investigations, which were retrieved as part of the literature search.

1.3.3 Evaluation of document delivery

After the decision had been taken to concentrate on the availability of journals as an indicator of document delivery capability of the medical library group collectively, the most appropriate methods had to be selected. The possible options were :

1. A survey of the users' perceptions of the quality of the libraries' document delivery service with a self-administered questionnaire as the most likely instrument for gathering the information.
2. An objective measurement by conducting a Document Delivery Test at each site.

The first potential approach presented many logistical complications. The target user group was dispersed in seven main centres and control over the data could prove problematic. There are several studies in the literature warning against the dangers of imperfect questionnaires (Payne, 1951; Berdie & Anderson, 1974; Bookstein, 1982; Bookstein & Lindsay, 1989). It was thus decided not to directly involve the users of biomedical journals, but to use objective methods for

the gathering of quantifiable data. The users' utilization of the literature is, however, represented by the citations provided in their publications. As Smith (1981:85) puts it "Citations ... provide data by which one may build pictures of user behavior without ever confronting the user himself."

Availability study

The process of conducting a Document Delivery Test to determine availability of documents was such an integral part of the investigation, that the methods are explained in detail in Chapter 4. In summary, the following steps were followed to conduct the *Document Delivery Test* :

- * Selection of a representative sample of bibliographic references of journal articles required by South African biomedical researchers, the *citation pool*.
- * Design of a *checklist* to record the availability of the items in the citation pool.
- * Analysis and presentation of the results.

1.3.4 Gathering of the data

Source of the data

At the outset, two sets of documents were constructed. These documents were the source of the data used in the study :

1. A collection of 320 articles published by South African biomedical researchers during 1989.
2. A sample of 307 articles drawn from the 7158 citations in the above collection constitute the citation pool used in the Document Delivery Test.

Collection of data

All the field work, checking and inputting was done by the author. The quality of the data therefore has a uniform character.

The first set of articles was used as

- * The reference source for the availability study.
- * A source of scientometric information.

The second collection was

- * Primarily the tool for measuring availability of journal articles.
- * A source of scientometric information.

Where feasible, the same characteristics were documented for both sets of data. This allowed for the comparison of factors common to both collections, reinforcing the value of the evidence collected in similar citation populations. The procedures for the documentation of the characteristics in the two collections of articles were only slightly different. In both cases,

- * Spreadsheets were used to record the results of this examination.
- * Each article was examined and the required characteristics recorded.
- * Each characteristic was treated as a variable and received an abbreviated code as the label of separate columns.
- * The identification or accession number of the source document (article) was used as unique identification number and occupied a separate row in the spreadsheet.

The main difference lay in the dual function of the second spreadsheet, as that necessitated the recording of the availability data of each article as determined during the Document Delivery Tests. The way in which this was done is explained fully in Chapter 4.

1.3.5 Data management

The files that contain the spreadsheets were imported into the MRC mainframe computer (APPENDIX 2 and 5). Standard statistical procedures were subsequently applied using the Statistical Application Software (SAS) package. The computation and statistical analysis were done by the Institute for Biostatistics of the Medical Research Council.

1.3.6 Interpretation of the data

In this study, descriptive statistics, rather than inferential statistics were used. The sub-samples differ extremely with respect to size and distributional characteristics, influencing the choice of statistical methods used. A greater emphasis was placed on non-parametric and robust methods. The measures of central tendency (mode, median, mean) and measures of variability (standard deviation, percentile range and interquartile range) were found most appropriate to summarize the data. Correlation analysis was used to explore the relationship between different variables.

Correlation analysis is a statistical technique for establishing the degree to which variables are linearly related and can be determined by means of parametric or non-parametric methods. Parametric methods provide for greater precision than do non-parametric methods. Non-parametric methods are based on rankings and are therefore not affected by extreme values. In this study several of the variables contain extreme values, e.g extraordinarily many references in a paper or very many authors to an article.

The Pearson product-moment correlation coefficient is a parametric method, while the Spearman rank order correlation coefficient is a non-parametric measure. Both Pearson and Spearman correlations were calculated for the tables (APPENDIX 4 and 7) for each of the two sets of data .

The scale for interpretation (Hafner, 1989 : 180) of the correlation 'r' :

Table 1.1 *Interpretation of correlation scales*

Value of r	Interpretation
0.0 - 0.25	Little or no relationship
0.5 - 0.75	Moderate to good relationship
0.8 - 1.00	Very good to perfect relationship

Presentation of the data

The results of both facets of the study are presented in the form of a report. Where appropriate, graphic presentation elucidates the results. An especially useful device of the SAS program, the 'box-plot' or 'side-by-side' or 'box-and-whisker' plot was applied to illustrate the results of the citation study in Chapter 3. A boxplot represents useful information about the distribution of data values. On the SAS output it is easy to identify the 'box' and 'whiskers' extending from the end of each box and represented by a dashed line. Within the box a plus sign (+) marks the position of the median and the ends of the box represent the lower and upper quartiles. This means that 50% of the variable batch values lie within the interval defined by the box. Extreme values are indicated by the extended 'tail'. Where linear relationships between variables were investigated, the results are expressed in the form of a scatter diagram.

The famous statistician, Radhakrishna Rao (1989:xii), recently prefaced a new book with the following aphorism

"All knowledge is, in the final analysis, history.
All sciences are, in the abstract, mathematics,
All methods of acquiring knowledge are statistics."

A different view of the value of statistics is given in the overused phrase "lies, damn lies and statistics" (a distorted quotation of a statement ascribed to Disraeli). The researcher's own perception of the usefulness of the statistical method is perhaps midway between those of the academically chauvinistic statistician and the banal sceptic. The statistical method is seen as a powerful tool that can, when used correctly, elucidate a research problem in an unbiased and objective manner, thereby assisting in the achievement of the aims of the research. It should, however, not be abused to replace sound deductions based on experience and insight. The injudicious use of statistics could even obscure the problem.

1.4 Conclusion

An assessment of the results concludes the investigation. The initial objectives of the project are discussed in relation to these findings and recommendations for further research proposed.

1.5 Glossary

The terminology or vocabulary used in the text of this report was, at very least, influenced by the literature consulted. The following operational definitions of terms were adopted :

- Availability :** The immediate locatability of an item is expressed in terms of 'availability'.
- Accessibility :** An unavailable item may, after some delay, be obtained; it is then considered accessible .
- Average :** A value which is typical or representative of a set of data. Averages are also called measures of central tendency. There are three kinds of averages :
1. **Mean:** the total of the values of a set of observations divided by their number
 2. **Median:** the value of the central item when data are arranged by size
 3. **Mode:** the observation that occurs with the greatest frequency.
- Bibliometrics :** The quantitative study or measurement of books and other sources of information.
- Citation :** The acknowledgement by an author of a previously published communication.
- Citation analysis :** A bibliometric technique which uses bibliographical references as its source data.
- Correlation :** The mathematical relationship between two or more variables
- Correlation Coefficient:** An indication of how two or more variables are related.
- Data :** Recorded information in its original collected form.
- Descriptive Statistics:** A widely known statistical method that summarizes numerical data in terms of averages and other kinds of measures for descriptive purposes.
- Document Delivery :** All or part of the library procedures involved in bringing together the information source and the user who demands it; making physically available.
- DDT:** Document Delivery Test. A formal measure of the extent to which a system is capable of providing a representative sample of documents.
- Effectiveness :** A measure of how well a service satisfies the demands made on it by its users.
- Figure :** Usually a chart, illustration or graph which is used to present statistical data

- Impact Factor :** A ratio calculated by ISI which indicates how frequently a journal was cited in the two preceding years.
- Journal :** A serial publication appearing at regular, predetermined intervals under the same title, normally identified by an ISSN (International Standard Serial Number).
- Parameter :** A quantitative characteristic
- Performance :** The level of effectiveness
- Population :** The entire group or collection of things being examined.
- Random sample :** A sample drawn in such a way that every combination of the possible sample elements of the population has an equal chance of being selected.
- Range :** The difference between the largest and the smallest numbers of the data.
- Reference :** A bibliographical description of a document
- Regression analysis :** Methods by which estimates are made of the values of a variable from the knowledge of the value of one or more other variables.
- Sample :** A small part of the population or universe.
- Scientometrics :** The investigation of the nature and dynamics of all manifestations of scientific communication by means of quantitative analyses.
- Standard deviation :** The square root of the variance, it is generally used to measure the dispersion in the units of the original data.
- Statistics :** Scientific methods for collecting, organizing, summarizing, presenting, and analyzing data, as well as drawing valid conclusions and making reasonable inferences on the basis of such analysis.
- User needs :** Information required by the user to improve his/her ability to perform the job.
- Variable :** A symbol that can represent any one of a given set of numbers or quantities. A quantity that may assume any of a specified set of values.

2 REVIEW OF THE LITERATURE

2.1 Sources used in literature search

2.2 Communication in science

2.2.1 Bibliometrics and scientometrics

2.3 Applications

2.4 Future developments

2.5 Evaluation of library services

2.5.1 The need for evaluation

2.5.2 The choice of areas for evaluation

2.5.3 The methodology of evaluation

2.5.3.1 Shelf-availability studies

2.5.3.2 Document Delivery Tests

2.6 Summary

2 REVIEW OF THE LITERATURE

The library and information science literature was consulted to gather information that would elucidate the research problem and support the investigation under review. Initially the literature search was not very topic specific and included general items on the evaluation of (especially academic) library services and the methods applied to such performance appraisal. The focus was then narrowed down to the methodology used for the evaluation of document delivery capability, and more specifically the accessibility and availability of documents.

2.1 Sources used in literature search

In library and information sciences research, as is the case with other social sciences, it is seldom possible to conduct a literature search that is limited to a neatly defined subject. In the present case, a fairly wide area was covered to form a large reference framework within which specific aspects were accentuated. The exploration of published sources included as general terms of reference :

1. Research methods
2. Evaluation of library services
3. Citation analysis

More directed literature searching focused on *document availability* studies and the nature of *biomedical research journals*. The identification of useful literature was approached in the conventional manner, i.e.

1. Location of monographic sources in the book catalogues of local university libraries, augmented by searches on SABINET, the national bibliographic network.
2. Manual and online searches of the databases of appropriate secondary sources : *LISA (Library and Information Science Literature)*, *Library Literature*, *SSCI (Social Sciences Citation Index)*.
3. A continuous current awareness programme by scanning new journals and alerting publications such as (the now defunct) *Cablis (Current Awareness Bulletin of Library and Information Service*, which was published by the British Library until the end of 1990), as well as review journals such as *Advances in Librarianship* and *Annual Review of Library and Information Science*.
4. The follow-up of references in the identified publications.

Several texts on research methodology in the social sciences generally and Library and Information Science in particular, proved very helpful (Bundy, Wasserman & Araghi, 1970; Goldhor, 1972; Busha & Harter, 1980; Leedy, 1980; Busha, 1981; Martyn & Lancaster, 1981; Mouton & Marais, 1985; Moore, 1987; Boshoff, 1988; Slater, 1990).

A complementary literature search explored the nature of science communication and citation analysis, concentrating on the characteristics of biomedical journal literature. There is a comprehensive body of literature on all the facets of the information framework outlined above. The literature on the preamble to each of these aspects are discussed separately :

- * Assessment of availability of journals.
- * Scientometric profile analysis of biomedical journal literature.

2.2 Communication in science

An exploration of the nature of the literature used by scientists augment studies dedicated to library performance. The structure of communication in science has received attention from sociologists, psychologists, historians and librarians (Price, 1963; Crane, 1970; Nelson & Pollock, 1970; Merton, 1973; Cronin, 1984). A conceptual understanding on the part of librarians of the way the science community communicate information among themselves, enhances mutual respect and contributes to a better relationship between Faculty and the Library; the credibility librarians are so concerned about.

Cronin (1984:2) puts it rather well: "The primary communication system is the principal mechanism whereby the scientific establishment records and rubber stamps the individual and collective achievement of its members" and gives three functions of the system :

1. To disseminate knowledge.
2. To ensure the preservation of standards.
3. To distribute credits and recognition to those whose earlier work has contributed to the development of ideas in different fields.

"In some respects the scholarly journal is the scientific establishment's ledger of achievement and roll of honour wrapped in one." Three types of studies have been conducted in the area of science communication (Crane, 1970):

1. Studies of the scientific literature itself.
2. Studies of how scientists obtain the information they need for their research.
3. Studies of the relationship between scientists who conduct research in the same area.

2.2.1 Bibliometrics and scientometrics

Bibliometrics

The term *bibliometrics* was coined by Pritchard in 1969. According to his original definition, it is "the application of mathematics and statistical methods to books and other media of communication." He expressed the hope that the term would be used explicitly in all studies which seek to quantify the processes of written communication (Pritchard, 1969:349). Almost every article on bibliometrics published in the last 20 years opens with an acknowledgement of Pritchard's use of the term, frequently quoting the above passage.

Broadus (1987) provides a history of what he calls the subdiscipline, following it up to the point of Pritchard's famous paper. Up till then, 1969, *statistical bibliography* described quantitative studies of (especially) science literature. Cole & Eales (1917) referred to their pioneering work as "statistical analysis" of the literature of comparative anatomy from 1550 to 1860. The semantic evolution advanced with the use of the term "statistical bibliography" (Hulme, 1922).

The subdiscipline called *bibliometrics* has been the subject of several review articles (Narin & Moll, 1977; Hjerppe, 1978; Lawani, 1981; O'Connor & Voos, 1981; Smith, 1981; Ikpaahindi, 1985; Hertzal, 1987; King, 1987; White & McCain, 1989). The interest manifest by these papers reflects the tremendous amount of research that takes place and results in publications.

According to Hertzal (1987), bibliometrics was primarily a collection development tool which has been expanded to the study of the structure of literature in the larger encompassing field of information science, but lacks coordinating theory :

" but it seems possible that as more theoretical information is converted to fact, and behavioral patterns are established for the assessment and evaluation of the structural components of literature (i.e. authors, publications, words, laws) and their relationships, the more probable causal explanations will be evident and bibliometrics will be closer to being recognized universally as a science."

According to White & McCain (1989:19) bibliometrics is the quantitative study of literatures as they are reflected in bibliographies. Its task, immodestly enough, is to provide evolutionary models of science, technology and scholarship. Distinctively, it construes these worlds as realized over time through publications - more exactly, through their bibliographic records.

In their review article, Narin & Moll (1977:36) suggest that early bibliometric papers resulted from "an innate curiosity about the functioning of the scientific enterprise." They discuss the nature of bibliometric data and in summary propose that bibliometric techniques are used in librarianship and information management and secondly, the study of science and scientists. Interestingly, one of the pioneers of citation analysis was a South African, Theo Friis (1957).

Scientometrics

Price is generally regarded as the father of what has become known as *scientometrics* (Merton & Garfield, *in forward to Price*, 1986:vii). Pritchard (1969:349) referred to scientometrics as a [Russian] term for the application of quantitative methods to the history of science, obviously overlapping with bibliometrics.

Braun *et al.* (1985:1) describes scientometrics as a subfield of bibliometrics, "the art of quantitative and statistical analysis of scientific literatures", specifically the generation, propagation and utilization thereof. The terminological hierarchy and the differences between these concepts are somewhat blurred as the terms are often used interchangeably. The methods employed by bibliometricians and scientometricians are similar, often the same; the difference would seem to lie in the purpose or objective of a specific project.

Data used in bibliometric investigation

The data used in bibliometric studies are publications (usually journals), references and citations, as well as the authors of these scientific publications (Hjerppe, 1978). Hjerppe (1978) gives an overview of the units, sources, methods and applications found in citation studies.

A great many bibliometric investigations involve the journal as the unit of analysis (as opposed to documents or authors). This is not surprising when one considers

- * The role of the journal as a major communications channel for research findings, particularly in the sciences.
- * The large proportion of the materials budget in research libraries devoted to scholarly journals.
- * The annual publication output of the ISI's *Journal Citation Reports*.

Two concerns have occupied much of the bibliometric literature : an emphasis on mathematical or statistical methods, and a search for theoretical propositions (O'Connor & Voos, 1981). The Bradford, Lotka and Zipf distributions are considered the basic laws of bibliometrics (Lawani, 1981; Ikpaahindi, 1985). Bradford's law of scattering describes how the literature on a subject is distributed in journals; Lotka formulated the productivity of scientists as an inverse square law (for every 100 authors contributing one article, 25 will contribute two articles, 11 will contribute 3 articles and 6 will contribute 4 articles); Zipf's law suggests that people choose and use familiar words, therefore the probabilities of the occurrence of familiar words are higher than those of unfamiliar ones.

Sources of bibliometric studies

Two international publication events dominate the documentation of bibliometrics. The first was the development of a computerized citation database, *Science Citation Index* by the Institute of Scientific Information (ISI) in 1964. The second was the establishment of the Hungarian journal *Scientometrics* in 1977 (articles published in English).

Journal citation studies

Citation analysis has become the most active area of bibliometric analysis. This is a direct result of the endlessly available data collected and published by the *Institute for Scientific Information* and the prolific publication output by its President, Eugene Garfield.

A citation represents the relationship or connection between at least two documents; the citing and the cited. Weinstock (1971) enumerated fifteen different reasons that motivate authors to acknowledge a previous publication:

- * Paying homage to pioneers.
- * Giving credit for related work.
- * Identifying methodology, equipment, etc.
- * Providing background reading.
- * Correcting one's own work.
- * Correcting the work of others.
- * Criticizing previous work.
- * Substantiating claims.
- * Alerting researchers to forthcoming work.
- * Providing leads to poorly disseminated, poorly indexed, or uncited work.
- * Authenticating data and classes of fact - physical constants, etc.
- * Identifying original publications in which an idea or concept was discussed.
- * Identifying the original publication describing an eponymic concept or term as, e.g. Hodgkins disease, Pareto's Law.
- * Disclaiming work or ideas of others.
- * Disputing priority claims of others.

Any set of documents containing reference lists can provide the raw material for citation analysis, and citation counts based on a given set of documents are precise and objective (Smith, 1981).

The advent of citation databases has changed the face of library research and, consequently, its literature. One can but speculate on the further exponential growth in papers based on quantitative analysis. In 1980 Hjerppe compiled a bibliography of more than 2000 (selected) items.

2.3 Applications

Applications of bibliometric and scientometric studies

The data produced by bibliometric studies can be of practical assistance by providing a more scientific basis on which to make decisions regarding the selection, retention, and location of bibliographic items in collections. Two bibliometric concepts have been proposed as being of great potential use in collection management : *scattering* and *obsolescence*. An extensive study by Line & Sandison (1974) provided the benchmark publication on obsolescence. Subsequent contributions came from Gapen & Milner (1981); Sandison (1987); Stinson & Lancaster (1987).

Smith (1981:47) is of the opinion that the qualitative methods employed at that time by librarians to manage collections are unlikely to be replaced by techniques based on studies of obsolescence and scattering. It does not follow that such studies therefore have no value; "it may be the case, however, that bibliometric studies will find their place as part of the science and sociology of scholarship, not as a means for improving collections of bibliometric items."

The literature of collection management tends to emphasize qualitative rather than quantitative methods (Wallace,1987). Despite having been around for many years, bibliometric studies do not appear to have been adopted into the mainstream of the literature of collection development. Bibliometrics seem to have been treated as a curiosity rather than as a valid methodology. Wallace (1987:47) concludes by recommending :

- * A set of consistent, easily applied formulae for measuring scatter and obsolescence in a working environment needs to be developed.
- * These formulae then need to be tested in a variety of settings in a consistent and replicable manner and the results of the tests consolidated and summarized.
- * The relationship between quantitative bibliometric methods needs to be explored in order to determine which techniques are most effective, and most cost effective.

Citations can be used as the instruments for two major themes - as tools for the librarian and as tools to analyse research activity. According to Smith (1981:94), there are eight types of questions that can be addressed by using citations :

- * 'Literature of' studies. In this case, one looks at citations in a particular area to describe patterns of citations.
- * 'Type of literature' studies. Used to gauge the dissemination of results reported in certain types of literature, such as government publications.
- * User studies. Descriptive, but have implications for collection development and design of services.
- * Historical studies. Based on the literary model of the scientific process
- * Communication patterns. Citations can be thought of as plausible indicators of scientific communication patterns.
- * Evaluative bibliometrics. Aggregates of scientific activity.
- * Information retrieval. Literature searching.
- * Collection development. Citation analysis has been applied primarily to the development of journal collections, where decisions to be made include : the (new) subscription to a particular title, to continue or discontinue a subscription, to weed or not to weed backruns of titles.

The present study is primarily an example of Smith's first category, as it is based on the literature of biomedicine, i.e. a particular subject area, e.g. Budd (1986); Frijdal & De Greve (1986); Kazlauskas, DeYou & Smith (1989). It also relates to the second category "type of literature" as journals are used as the bibliometric unit in the investigation.

Potter (1988) describes two types of classic bibliometric studies. The first is largely descriptive and attempts to enumerate the production of a body of literature by country, time period and discipline. The second type of study is more evaluative and attempts to study how a body of literature is used, usually by analyzing patterns of citations.

Place of publication

Journal literature can be placed in a hierarchical model that narrows the location down to a locus within a specific subdiscipline. In this study, the more specific category obviously concerned the literature of medicine :

- * World science literature
- * World medical literature
- * National science literature
- * National medical literature
- * Specialist medical literature

These categories interrelate and overlap in a cross fertilization process, as contributions by individual scientists transcend national borders. A focal point of the present research will be the scientometric profile of South African biomedical researchers in the wider than national context.

World science literature

The subject composition of the world's scientific journals has been the focus of several major studies (Hulme, 1923; Bourne, 1962; Gottschalk & Desmond, 1963; Price, 1963; Barr, 1967; Narin & Carpenter, 1975; Carpenter & Narin, 1980; Burke & Price, 1981; Lange, 1985). The fields of medicine, chemistry, agriculture and biological sciences are the largest organised disciplines, although there is a considerable amount of overlap between them (Bourne, 1962:162).

In his benchmark paper on the characteristics of the research literature used by chemists and physicists in the United States, Fussler recommended that studies be undertaken of the literature used in other subject areas. He maintained that it was necessary to ascertain the characteristics of the literature for the individual disciplines as well as establishing the network of relationships between subject disciplines (Fussler, 1949:107). The validity of the suggestion has not diminished in the more than forty years since its publication, which is testimony to the dynamic nature of science and its documentation.

World medical literature

The position of medical literature within world literature has received considerable attention, possibly because of the voluminous nature thereof - collectively, this body of literature was estimated at 22% of the global output of science literature (Carpenter & Narin, 1980).

Biomedical literature as target discipline occupies an *a priori* placement within the larger framework of scientific literature. Contributions to the research on different aspects of biomedical journals include the publications of Orr, *et al.* (1964); Sengupta (1972); Narin, Pinski & Gee (1976) and Frame & Narin (1977).

National science literature

The publishing activity in specific countries can be extracted from research data in global overview studies, for instance Martyn & Gilchrist (1968); Narin & Carpenter (1975); Burke & Price (1981); Carpenter *et al.* (1988).

The research of Braun *et al.* (1985) focused on scientometric indicators based on a five year science output of 32 countries. The six top ranking countries, USA, USSR, UK, West Germany, France and Japan were excluded from their study. Their data on the number and distribution of South African publications in nine disciplines are presented in Table 2.1. (Braun *et al.*, 1985:269) (See also Fig 1.2 in Chapter 1).

It is generally accepted that the USA is the leading country in the world as far as medical research publications are concerned (Brodman & Taine, 1958; Orr & Leeds, 1964; Frame & Narin, 1977; Carpenter & Narin, 1980). In earlier days, German science generally (Fussler, 1949; Price, 1963) and medical science particularly, were more prominent than today. Loosjes (1973) refers to a protest in 1841 against the great mass of German medical periodicals, then

Table 2.1 *Number of papers by SA authors by field of research*

FIELD	1978	1979
Clinical medicine	635	600
Biomedical research	90	87
Biology	72	80
Chemistry	99	91
Physics	64	47
Earth & space science	46	53
Engineering	76	77
Psychology	2	4
Mathematics	14	12
All fields combined	1327	1383

Frame & Narin (1976) investigated the relationship between (American) National Institutes of Health funding and biomedical publication output. In South Africa, Pouris (1989; 1991) is researching the effect of funding policies on research publications produced by South African scientists, while in the UK, Abbott (1990) describes an attempt at measuring research productivity at Aston.

Citation patterns in medical literature

The second type of study is more evaluative and attempts to study how a body of literature is used, usually by analyzing patterns of citations (Narin, *et al.*, 1976; Garfield, 1986).

2.4 Future developments

Finally, it is recognized by authors like Smith (1981) that citation analysis has certain limitations; that the availability of raw data for citation analysis may lead to the abuse or invalid manipulation of data to arrive at wild conclusions. There is even a possibility that citation analysis will cause a change in citation behaviour itself.

The increased use of electronic media for information handling, e.g. form of bibliographic references for material available in machine readable form must have an influence. Quality control, accessibility and author's permission are becoming relevant and problematic, for instance

the development of hypertext databases and copyright issues. "Perhaps the greatest potential contribution of citation analysis lies in the new insights which it can offer into this process. It is a process which concerns not only scientists and sociologists of science, but also those who work with the literature of science." (Smith, 1981:100)

2.5 Evaluation of library services

The documented contributions to the debate on the evaluation of library services logically divide into three main categories :

- * WHY evaluate?
- * WHAT should be evaluated?
- * HOW should that be evaluated?

2.5.1 The need for evaluation

In his foreword to Kantor (1984:v), Richard Talbot states rather dramatically "A specter is haunting the research libraries of the land. That specter is the fear of irrelevance", adding that, although he was not totally serious, there is an element of truth in this fear of irrelevance. "The pressures of the times seem to demand that library managers increasingly be able to justify library expenditures on the basis of achieved performance."

After the prosperous years of the Seventies and early Eighties, libraries world-wide are feeling the effects of tight budgets (Line, 1986; Mann, 1989). There are exciting technological developments with integrated computer systems giving libraries a new look and creating new expectations from their users. Librarians have to devise means to cope with increasing user demands in times of economic constraint.

Burton (1990) discusses the need for client-centred services, with an emphasis on accuracy of information provision, stating "the need for objective measurement of success of library and information services (LIS) has never been greater. With budgets and staffing under pressure, LIS managers must be able to demonstrate effective use of the service in order to prove that it merits continued support". In Rodger's view (1987), there is less money with which to attempt to do the same, or even more, than before. Line (1986) advocates improved efficiency of services as the obvious priority.

Hitchcock-Mort (1985:4) maintains "...libraries must re-evaluate everything they do and refocus on processes, procedures and details which ensure that what they expend their time, money, labor and effort on is directly useful to the community they serve." Similar views are expressed by Kania (1988:16) "...college and university librarians find themselves in need of useful and specific methods to help them determine how well their libraries meet the educational and information needs of their clients." Ravichandra Rao (1982:v) ascribes the state of recent evaluative studies on "the usefulness of libraries to society" to the considerable expenditure of funds on collection building and readership programme activities.

Over the last decade, Lancaster's publications provide a significant contribution, state-of-the-art analyses of the theory and practice of library evaluation (Lancaster, 1971; 1977; 1978; 1982; 1988; Lancaster & Cleverdon, 1977; Lancaster & McCutcheon, 1978; Porta & Lancaster, 1988).

Lancaster (1977) identifies four aims of an evaluation exercise :

1. To establish a type of 'benchmark' to show at what level of performance the service is operating.
2. To compare the performances of several libraries or services.
3. To justify the library's existence...an analysis of the benefits of the service.
4. To identify and expose possible sources of failure or inefficiency in the service with a view to raise the level of performance at some future date (diagnostic and therapeutic).

The term *evaluation* needs specific qualification. Hannabus (1987:248) discusses the importance of performance measurements in terms of "the goodness of the system", which "impels both users and staff, clients and managers, to consider [what should be evaluated] - and then [to] test [the specific system] operationally".

There is consensus on at least two important issues :

1. Library management need to evaluate their systems.
2. Effective evaluation can only take place within the framework of clear objectives.

Lancaster (1988:6) writes "evaluation of an information service is a sterile exercise unless conducted with the specific objective of identifying means of improving the service."

Library management is therefore faced not by the question of whether to evaluate, but what section or function of the library service to evaluate and, specifically, the selection of the most appropriate methodology to achieve the objectives.

2.5.2 The choice of areas for evaluation

Lancaster (1977) identified three possible levels at which evaluation may be carried out :

1. Effectiveness evaluation
2. Cost-effectiveness evaluation
3. Cost-benefit evaluation,

but adds that, in practice these distinctions become rather blurred, if an attempt to identify them is made at all.

Lancaster defines the measurement of *effectiveness* as "an evaluation of user satisfaction", but notes that such investigations are often restricted to the expressed needs of users, ignoring the problem of unexpressed needs. A further distinction can be drawn between macroevaluation, a purely quantitative measure of how well the system performs, and microevaluation, which investigates the causes of, for instance, shelf failure (Lancaster & McCutcheon, 1978). The studies reported by Saracevic, Shaw & Kantor (1977) and Ciliberti *et al.* (1987) are examples of such analytical or diagnostic exercises. A systems approach is followed by Du Mont & Du Mont (1979); Du Mont (1980) and Du Mont & Du Mont (1981).

A *cost-effective* study relates the measures of effectiveness to that of cost, whereas a *cost-benefit* analysis attempts to assign some actual monetary value to information and thereby attempt to correlate the cost of a service and the benefits to the user.

Any type of service activity needs to be evaluated on the basis of cost, time and quality criteria. Cost and time criteria are fairly obvious, but the 'quality criteria', in terms of information services, those which measure success, are more complex (Lancaster, 1988):

- * Does the user get it (the information he/she needs) or not?
- * How completel or accuratel is the information he/she receives?

The main evaluation criteria, according to a review article by Evans, Borko & Ferguson (1972) are :

- * Accessibility - the term used here in terms of services and classes of users.
- * Costs - expenditure on staff; unit costs, for instance the ratio between the book budget and users.
- * User satisfaction which, here, encompasses evaluation of the collection.
- * Response time or speed of services.
- * Cost/benefit ratio - e.g. service expenditure in relation to number of users.
- * Use - gross use made of the service, including circulation and reference services.

The literature was thought by Evans *et al.* (1972) to be lacking in a consideration of

- * The total service program.
- * The importance of using multiple criteria for evaluating service functions.

These shortcomings preclude the design of valid library performance. It is recommended that precise operational procedures should be developed (Evans *et al.*, 1972) :

- * Defining the variables involved in the measurement of each criterion concept.
- * Specifying the statistical protocol and formulas needed to calculate the criterion measures.
- * Suggesting a procedure that will enable one to combine these individual criterion measures to evaluate total library performance.
- * Developing a procedure to weight the individual criterion measures in accordance to each library's estimation of the importance of services being provided.
- * Thereby arriving at a procedure whereby meaningful comparisons can be made of libraries.

The objective of the services offered by a library can ultimately be reduced to making required documents available to its user community. It is therefore logical to assess the availability of such documents. Such a process implies the identification of required documents, the measurement of the availability thereof, as well as the assessment of user satisfaction or dissatisfaction with the capability of the system. Contributions to this aspect of the literature include the publications of Dougherty (1973); Bonn (1974); Burns (1978); Budd (1982); Christiansen, Roger-Davis & Reed-Scott (1983); Goody (1988).

Wilson (1977) discussed four methods that illustrate different approaches to client-centred evaluation studies :

1. Circulation statistics
2. Failure surveys
3. Standard lists
4. Document delivery tests

Poll (1990) explains the performance evaluation in academic libraries in very practical terms. She summarizes five measures :

1. Document availability
2. Document delivery (or access)
3. Evaluation of the collection
4. Evaluation of reference service
5. End user satisfaction, referring to whole library or specific services.

Document delivery is an umbrella term for a number of logistically related procedures in library service. For the purposes of specific measurement, a more precise definition of the term and the scope of the study is necessary. The wish to borrow documents reflects one of the identifiable indicators of user needs. The ability of the library to meet this demand by providing the material, constitutes an identifiable and therefore measurable document delivery capability.

Buckland (1975:xi) stated categorically "the essentially logistical problem of making library books physically available when wanted by library users is central to librarianship". *Making physically available* is an acceptable definition of document delivery. The study of the logistics of document delivery should therefore fit in with Buckland's concept of what is fundamental to librarianship. Many authors agree that document delivery capability is a valid indicator of libraries' success rate.

Cronin (1985:21) surmises "...because document delivery lends itself to quantitative measurement, it has become a favorite variable in library performance studies." Libraries routinely collect data or "statistics" on the number of items in the collection, items issued and items requested through interlibrary loan systems. More recently, especially with the advent of sophisticated computerised systems providing micro-information, the methodology for analysing the data has improved significantly.

Availability and *accessibility* are two crucial attributes of document delivery. The assessment of these attributes would constitute a significant achievement along the way to total evaluation of the concept *information services*. Mansbridge (1986) reviewed over 40 availability studies that span half a century.

A large academic library is a complex system and allows for internal specialisation, each sector with a specific objective. The common goal, the satisfaction of the information needs of its primary clientele, should, however, not be forgotten. There is an extensive research literature on the subject of information needs, including several comprehensive review articles (Line, 1973; Wilson, 1974, 1983; Kunz, et al., 1977; Crawford, 1978; Dervin & Nilan, 1986; Rohde, 1986; Green, 1990).

The following observations are relevant :

- * Document delivery can be interpreted very broadly to encompass all library activities, from the selection of material through the processing stages and the eventual physical placement on the shelf.
- * The term *document* refers to all sources of recorded information, irrespective of physical format.
- * "An effective information system is one that achieves the purposes of its users" (Miller, 1989).
- * An academic or researcher requires an effective library or information system to achieve success.
- * An effective information system provides its users with the information they require within a specific time frame.

2.5.3 The methodology of evaluation

Quantitative methods are used to obtain and interpret data with the aim of achieving objective measurement or evaluation, whereas *qualitative* techniques address problems subjectively, emphasising the perceptual element. There is a significant divide between the adherents of quantitative, as opposed to qualitative research methods in the realm of library-related studies.

In their review of research literature up to the end of the sixties, Evans *et al.* (1972:102) found the measuring instruments to be insufficiently sensitive to both quantitative and qualitative factors of library service and therefore to be "not completely acceptable for either librarians or nonlibrarians".

Ravichandra Rao (1985:v) contends that librarians, "like managers in industries, need objective data to take timely decisions, that until recently, evaluations were subjective, based purely on the opinions of individuals or group". He defines quantitative data as "the observed values of a set of variables with respect to some or all members of the population" (p10). Statistical methods as applied to library problems are central to the quantitative analysis of the management of libraries. In this context, Rao used the rather contrived word *librametry*, but it never caught on as the term *biblometrics* did, for instance.

Wilson (1977:29) calls quantitative evaluation "generally the simplest kind of evaluation to perform...counting something" and qualitative evaluation "much more difficult because one is asking..how 'good' the collection is".

The objective measurement of systems include sampling techniques and the statistical (i.e. as in mathematical) presentation of data, e.g. probabilities, correlation studies, analysis of variance, etc. It has become a highly cerebral approach to quantifiable phenomena in librarianship. The advent of integrated computer systems provide an increasing amount of sophisticated information about use and users. These techniques are very valuable in interpretation of data from well designed research projects.

The evaluation perspective is mediated by human perception. Subjective 'evidence' thus requires the use of qualitative methods developed and employed in the social sciences, especially the survey techniques used by sociologists and human behaviourists.

Qualitative methods applied to evaluation of library services

The perceptions of the people who use a library cannot be objectively analysed, as there are too many unknown variables. Sociological and business research emphasise the value of well designed and executed surveys. This is one of the best researched or rather most practiced subareas of library and information science, consequently very well documented. Many authors warn against the seemingly simple methodology offered by the use of a survey conducted by means of a questionnaire (Payne, 1951; Oppenheim, 1966; Berdie & Anderson, 1974; Heather & Stone, 198-; Bookstein, 1982; Bookstein & Lindsay, 1989). A badly conducted survey is dangerous as the comparative ease with which results can be obtained could lead to invalid conclusions.

In the field of information science, Miller (1989) discusses four measurement categories. What he calls 'user perceptions' assume special relevance for library system application. He refers to studies of information systems effectiveness that suggest that users' evaluations of their information systems influence subsequent usage and realized value to the organization. A novel approach consisting of four 'methods' or criteria is proposed by Shaughnessy (1990):

1. Reputation
2. Institutional resources
3. Focus on outcomes
4. Value-added method

The main objective is to focus the library staff's attention on quality, as "The point that needs to be made and understood by all concerned is that a library's performance is nothing more or less than the sum total of the performance of its individual staff members" (Shaughnessy, 1990:5).

Quantitative methods applied to the evaluation of library services

Several tests have been designed to measure the ability of the library to provide documents required by its users:

2.5.3.1 Shelf-availability studies

The heading was put in the affirmative, but in the literature the more negative terminology "reader or shelf failure" is frequently used (Urquhart & Schofield 1971; 1972; Gore, 1975; Schofield, Cooper & Waters, 1975; Saracevic, *et al.*, 1977; Goehlert, 1978; Murfin, 1980; Kantor, 1981; Schwarz, 1983).

Analysis of circulation statistics

Several research projects (McGrath, 1971; Buckland, 1975; Harris, 1977; Hindle & Buckland, 1978; Lane, 1987) indicate a close relationship between items used in-house and items borrowed. This means that the same library material that was used in-house, was also in demand to be taken out. The implication of these results are that analysis of the circulation data would identify the titles 'used', without necessitating a rather difficult exercise to ascertain the use in the library (e.g. photocopying, browsing). The circulation figures represent an underrepresentation of the volume of use. The circulation information generated by integrated online systems is not yet fully utilized.

The identification of barriers between the user and required information sources indicates necessary changes in library procedures or policy, e.g. loan periods (Buckland, 1975; Vickers, 1983; Haag, 1989).

2.5.3.2 Document Delivery Tests

Document delivery tests are similar to shelf-availability exercises. The additional element concerns the time factor, or immediacy factor, as it was dubbed by Kantor (1984). The term Document Delivery Test (DDT) was first used by Orr *et al.* (1968a). The research was contracted by the Institute for Advancement of Medical Communication and resulted in a number of benchmark papers (Orr, *et al.* 1968a; 1968b; 1968c; Orr, 1970; Orr & Schless, 1972).

A Document Delivery Test consists of two essential components, the *citation pool*, or list of bibliographical items which is used to test whether a library (a) owns an item and (b) can locate it; and a *score sheet*, or checklist for recording the status or whereabouts of each item.

The citation pool can be constructed by collecting citations actually searched for by users or by simulated requirements, as perceived to be representative of a certain group. There are advantages as well as disadvantages to both approaches.

Researchers who used actual requests or recorded use include Line (1973); Buckland (1975); Saracevic *et al.* (1977); Kantor (1984). The collaboration of users are a prerequisite in this instance. There are inherent drawbacks to this approach. At best, it reflects only some of the needs of a section of the potential user population. The needs of the non-user are excluded, as are the potential or future needs of even the present user sample. The non-representation of the needs of the non-user of a library service is a factor in favour of the alternative, the critically constructed or simulated bibliography.

The literature provides guidelines for such a simulation. Generally it is not recommended to use recent journal issues from the test library, as this may be biased in favour of the local collection. It is suggested that items from a library with similar collections and of a similar size be sought. This argument presents a problem (Lancaster, 1988). If, indeed, one is endeavouring to simulate the citations the typical user from a specific library is likely to encounter, the probability of its occurring in one of the current subscriptions on view must be exponentially greater than otherwise. The construction of a citation pool approach was followed by Orr *et al.* (1968a); Wilson (1974, 1977, 1983); Kaske (1979); Kolner & Welch (1985).

Availability studies have almost always been limited to books, i.e. items in the book catalogue (Murfin, 1980; Mansbridge, 1986). Most of the studies concentrate on known-item searches, although a few included subject searches (e.g. Porta & Lancaster, 1988). The ARL (American Research Libraries) standardized methodology developed by Kantor (1984) and modifications thereof have been widely applied (Feri & Robinson, 1986; Reville, 1987; 1988; Rashid, 1990). Feri & Robinson (1986) conducted a study to determine the rate of user success and failure in finding known items at a medium-sized, open stack academic library: users failed to find 50% of all materials they seek. Eventually, 61.3% was found. Rashid (1990) investigated the availability rate of a medical library collection. The results differentiated between performance measured with and without the help of a librarian. The overall measure of book availability was found to be 59.60%, without a librarian's help, and 63.50% with the help of a librarian.

Kilgour (1989) used data from 16 availability studies and recalculated their results in a uniform manner. The studies had all been known item searches conducted at academic libraries. The availability rate ranged between 0.540 and 0.629, with a mean of 0.594 (59.4%, expressed as a percentage). The classic DDT can be used for more purposes than just assessing availability *per se*. An analysis of the strengths and weaknesses of the stock provide valuable management information that can be used in collection development decisions (Smith, 1981).

2.6 Summary

It is clear from a survey of the literature that library managers accept that accountability is a factor to be reckoned with. Consequently, the theoretical as well as practical issues pertaining to assessment, evaluation and performance appraisal receive attention. The methodology advocated and employed by the various perpetrators of evaluation exercises vary between hard quantitative measures of mathematical statistics to the perceptions theory of the behavioural sciences. There is, however, a perceivable shift towards an integrated approach where techniques from both categories are used to complement one another. This offers scope for a multidisciplinary team approach and a general enhancement of the quality of library evaluation research and the credibility of the results obtained.

There is a growing awareness of and emphasis on the use of standard, repeatable methodology. Certainly, the oversimplified approach of basing conclusions on the results obtained from conducting a user survey by means of an imperfectly constructed questionnaire, is seen as suspect and even dangerous. Bibliometric methods, especially those of citation analysis, are gaining in popularity. There is, however, also an awareness of the inherent dangers in misinterpreting the mass of data so easily obtainable from a proliferation of electronic databases.

The effectiveness of library systems and functions as a whole are seen as suitable areas for assessment. The very diversity of such operations necessitates a compartmentalization for assessment purposes. These subsystems should be evaluated against standard criteria. Only an awareness of the "state of the art" of the functionality of an area within the library system makes measurable objectives for the maintenance of the high standard or improvements thereof possible. The functions involved in document delivery receive a fair amount of attention as it is a visible and client-centred part of the service. Within the sphere of information science in library services, the research with the greatest impact on other information science researchers seem to concentrate on determining the availability of documents in library systems.

3 THE CHARACTERISTICS OF JOURNAL ARTICLES WRITTEN AND CITED BY SOUTH AFRICAN BIOMEDICAL RESEARCHERS

- 3.1 Introduction**
- 3.2 Rationale for selecting characteristics**
- 3.3 Source of the data used in this study**
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- 3.4 Statistical procedures and presentation**
- 3.5 Identification and description of characteristics**
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 - 3.5.3.3.3 Number of references to other material**
 - 3.5.4 Qualitative criteria**
 - 3.5.4.1 Inclusion by major indexing services**
 - 3.5.4.2 Inclusion by PISAL**
 - 3.5.4.3 SCI Impact Factor**
- 3.6 Conclusions**

3.1 Introduction

Scientific research is primarily published and disseminated in serial or journal publications. The published information is available and can be used as a building block in the creation of new knowledge. The journal is the major formal channel in which research and other scholarly activities are recorded and communicated (McCain, 1991). Price proposed, as a formal definition "to take as science that which is published in scientific papers" (Price, 1969), while Cronin (1984:2) calls the scholarly journal "the scientific establishment's ledger of achievement and roll of honour wrapped into one." The fundamental unit of investigation selected for this study is therefore also the article or paper as published in a research journal.

According to Braun *et al.* (1985:5) :

"Bibliometrics considers books, periodicals, etc. as formal and tangible documents, its major purpose being the quantitative analysis of library collections and services with a view to improve scientific documentation, information and communication activities. Scientometrics analyses the quantitative aspects of the generation, propagation and utilization of scientific information, in order to contribute a better understanding of the mechanism of scientific research as a social activity".

In terms of this definition, the present study can be regarded as an attempted synthesis of these approaches. The basis of this project is the investigation of specific characteristics of journal articles written and cited by South African biomedical researchers.

3.2 Rationale for selecting characteristics

The literature of bibliometrics, scientometrics and citation analysis as well as texts on scientific communication were consulted. There are numerous publications that proved particularly useful in the selection of relevant attributes for this project, e.g. Fussler (1949); Bourne (1962); Gottschalk & Desmond (1963); Garfield (1963, 1976, 1986); Price (1965, 1969); Orr & Leeds (1964); Martyn & Gilchrist (1968); Sengupta (1972); Line & Sandison (1974); Narin & Carpenter (1975); Frame & Narin (1977); Narin & Moll (1977); Hjerppe (1978, 1980); Braun *et al.* (1985).

The characteristics of journal articles examined during the research project form four broad categories, geopolitical locality, chronological attributes, quantitative factors and qualitative criteria.

3.3 Source of the data used in this study

Specific characteristics of the journal articles used for the construction of the citation pool were analysed concurrently with the availability study described in the next chapter, where the method used to select these journal articles is also discussed more fully.

It should be reiterated that two separate but linked sets of data were used -

1. A population of 320 journal articles published in 1989 by South African authors, hereafter called SET A for brevity.
2. An older population of 307 journal articles, a sample of the articles cited in the 1989 publications mentioned above, hereafter called SET B.

3.3.1 Gathering and recording the data

The Institute for Biomedical Communication maintains an archival copy of each item indexed and found in their SAMED database. SET A was obtained from this database. The researcher had full access to this archive of publications, as well as work space and the use of a computer for recording the variables of each article in SET A. SET B, however, consists of a sample of citations from SET A and were not conveniently deposited in a central location. The articles were dispersed and not necessarily available for scrutiny. An example of an element left out of the analysis of the articles in Set B is the proportionate representation of types of publications (monographs or journals) in the list of citations.

SET B was also the citation pool used for the Document Delivery Test. This determined the need for two elements thought to be linked to availability, namely whether a journal title was found in PISAL, as well as its SCI Impact Factor. These attributes were not dependent on the examination of the source publication. Neither of these attributes was included in the description of SET A.

Most of the characteristics analysed were common to both sets of data, but certain elements were only recorded for one of the sets. There were two causes for the discrepancies :

1. The accessibility of the documents in SET A made more detailed analysis of their properties possible, while time and logistical factors prevented fuller attention to the articles represented in SET B.
2. Attributes related to availability of documents, were more relevant to the items in SET B.

The following variables were noted and considered in the analysis of SET A:

- Number of authors
- Number of pages
- Number of citations
- Number of citations to monographs
- Number of citations to journal articles
- Number of citations to different journal titles
- Number of citations to the source journal
- Date of the earliest citation
- Date of the most recent citation
- Chronological span
- Geopolitical region of publication
- Inclusion by major indexing services
- Subject (of funded project)

The data from the publications in SET A were recorded in a spreadsheet using the IBC inhouse program 20/20 (See APPENDIX 2). WordPerfect was used to convert the data for entering on the MRC mainframe computer.

A somewhat different approach had to be used to collect the data from the items contained in SET B. Items were physically traced and examined where possible. Items not readily available, were verified bibliographically. VPPlanner Plus software was used to record the data, which was subsequently uploaded to the mainframe computer (See APPENDIX 5).

The traits identified were:

- Publication date
- Number of authors
- Number of pages
- Number of citations
- Date of the earliest citation
- Date of the most recent citation
- Chronological span
- Geopolitical region of publication
- Inclusion by major indexing services
- SCI Impact Factor
- Inclusion in PIsal

3.4 Statistical procedures and presentation

All statistical analyses were done by using the Statistical Application Software (SAS) program. Great care was taken to ensure the correctness or "cleanness" of the data. Values are only absent where unavailable. In certain cases, extreme values were omitted to enhance the graphic presentation. Where appropriate, figures are rounded to the second or third decimal. Caution should be exercised where small subsets of data occur in comparison with much larger groups, as this influences the reliability of deductions.

The analysis of the results involved descriptive statistics, with the emphasis on specific attributes, characteristics or variables. Measures of statistical location that describe different *average* values, such as the concepts *mean*, *median*, *mode*, were mainly used. In the standard tables of descriptive data the *median* was mostly preferred to the *mean* or *mode* as it ensures an equal number of sample points on either side thereof. The comparison of the arithmetic mean with the median is an indication of the *skewness* of a distribution. The box-and-whisker plot is a graphic method well suited for comparing data, as it can succinctly illustrate the differences in distribution of values from multiple subsets.

Most of the emphasis fell on the analysis of univariate values, although bivariate analyses were found appropriate in illustrating differences in distribution according to, for instance, the country or region where journals originated.

Extensive use is made of graphic presentation of the data.

3.5 Identification and description of characteristics

The different attributes of each set of data are discussed and illustrated to strengthen the veracity of deductions. Where possible, the local findings are compared to results reported in other studies reported in the literature.

3.5.1 Attributes related to geographical locality

In the geographic sense, the word 'locality' is synonymous with 'place' or 'position'. In the present context, it has two meanings

1. The place of publication, i.e. the geographical or national origin of a journal.
2. The conceptual position within the family of scientific knowledge.

3.5.1.1 Geopolitical region

The scientific output of a country or nation is measured in terms of the publication activity of its scientists (Narin & Carpenter, 1975:80). The use of literature as an indicator of national scientific activity has a long tradition in science. In the preface of his seminal work, "*Little Science, Big Science*", Price states his intention to treat science as a measurable entity: "I shall attempt to develop a calculus of scientific manpower, literature, talent, and expenditure on a national and on an international scale" (Price, 1963:xvi). The data he used so effectively were the publications of science.

Narin & Moll (1977:36) refer to a count and elementary categorization of publications by country and field as "the most basic bibliometric data", while Hjerpe (1978:25) includes place of publication in what he calls "the most obvious variables (features) of a document that can be analyzed in a bibliographical study using a journal article". The majority of bibliometric studies perused by the researcher include at least some reference to the country of publication.

Results of this investigation

The present study is by the very nature of its objectives, a regional exercise as it aims to investigate the characteristics of articles used by and published by South African biomedical researchers.

Five geopolitical areas were identified and tabulated, namely the United States of America, Republic of South Africa, Europe, United Kingdom and an 'Other' category for all international publications emanating from areas outside the four regions already specified, e.g. Australia or India.

The regional representation of the journals in each data set is enumerated in Table 3.1 and illustrated graphically in Figure 3.1.

Table 3.1 *Distribution of source journals according to place of publication*

	USA	RSA	EUROPE	UK	OTHER
	Number of documents				
SET A	83	110	42	73	12
SET B	175	19	49	58	6
	% Occurrence				
SET A	25.94	34.38	13.13	22.81	3.75
SET B	57.00	6.19	15.96	18.99	1.95

An analysis of this comparison and data from the SAS tables support the following observations:

SET A

- * The high local publication rate; 11.56% of the articles were, for instance published in *South African Medical Journal*.
- * South African authors publish 65.62% of their papers in international journals indicating their acceptability by peers outside the country.
- * South African authors publish an almost equal number of articles in American and British journals (25.94% : 22.81%), although citing predominantly from American journals (57% : 18.99%).
- * Although a high percentage of the articles were published in South Africa, the combined number of articles published in the rest of the Western world exceed the local sources.

SET B

- * Articles published in American journals rank first in the bibliographies of SA authors (57%).
- * Journals emanating from Britain and Europe form a sizable subset (34.95%) of publications.
- * The influence of the Western hemisphere, i.e. the USA plus the EEC countries dominates the source of information with a 91.86% share of the cited publications.
- * Very few articles from South African journals are cited, a total of only 19 articles (6.19%) out of a possible 307. *South African Medical Journal* accounted for 12 of these citations (3.91%).

The seeming dominance of local publications in SET A could arguably have resulted from the timing of the analysis, which was undertaken in July 1990, i.e. some six months after the end of 1989, which was the publication date in question. The IBC had by then (July 1990) received 450 items for indexing. Of these 324 were journal articles linked to MRC research funds. One year later, the numbers had grown to 843 and 406 respectively. More are expected. (The disproportionate growth in the number of items in the database that are not linked to MRC funding results from the less specialised indexing undertaken for the *Index to South African Periodicals*).

It would not be unreasonable to suppose that the IBC is more likely to receive local publications for indexing more quickly than reprints of articles published in international journals. If it were so, it would understandably influence the geographic composition of the SAMED database. To test this assumption, the IBC database was interrogated a year later, i.e. June 1991. The results are presented in Table 3.2. The "local publications come in faster" theory is disproved as the extra year caused no significant change in the composition of the origin of publications in SET A. The South African share of publications is, in fact, marginally higher than it was in the middle of 1990, as is the percentage of American-published articles. The more recent tally of articles published in European and British journals show a drop when compared to the 1990 figures.

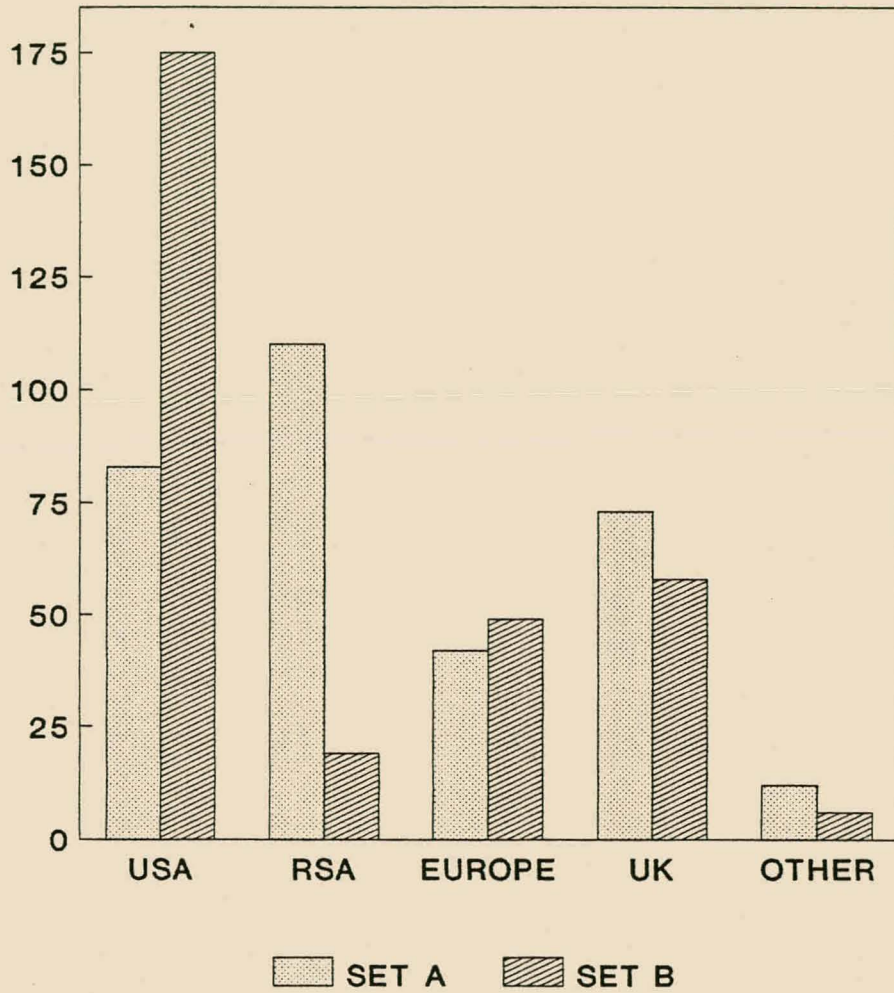


Fig 3.1

Distribution of source journals by place of publication: SET A & SET B

Table 3.2 Distribution by place of publication of 1989 articles in the SAMED database

	USA	RSA	EUROPE	UK	OTHER	TOTAL
1991	109	142	50	84	20	405
%	26.91	35.06	12.35	20.74	4.94	100.00
1990	83	110	42	73	12	320
%	25.24	34.38	13.13	22.81	3.75	100.00

In addition to the specific geopolitical perspective, locality was found to have a bearing on the results of some of the other variables under investigation, e.g. the number of authors per paper was affected by the place of publication. These perspectives are discussed in the appropriate sections.

3.5.1.2 Subject locality

In a narrower sense, the subject matter of a publication places the contribution within the larger body of knowledge i.e. an intellectual or academic location. Several studies of individual journals or subdiscipline groupings have been reported, e.g. Sengupta (1972); Narin *et al.* (1976); Swanson (1987).

Subject specialization : results of this study

A finer subject categorization within South African biomedicine was explored in this study. Only the subject matter of the papers by South African authors (SET A) was noted.

The SAMED database includes as one of the indexed fields, the subject category corresponding to the registered project for which MRC funding had been granted. There are currently 25 fairly general subject areas (Table 3.3). A record of the subject category of each paper formed part of the data gathered for SET A. These data represent a part of the research output of one year only. No valid deductions can thus be made on the basis of a one-off time slice. A similar analysis over a longer time period offers scope for further research.

Table 3.3 *Research projects funded by the MRC*

Biomedical engineering
 Bone research
 Cardiology
 Community health
 Dentistry
 Endocrinology
 Environmental and occupational health
 Gastroenterology
 Genetics
 Gynaecology, obstetrics and neonatology
 Haematology
 Immunology
 Microbiology
 Molecular biology
 Nephrology, urology and andrology
 Neurology and neuroscience
 Nuclear medicine and imaging methods
 Nutrition
 Parasitology
 Pathology, cell biology and embryology
 Pharmacology and anaesthetics
 Psychiatry and mental health
 Pulmonology
 Radiotherapy and radiobiology
 Virology

The subject categories in which at least 16 papers (5% of the total) had been published, are shown in Table 3.4. The "N" value is the actual number of articles; the percentages refer to the "N" of the specific subject, not to all of the articles in SET A.

Table 3.4 *Distribution of subject categories ranked according to journal origin*

	N	USA	RSA	EUROPE	UK	OTHER
Nutrition	27	22.22	25.93	18.52	18.52	14.81
Molecular biology	24	16.67	16.67	20.83	45.83	0.00
Genetics	21	14.29	14.29	33.33	28.57	9.52
Immunology	21	33.33	28.57	14.29	23.81	0.00
Neurology	21	47.62	23.81	9.52	19.05	0.00
Parasitology	20	10.00	65.00	0.00	25.00	0.00
Cardiology	17	64.71	11.76	5.88	5.88	11.76
Endocrinology	16	31.25	12.50	37.50	18.75	0.00

The most productive subject was NUTRITION, with 27 counts (8.44% of the articles), followed by MOLECULAR BIOLOGY with 24 counts (7.50%), the third spot with 21 counts (6.56%) is held jointly by GENETICS, IMMUNOLOGY and NEUROLOGY. An analysis of where these articles were published was done for each subject. There is a relatively even distribution between local and international publications, with three exceptions : all four articles in the category CLINICAL PSYCHOLOGY as well as all of the fourteen articles in the category COMMUNITY HEALTH were published in South African journals, suggesting that it is more appropriate to publish articles of specific local interest in local sources. The articles representing PARASITOLOGY also appeared mainly (65%) in South African journals. Articles on cardiological research seemed much more likely to appear in American journals, while genetic research favoured European and British publications to American. Again, the sample is really too small (between 1 and 27) to be significant for generally valid deductions. A longer time span and therefore a greater number of papers could be used to correlate research funding with research output.

3.5.2 Chronological characteristics

In scientometric studies, the time perspective are essentially of two kinds :

1. Static, i.e. the study describes a situation at a specific point in time
2. Dynamic, i.e. the study traces the temporal (citation) pattern identified in the study units (Hjerpe, 1978).

In this project, elements pertaining to both of these approaches will be used.

The temporal or time perspective within each data set is analysed from four interrelated perspectives :

1. The date of the publication itself
2. The date of the earliest document cited
3. The date of the most recent publication cited
4. The time span, i.e. the difference between the earliest and most recent dates.

The date when a publication becomes available to the scientific community is significant in terms of intellectual stake claiming. The chronological variable is inevitably linked to bivariate or even multivariate relationships with other attributes and their distribution.

The force driving scientists to lay claim to newly won knowledge as their own, what Price called "the never-gentle art of establishing priority claims" (1963:59) emphasizes the importance of the date of a publication. It is also an essential element in the analysis of the chain of scientific communication.

There are several factors that influence the time span linking a current publication with its earliest citation. According to Line & Sandison (1974), literature may decline in use more slowly when

- * It is descriptive (e.g. taxonomic botany or methodology).
- * It deals with concepts (e.g. philosophy).
- * It is critical.

Fussler (1949:85) used the pleasing phrase "temporal span of the literature" to describe the time period that elapses between publication and acknowledged use (citation) of an article. The concept of obsolescence is an integral part of any discussion of the use of literature over time as explained in the review article by Line & Sandison (1974).

The date of the most recent citation referred to, is the other extreme time parameter in the chronological span of the subject literature. Information about the age of the latest publications indicates the rapidity with which publications are disseminated and incorporated into the research cycle.

Chronological citing patterns vary between different scientific disciplines (Fussler, 1949; Price, 1970; Line & Sandison, 1974). Local factors are also likely to influence these patterns, even in a subject area as well established and researched as biomedicine. All the time related aspects of journal literature used by South African researchers will be included as part of the present project.

Results of this study

3.5.2.1 Publication date

The articles in SET A were all products of the 1989 publication year. The dates of the papers they cited as references, i.e. SET B, provide an interesting perspective on the age of documents used. A median value of 1982 means that 50% of the references were published in the last seven years and 75% during the last 12 years of the period under review.

The histogram in Fig 3.2 illustrates that the cited articles incline towards recent publications.

The accumulative diagram of the results between the years 1910 and 1989, as depicted in Table 3.5, further emphasizes the strong bias towards recently published information

Table 3.5 *Distribution of publication age of references cited by SA authors*

YEARS	% OF TOTAL	CUMULATIVE %
0 - 4	29.1	29.1
5 - 10	37.2	66.3
11 - 20	22.3	88.6
21 -79	11.4	100

Price (1965) calculated that 30% of the citations used in science literature are highly selected references to recent publications between 1 and 6 years old. The other 70% represents a random distribution of all the papers that have ever been published, regardless of date.

The effect of geopolitical factors on publication date

The country or region where the source journal is published was used as a parameter in investigating the variable "date of publication" of the articles in SET B. The position of the median and mean as shown in the side-by-side plots in Fig. 3.3 indicate that publications emanating from the USA represent more recent literature than the other origins. All the distributions are positively skewed, with the exception of the UK, where the spread is symmetrical.

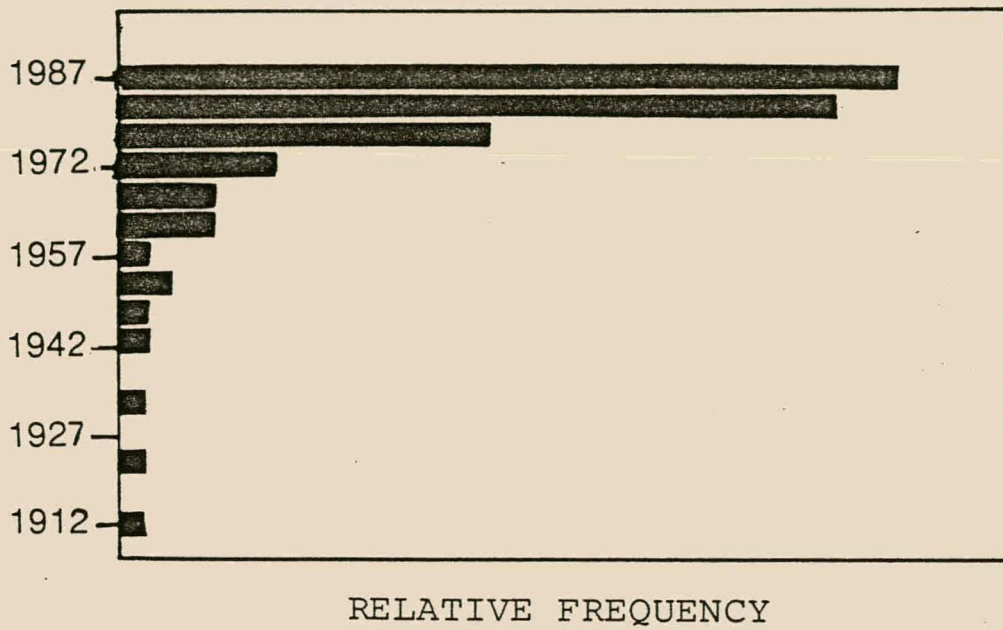


Fig 3.2 *Distribution of articles in SET B by date of publication.*

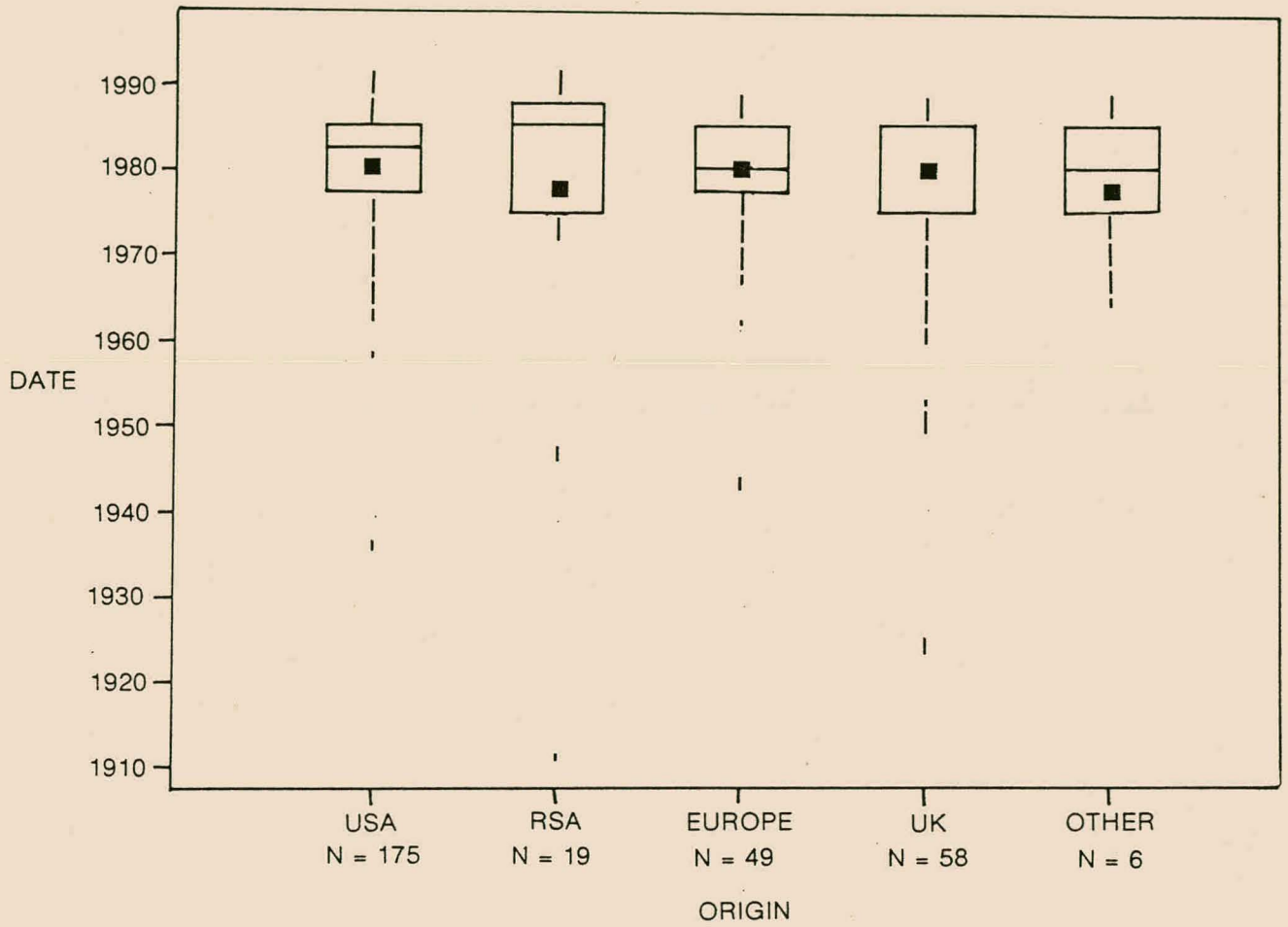


Fig 3.3

Geographic distribution of articles in SET B according to date of publication

3.5.2.2 Date of the earliest cited reference

The availability of two sets of data has the advantage of comparative analysis. In SET A the oldest publication dates from 1841, with the median earliest citation date at 1965, 24 years before the source publication appeared in print (1989); SET B went back as far as 1812, although the median value was 1957, 24 years before its median publication date (1982).

When comparing the data from SET A with those in SET B, it should be stressed again that the source articles in SET B did not appear in the same year, whereas all the papers in SET A came from 1989. The relationship between the date of earliest citation and the publication date of the article in SET B is illustrated as a scatter diagram in Fig 3.4.

In the next graphic presentation, Fig 3.5, the distribution of the earliest citation for SETS A and B are compared and found to be remarkably similar to each other.

Extreme values were left out of the range to improve the dimensions of the graph. The size of the symbol is directly related to the number of observations at that position. The markings on the periphery suggest individual occurrences rather than trends. The pattern also illustrates that many of the more recent publications cited some of the earliest publications. There will always be relevance in classical papers, as well as taxonomic firsts in disciplines such as mycology and bacteriology. One could surmise that improved retrieval and document delivery procedures increase the probability of older documents being used and cited.

3.5.2.3 Date of the most recent cited reference

The source articles in SET A were all published in 1989 journals; it is significant that 60 included 1989 citations and 130 cited 1988 publications. One article had a 1979 publication as its latest reference. The median date of the latest citation was 1988, indicating that 50% of the latest references were that recent.

The median date for the latest citation in SET B is 1981 which is also only one year short of its median publication date; the incidences spanned from one in 1923 to one in 1989. The scatter-plot in Fig 3.6 clearly shows the majority of most recent citations in relation to the date of the source publication of articles in SET B, are concentrated in the 1980 + period.

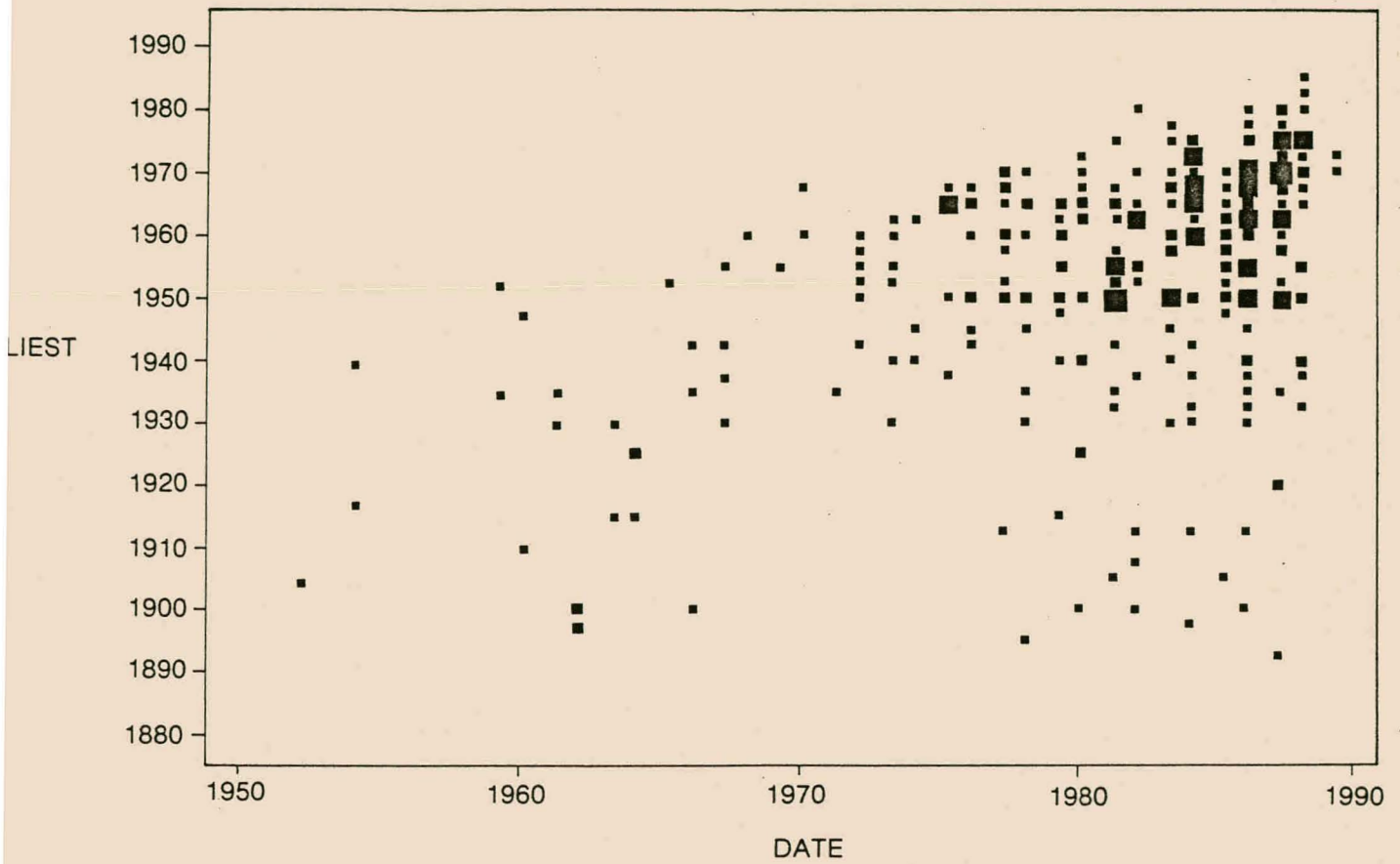


Fig 3.4 *Scatter diagram of publication date of articles in SET B in relation to the date of its earliest citation*

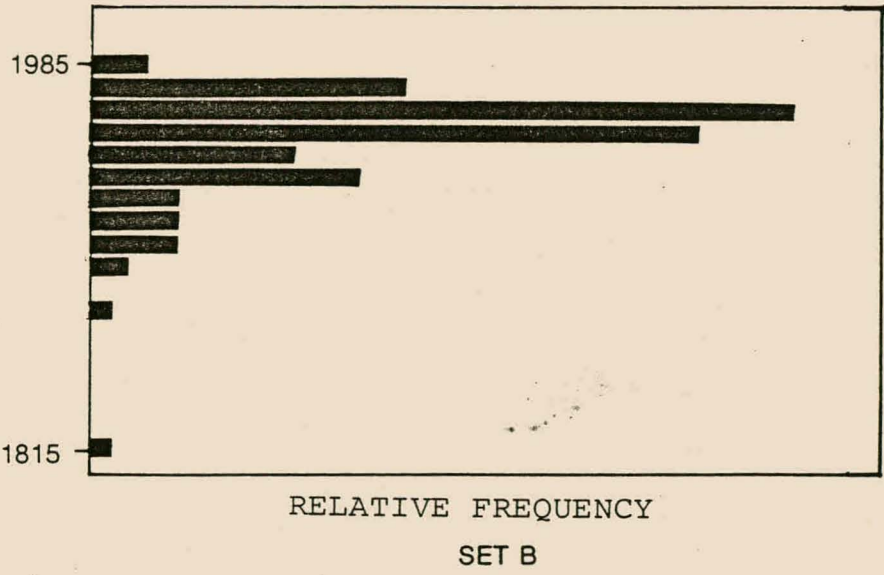
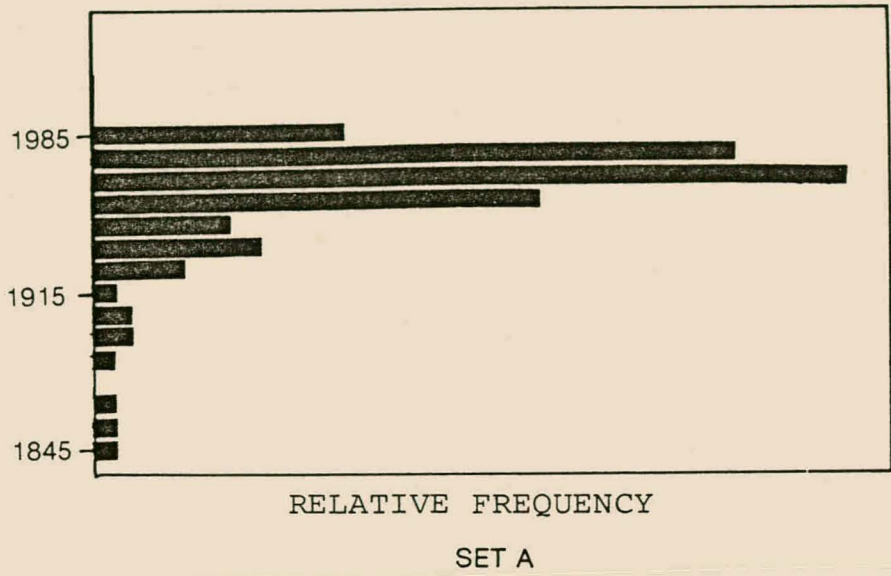


Fig 3.5 *Distribution of earliest citations in SET A & SET B*

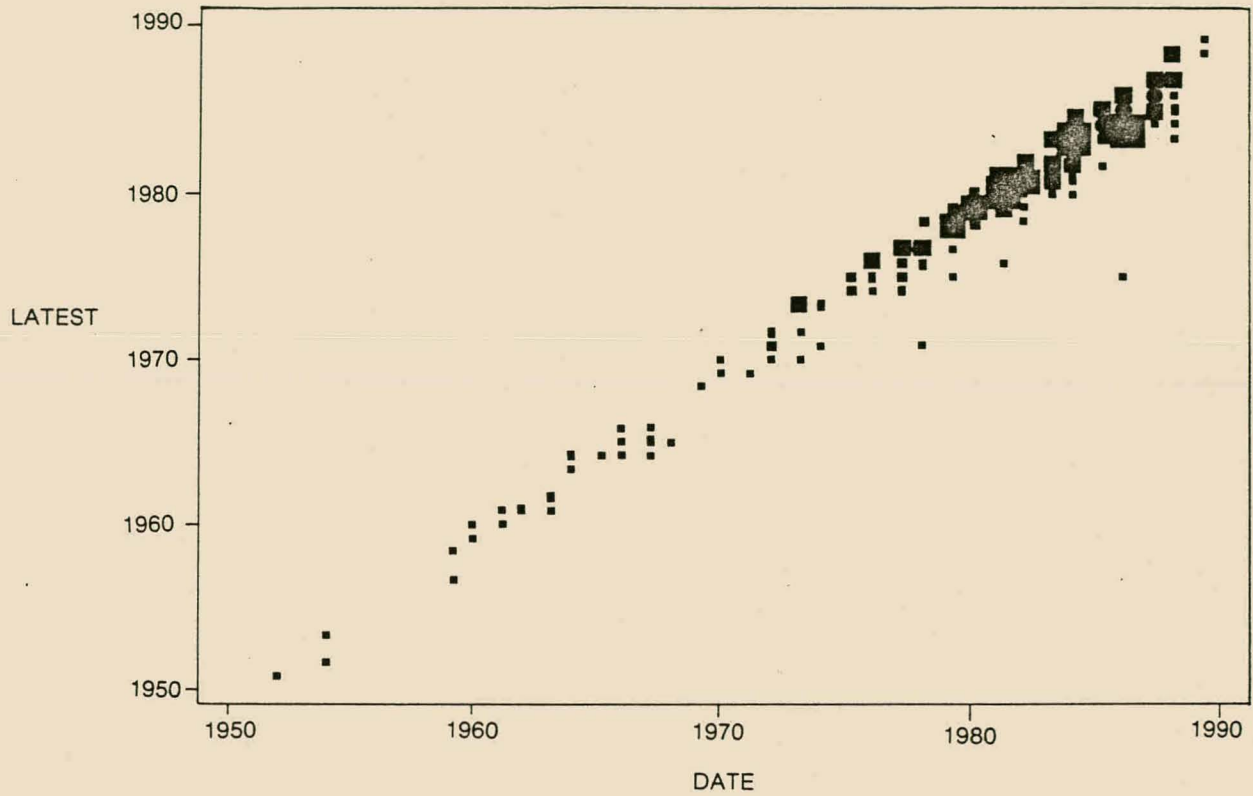


FIG 3.6 *Scatter-plot of publication date of articles in SET B and the date of its most recent citation*

Figure 3.7 illustrates the distribution trends of most recent citation dates, from both sets of data. The distribution patterns are very similar, as was the case with the earliest citation. In SET A, publications from the first year is well represented, the second year has the most occurrences, followed by still strong but diminishing counts in the third, fourth and fifth years. SET B showed the same trends, although the first six years show strong activity. The longer span can be ascribed to the range in publication dates from SET B documents. Essentially, the picture is the same : a strong emphasis on the use of recently published material.

3.5.2.4 Chronological span

The citation "life" of the literature of a discipline is important. In terms of practical librarianship, for instance, there are implications affecting open shelf and remote storage decisions. Line & Sandison (1974) and Price (1963) contributed to this debate.

The median time span of cited material in SET A is 22 years, against the 23.5 years in SET B. As is the case with the other chronological attributes, the patterns formed by the time range in each data set is very close to the other (Fig 3.8).

In summary, the chronological attributes of both sets of data are given in Table 3.6.

Table 3.6 *Medians of the chronological attributes of journal articles*

ATTRIBUTES	SET A	SET B
Publication date	* 1989	1982
Earliest reference	1965	1956
Latest reference	1988	1981
Time span	22 years	23.5 years

* The actual date, not a median.

Unlike other characteristics, the chronological factor did not seem to be affected by the geographic distribution of the source journal, with the possible exception of the date of publication of articles cited by South African researchers: the median publication date was older than for instance American source publications. As there are only 19 references to South African journals, it cannot support anything but preliminary deductions.

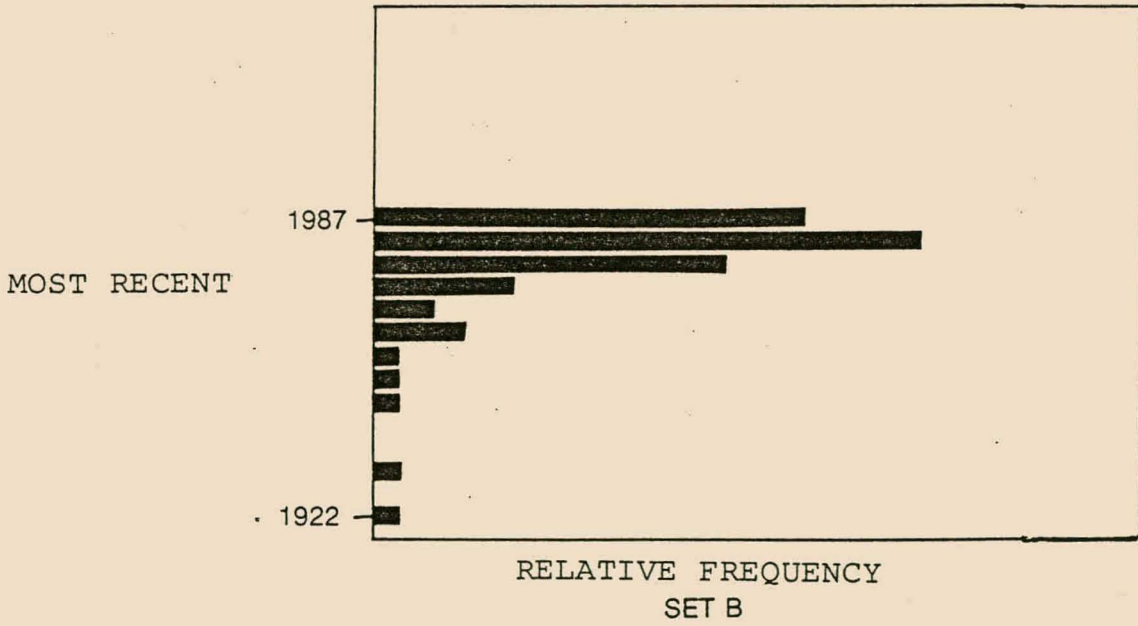
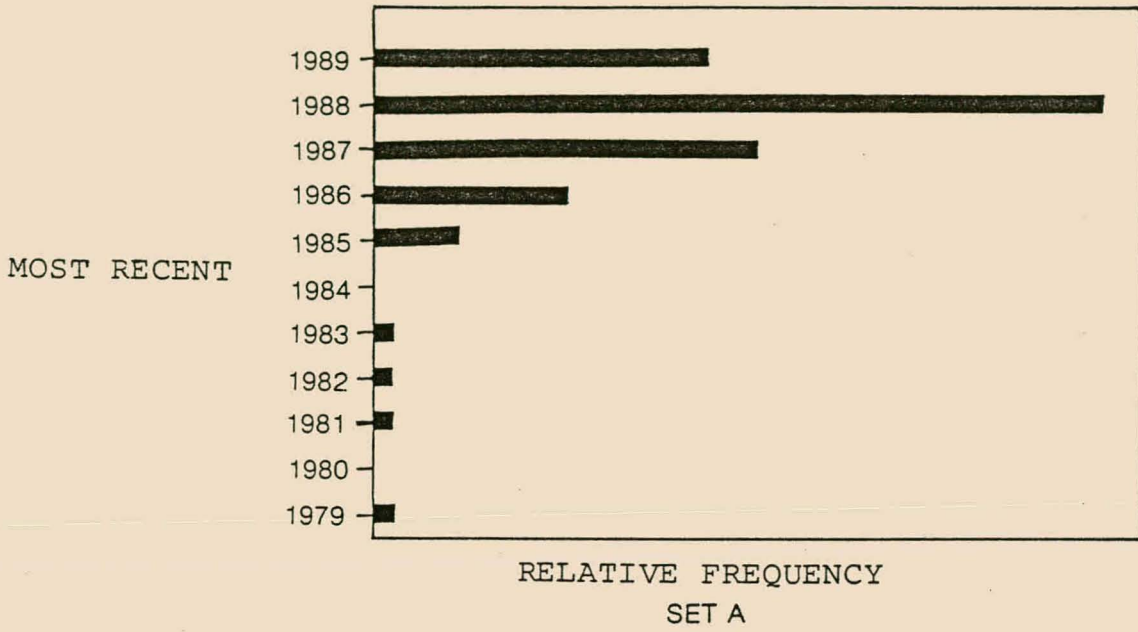


Fig 3.7 *Distribution of most recent citations in SET A & SET B*

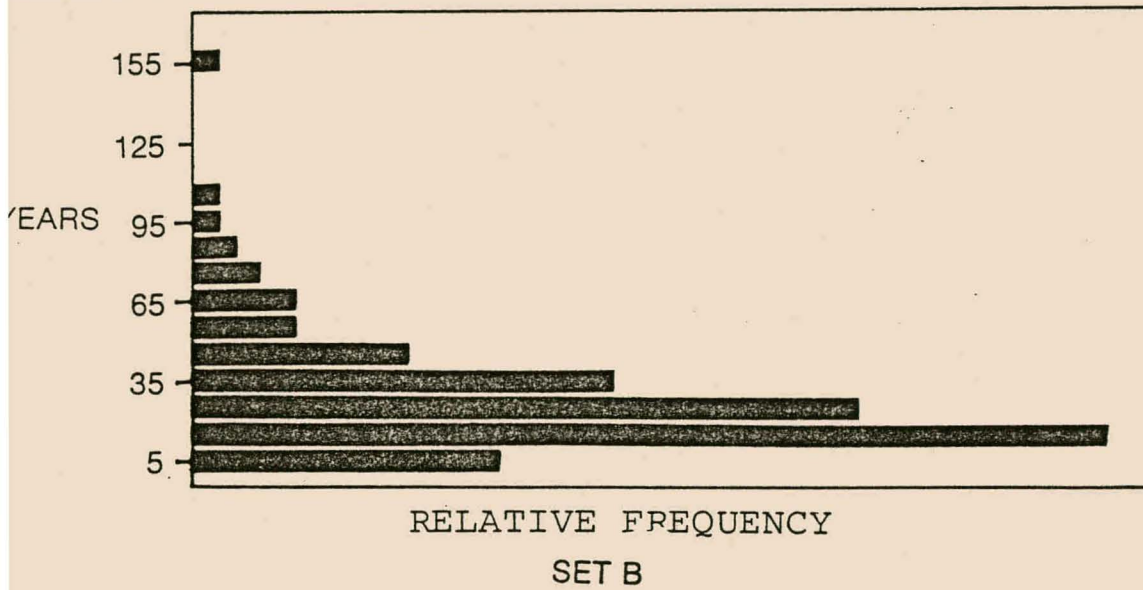
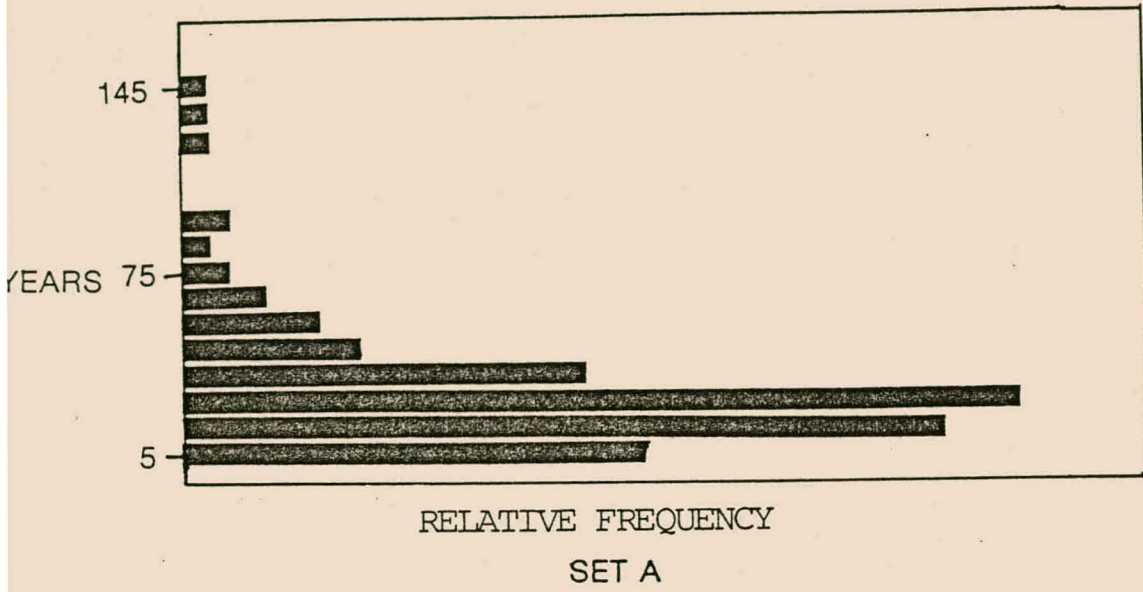


Fig 3.8 *Distribution of time range in SET A & SET B*

The chronological profile of articles published and cited by South African researchers is similar to the results of citation studies in other scientific publications. This is illustrated especially by the consistently similar dynamics in the use of information illustrated by the papers in SETS A and B.

3.5.3 Quantitative criteria

The numerical characterization of publication productivity is based, according to Hjerpe (1978) and Braun *et al.* (1985), on the following primary units:

Number and distribution of publications

Number and distribution of authors

Number and distribution of pages

Number and distribution of references

Number and distribution of citations

The variables grouped together as quantifiable characteristics in this study are the *number of authors, number of pages, number of references and number of the different types of references.*

3.5.3.1 Number of authors

In statistical terms, the number of authors of an article is a discrete variable.

Price (1963) discussed the phenomenon of multiple authorship in historical context. He used data from *Chemical Abstracts* showing that at the beginning of this century more than 80% of all papers had a single author, and almost all the rest were pairs, mostly a professor and his graduate student. Since then, the trend towards multi-author papers has increased steadily. Price predicted "if it [the rate of increase] continues at the present rate, by 1980 the single-author paper will be extinct." At that time, 1963, only one paper in four had a multiplicity of three or more authors, but as the three-authored papers were accelerating more rapidly than two-authored, four-authored more rapidly than three authored, Price expected more than half of all papers to be in that category by 1980 "and we shall move steadily towards an infinity of authors per paper".

Clarke (1964) refuted Price's extrapolations concerning the exponential increase in number of authors per paper and claimed that biomedical journals could not be compared with e.g. chemistry journals. She predicted that in the year 1980, the average number of authors per paper would still be about 2.3. She concludes her rather controversial comparison between authorship habits of biologists and chemists by speculating that the difference (i.e. higher incidence of collaboration between chemists) can be ascribed to the maturity of seasoned (biological) scientists who have less need for multiple research collaboration than do the chemical writers who are, *on the average*, less well established as independent investigators.

Price ascribed the trend towards multiple authorship to a diminishing ratio of scientific manpower to number of papers appearing in a given discipline. In 1963 he gave 2.5 to 3 authors as the average for a scientific paper. Despite differences of opinion on the extent of multiple authorship, the phenomenon has certainly become the accepted norm for non-review articles (De Villiers, 1984; Ajiferuke, 1991). Coincidentally, the latter articles were both written by single authors.

De Villiers (1984) compared articles published in the *South African Medical Journal* in 1971 with those that appeared in the same journal in 1982. He found a significant rate of increase in the number of authors per article (mean number 1.77 and 2.35 respectively) and diagnosed the growing trend towards multiple authorship as a symptom of the 'publish or perish' syndrome. De Villiers further speculated that the previously dominant role of review articles had been taken over by research articles; possibly heads of departments had become more prone to tag their names to articles emanating from their departments; perhaps those people who previously merely received an acknowledgement, now insisted on author status and, more positively, perhaps members of departments collaborated better these days.

Although Price's (tongue-in-the-cheek) prophecy of the demise of the single-authored article has not quite come about, there was a strong case to be made for measuring the level of collaboration between South African biomedical researchers.

Results of this study

The findings in this study contradict Clarke's projection. A median of 3.39 authors per paper was represented in SET B (median publication date = 1982, mean date = 1979). In table 3.7, a comparison of the data from SET A and SET B shows an increase in the number of authors of articles published in American biomedical journals over a relatively short period of time, 7 to 10 years.

The authorship of articles written by South African researchers is very similar to tendencies described in the literature. In SET A the number of authors per article ranged from 52 incidences of single authorship, to one article with 14 collaborators. The mean average for the documents written by South Africans was 3.34 authors per article (Std Dev 1.91) and a median value of 3.

The side-by-side plots (Fig 3.9) illustrate the distribution of the number of authors per article in each set. The graphs are almost identical, with median values, first and third quartiles seemingly the same. It shows a few extreme values in SET A. In other words, some articles in SET B had extraordinarily many authors for the same article. One paper was, in fact, written by 27 authors.

Origin of source publication

When the data is broken up according to the place of publication of the source journal (Table 3.7), the distribution pattern differs markedly. The mean of 2.59 authors per article in South African (1989) publications is indeed comparable with the evidence on authorship of articles in *South African Medical Journal* presented by De Villiers (1984). Although there is an indication of an increase over the last seven years (from De Villiers' 2.35 to the present study's 2.59), the multi-authorship figures in local publications are considerable lower than those in all the other regions, but especially when compared to articles in American and British biomedical journals.

Table 3.7 *Distribution of number of authors per article according to place of publication*

	USA	RSA	EUROPE	UK	OTHER
SET A					
N=	83	110	42	73	12
Mean	4.02	2.59	3.60	3.63	2.91
Std Dev	2.32	1.36	1.38	2.07	1.56
Median	4	2	4	3	3
SET B					
N=	174	19	48	56	5
Mean	3.35	3.21	3.85	3.30	2.00
Std dev	1.76	2.66	3.98	2.21	1.22
Median	3	2	3	3	2

South African published articles are characterized by a smaller number of authors per paper than those published in especially American and British biomedical journals. The limited study undertaken by De Villiers (1984) is supported by the data collected in this study; there is a slight increase over the last seven years, from 2.35 in 1982 (De Villiers, 1984) to 2.59 in 1989 as established by this study. The increasing trend predicted by Price is also borne out when comparing the number of authors per paper published in American journals, a mean of 3.35 in SET B (*circa.* 1982) to 4.02 in SET A (1989), approximately 7 years later.

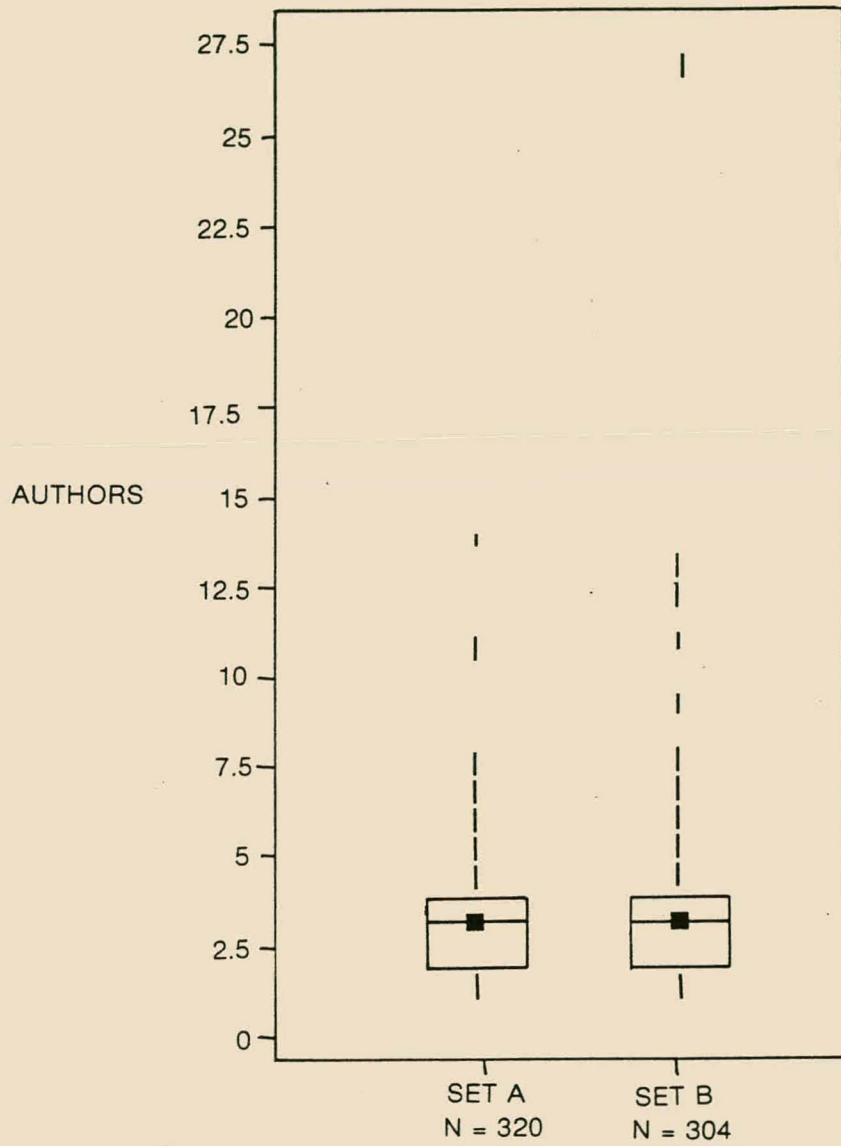


Fig 3.9

Comparison of distribution of authors in SET A & SET B

3.5.3.2 Number of pages

The length of an article is a frequently used measure or attribute. A variety of physical measures have been used to assess the amount of information contained in a scientific article, e.g. counting pages, number of words, even calculating the mass of paper. After investigating the different methods, Orr & Leeds (1964) stated that they had not found appropriate data for assessing the average length of biomedical papers. It is, at best, a quantitative indicator and length cannot be equated with quality of content.

Results of local study

The use of number of pages to an article was limited to possible correlations with other variables within the controlled data obtained from this study, not as a direct or quantitative comparison with other collections of literature.

The number of words in an article provide a far more accurate indicator of length, as the physical page size of printed journals vary greatly. Typographical style also determines the capacity of a page. A word count was not a feasible option in the present study. The number of pages was manually counted and recorded.

With these limitations in mind, an arithmetic mean of 5.95 pages was established in SET A, with a markedly longer value of 8.56 pages in SET B. In SET A, one article was only one page long and the longest spanned 22 pages, whereas the spread in SET B varied between 2 and 83 pages. The analysis of this characteristic for both sets of data is given in Table 3.8. There seems to be a trend towards shorter articles, when comparing SET B (chronologically the first generation) and SET A, (the second generation).

One could speculate that the pressure to publish as many papers as possible, or salami slicing as it is scathingly referred to, influences the length of individual articles. A specific investigation of the publications in question may, however attribute the seeming shrinkage to typographical factors, e.g. printing economy. An in-depth analysis of the length of articles fell outside the scope of this investigation.

Table 3.8 *Statistical detail of page length of papers according to origin of source journal*

	USA	RSA	EUROPE	UK	OTHER
SET A					
N=	83	110	42	73	12
Mean	7.04	4.60	6.40	6.59	5.17
Std Dev	3.87	2.35	2.94	3.45	2.04
Median	6	4	6	6	5
SET B					
N=	174	19	48	56	5
Mean	8.94	4.95	9.08	8.42	5.40
Std Dev	8.01	3.72	7.26	7.48	3.21
Median	7	4	7	6	4

In Fig 3.10 the distribution of number of pages in each set of data is illustrated by means of side-by-side plots. The heavier tail depicting the number of pages in SET B indicate the presence of several exceptionally long papers; SET A is represented by a more contained box-plot, showing an even distribution of the data.

Geographic distribution

The effect of the geographic origin of the source journal on the number of pages is illustrated in Fig 3.11 for SET A and in Fig 3.12 for SET B. Both sets of data showed longer publications as originating in the USA, as well as ascribing singularly long articles to American journals. In both SETS A and B, the British and European profiles are similar to the American picture. South African journals show a somewhat different distribution of number of pages: the articles are markedly shorter than those occurring in journals of European or British extraction; the mean and median values are clearly lower than those of the other groups. The 'Other' category also indicates a tendency towards fewer pages per article, but the subset is too small for valid conclusions.

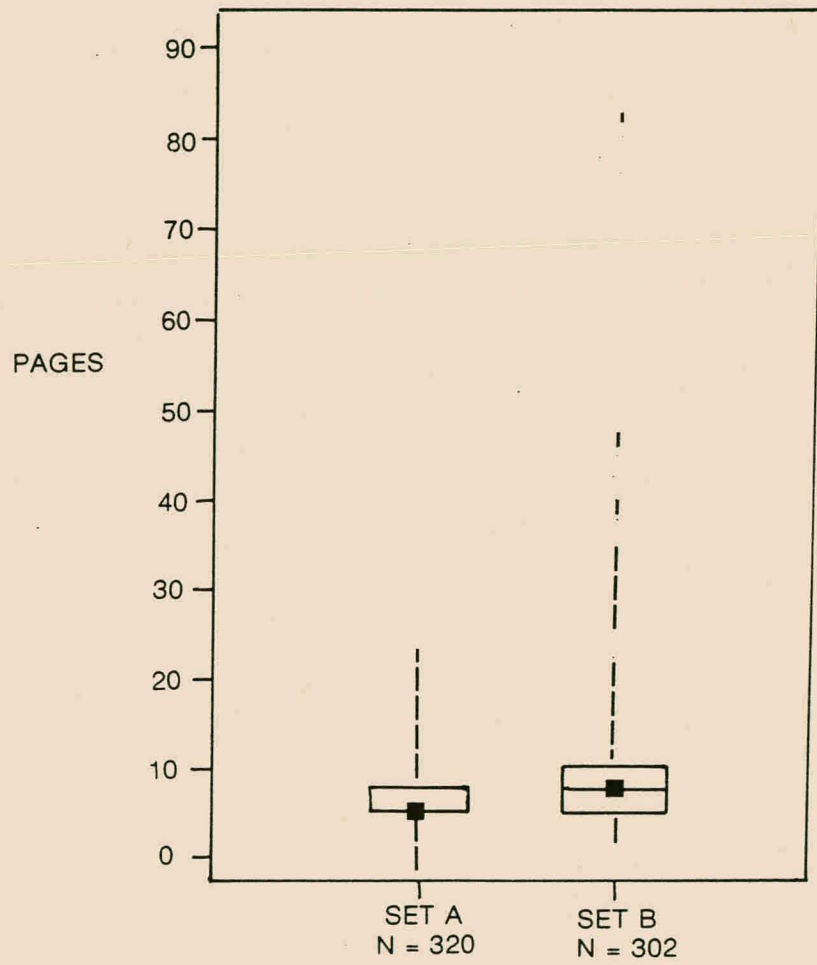


Fig 3.10 *Distribution of number of pages in SET A & SET B*

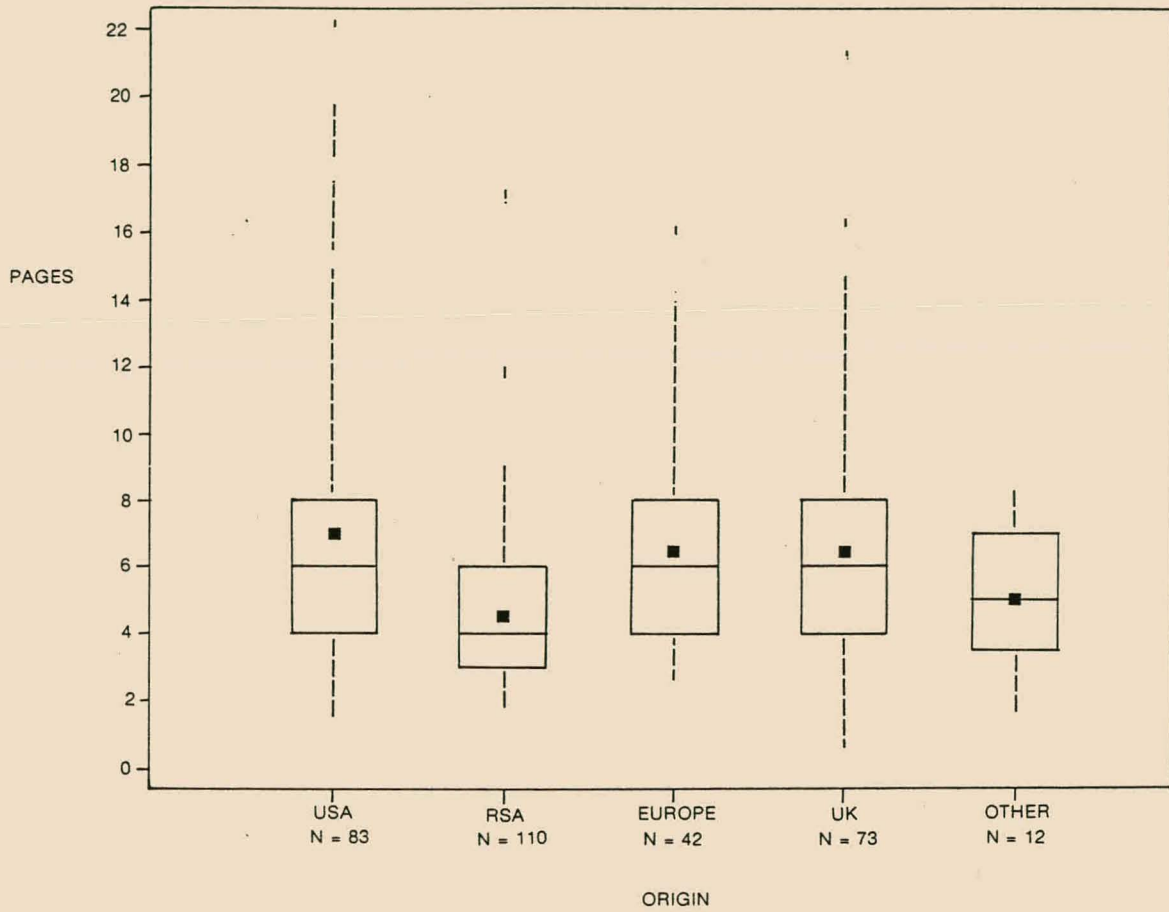


Fig 3.11

Distribution of number of pages per article in SET A according to the origin of the source journal

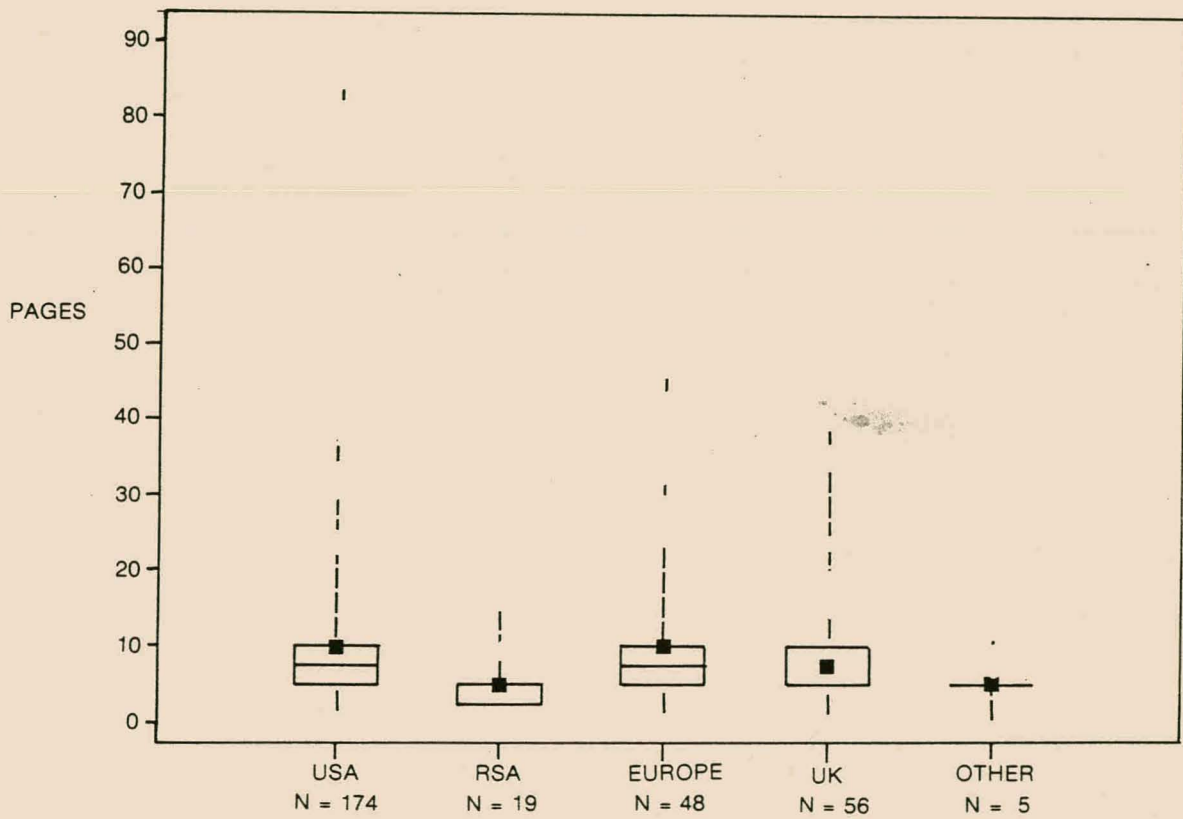


Fig 3.12 *Distribution of number of pages per article in SET B according to the origin of the source journal*

Relationship of length of article and number of references

A moderately strong positive correlation between page length and number of references was found in both sets of data. In SET A, the Spearman correlation between *Pages* and *Citations* (References) is 0.47673; in SET B even higher, 0.57246. In SET A the additional reference dependent variables, e.g. number of journals, number of journal self-citations and number of journal titles also show some influence of the length of the article.

This simply means that longer articles tend to list more references. One could speculate that the length of a paper is an indication of the amount of information conveyed and that it might conceivably acknowledge a proportionately greater number of previous publications.

Relationship with number of authors

The number of authors does not seem to have any influence on the length of an article, but the extreme values, i.e. very short or very long articles, only one or very many authors tend to represent single occurrences (Figures 3.13 and 3.14). Long articles occur more frequently where there are five or fewer authors.

3.5.3.3. Number and type of cited references

All scientific publications rely on a great number of ideas communicated previously. The authors of the papers do not treat these ideas at length, but instead refer to the publication where it is formulated more fully (Braun *et al.*, 1985). The product of such referral or act of acknowledgement of a previous publication is, in bibliographical terms, a citation. Smith (1981:85) calls citations "signposts left behind after information has been utilized". Citation analysis, therefore provides an unobtrusive, or nonreactive, measure of one of the kinds of uses scientific literature is put to.

The effect that the advent of *Science Citation Index* had on bibliometric studies can hardly be overestimated. As a result of the amount of data available from this source, citation analysis has been called "undoubtedly the most celebrated scientometric technique" (Braun *et al.*, 1985:13), and "the most active area of modern bibliometrics is concerned with citations" (Narin & Moll, 1977:38). Cronin (1984:25) waxed eloquent on the subject of citations: "Metaphorically speaking, citations are frozen footprints on the landscape of scholarly achievement; footprints which bear witness to the passage of ideas".

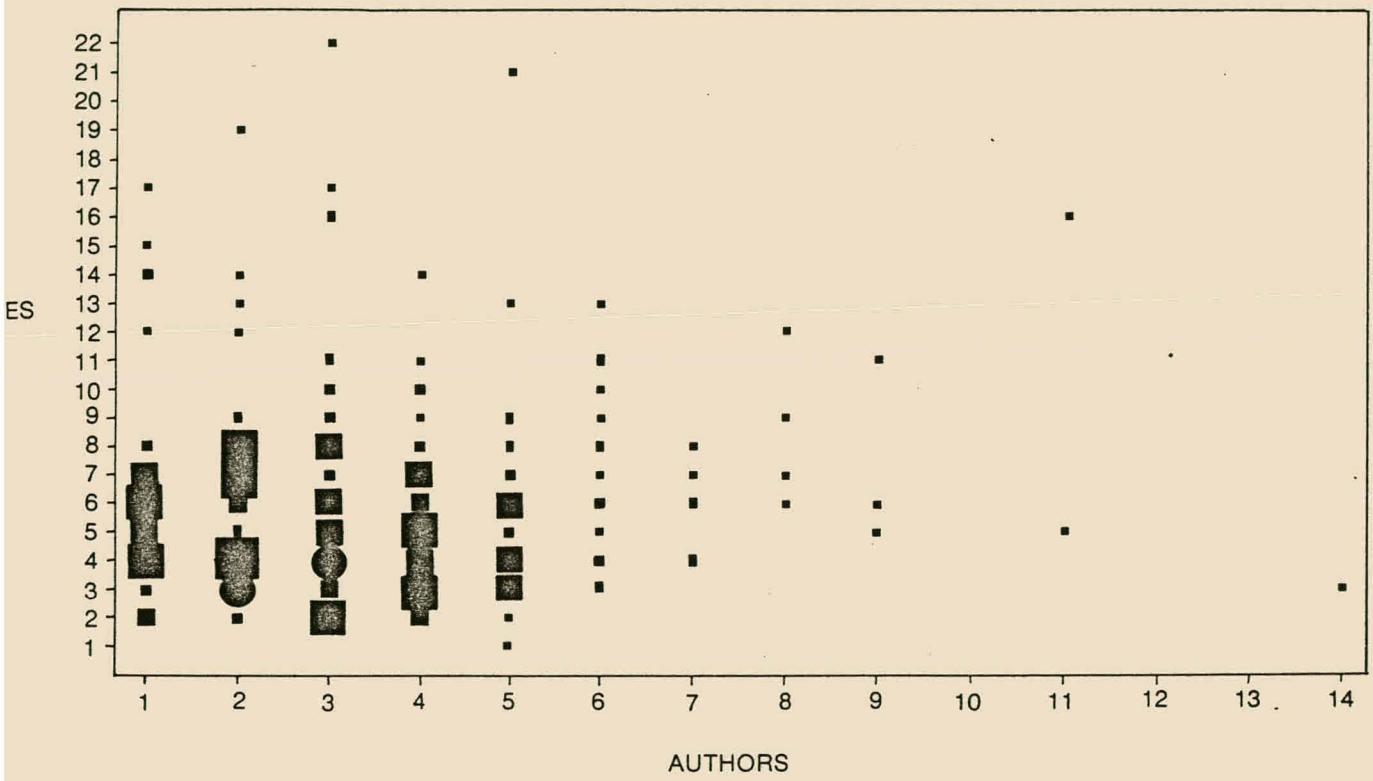


Fig 3.13 Scatter diagram of number of pages in relation to the number of authors : SET A

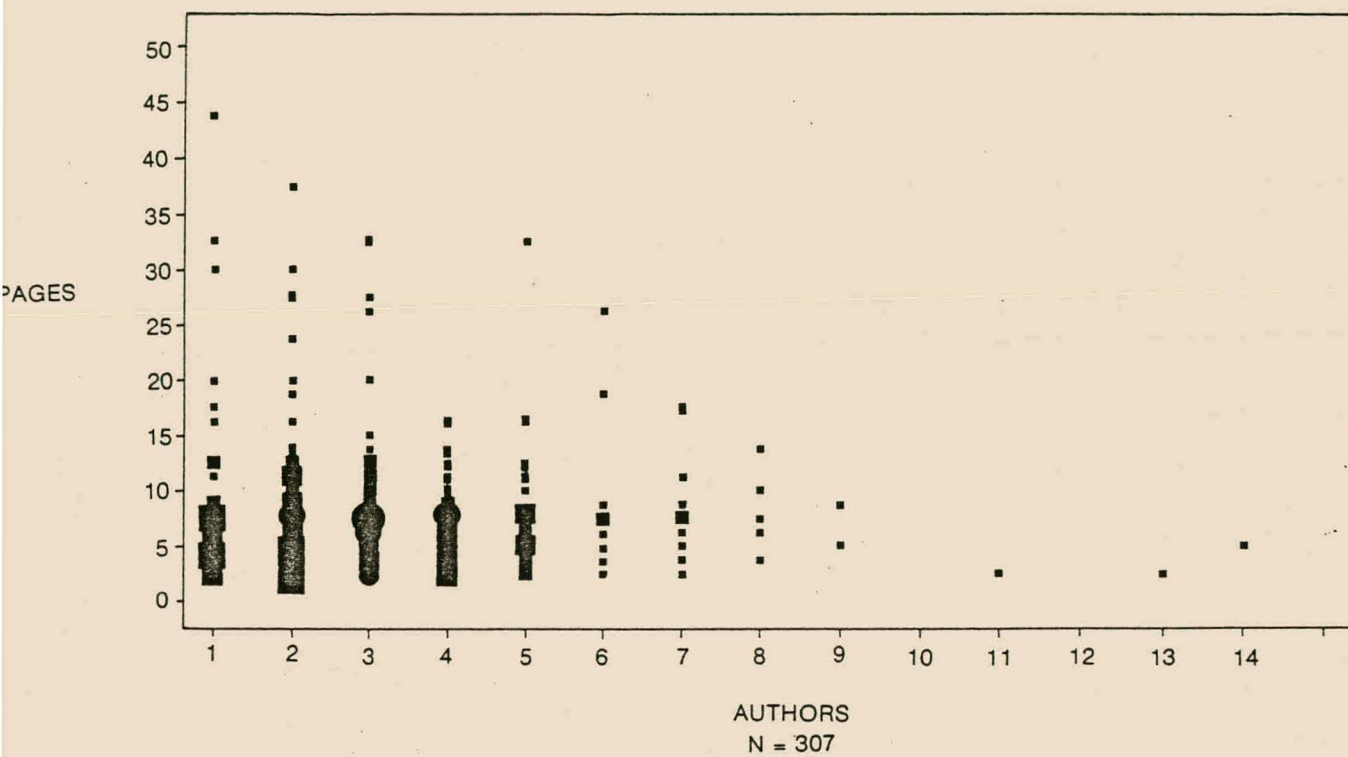


Fig 3.14 Scattergram of number of pages in relation to the number of authors : SET B

A bibliographical *reference* becomes a *citation* when acknowledged as a source of information by the author of a later publication. In the present study, the publications that constitute SET B were cited by the authors of SET A, and a specific relationship of citing papers to cited papers are thus prevalent. To some extent the terms are frequently used interchangeably, but in this study the word *reference* is preferred to describe a bibliographical entity or unit *per se*, and *citation* when the the cited relationship of the reference is the primary issue.

It was not feasible to attempt citation patterns, co-authorships or even relationships between cited journals in this study. This can only be done where the references are available in an electronic database of citations, e.g *Science Citation Index*.

Results of this study

The number of references cited by the authors of papers in both sets of data was established and compared in Table 3.9. SET A contained a total of 7158 citations. This translates to an arithmetic mean of 22.369 references per paper. A wide range was found: 11 articles contained no (0) citations, while the highest count was 135.

The articles in SET B collectively cited more references than those in SET A. The mean number of references per paper was 30.838, which is significantly higher per unit than SET A. Seven articles in SET B provided no references whereas, at the other extreme, one article cited 236 references.

Table 3.9 *Statistical attributes of references in SET A and SET B*

	Total	Mean	Std Dev	Median	Range	Mode
SET A N = 320	7158	22.369	16.651	19	135	16
SET B N = 307	9282	30.838	28.704	25	23.6	28

In Fig 3.15 the profiles of reference cited in the two sets of data are compared. The articles in SET A show an even distribution, but average fewer references per paper than those in SET B and have fewer examples of exceptionally many references.

Regional influence

In Figures 3.16 and 3.17 the number of references per bibliography is expressed as a function of their origin or place of publication. The distribution of number of references per paper is generally skewed towards a larger number of references in SET B, in other words, the older generation, SET B, contained more references per publication than those in SET A.

The continuing trend towards increasing specialization may cause a decrease in the number of references. In a very specific field, two or three citations may represent 100% of the available literature! An alternative or supplementary factor in the decrease of number of references per paper may simply be that the pressure to publish more frequently allows less time for extensive literature surveys.

A comparison between the USA, Europe and the UK on the one hand and the RSA on the other, shows that the articles published in local journals contained far fewer references than those published in the western world. The subset 'Other' is too small for comparison. The box-plots depicting the data for the articles from the RSA and Europe show a tendency for the median and mean values to coincide. This indicates a reasonable measure of symmetry or similarity to the distribution curve and very few extreme values.

Articles from American journals consistently contain a greater number of references than those from other geopolitical areas. The papers with the most references over-all also come from the USA.

This supports the assertion from Frame & Narin (1977:1792) that the "United States research in biomedical areas stands out dramatically as the most heavily utilized research in the world. Over half of the total world citations go to both American clinical medicine and biomedical research."

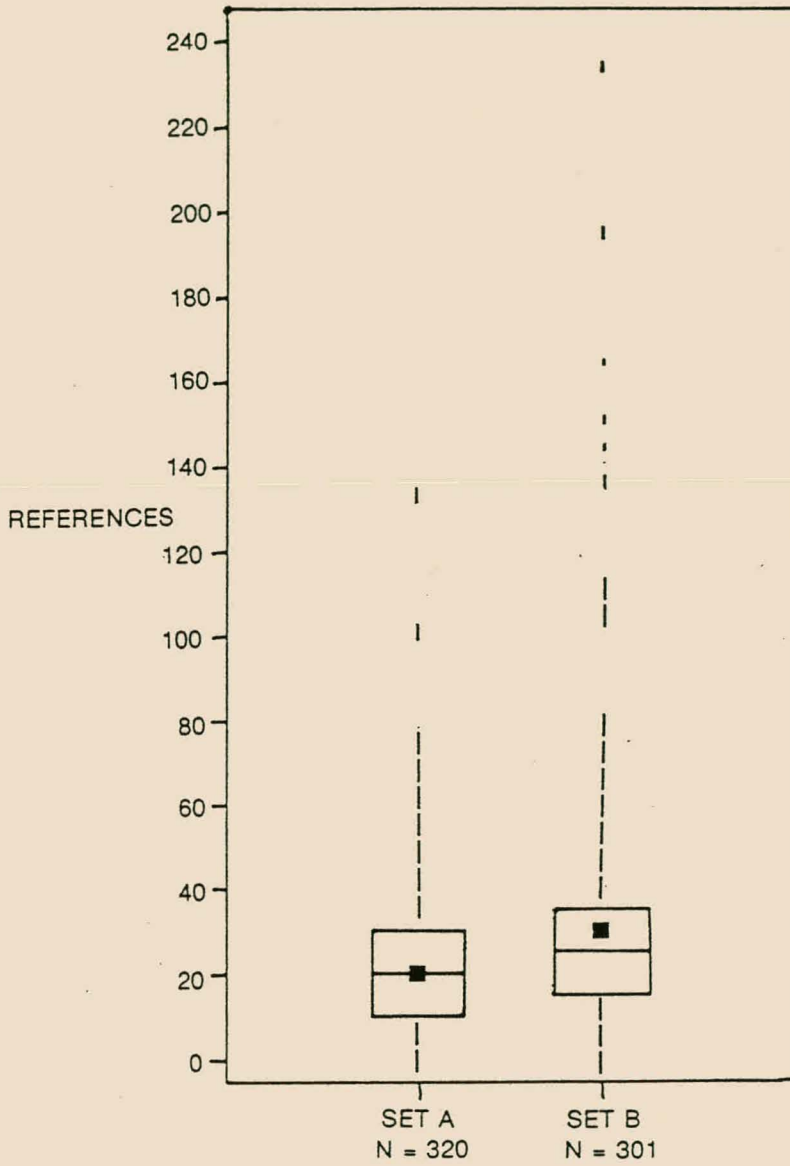


Fig 3.15 *Distribution of references in SET A & SET B*

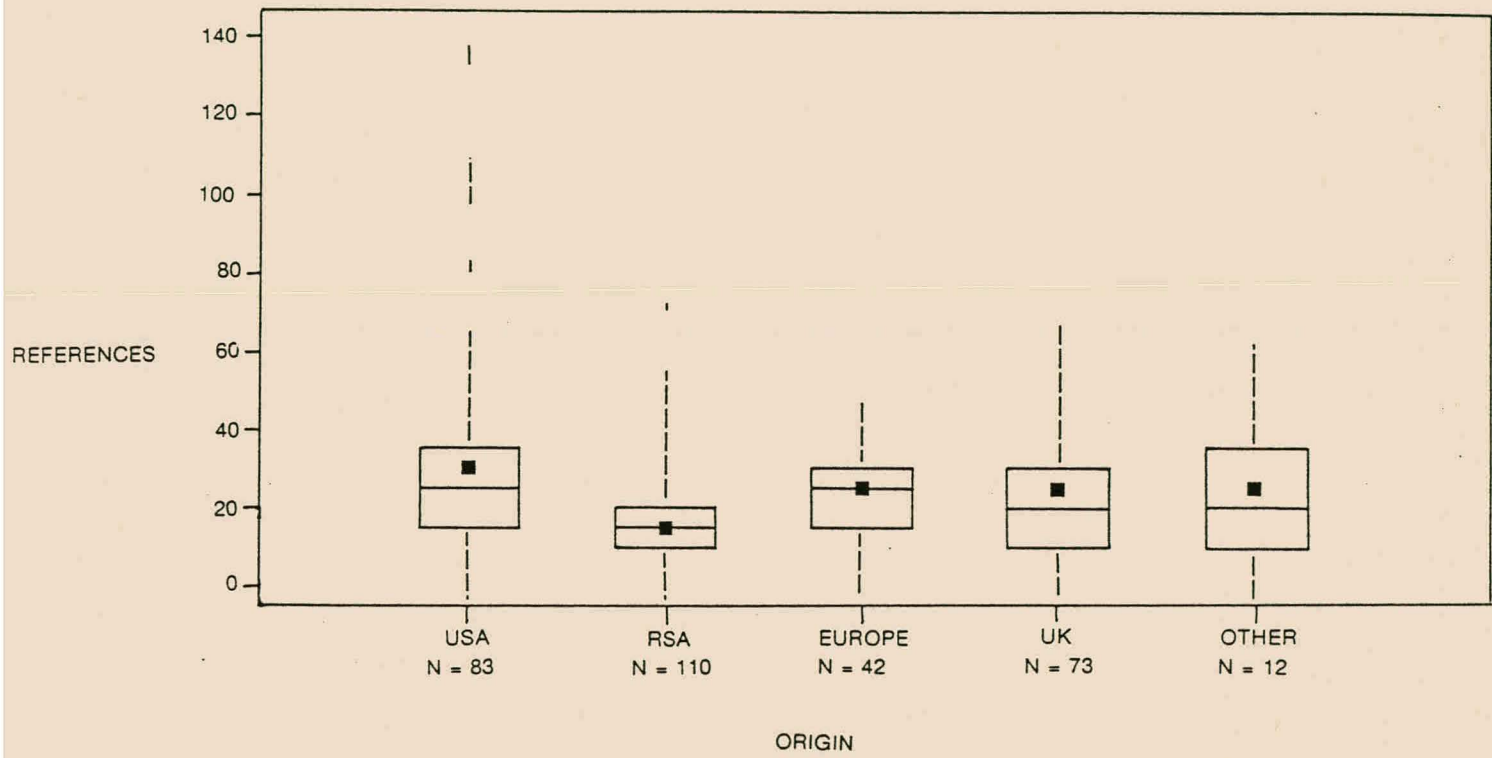


Fig 3.16 *Box-plots of references by origin: SET A*

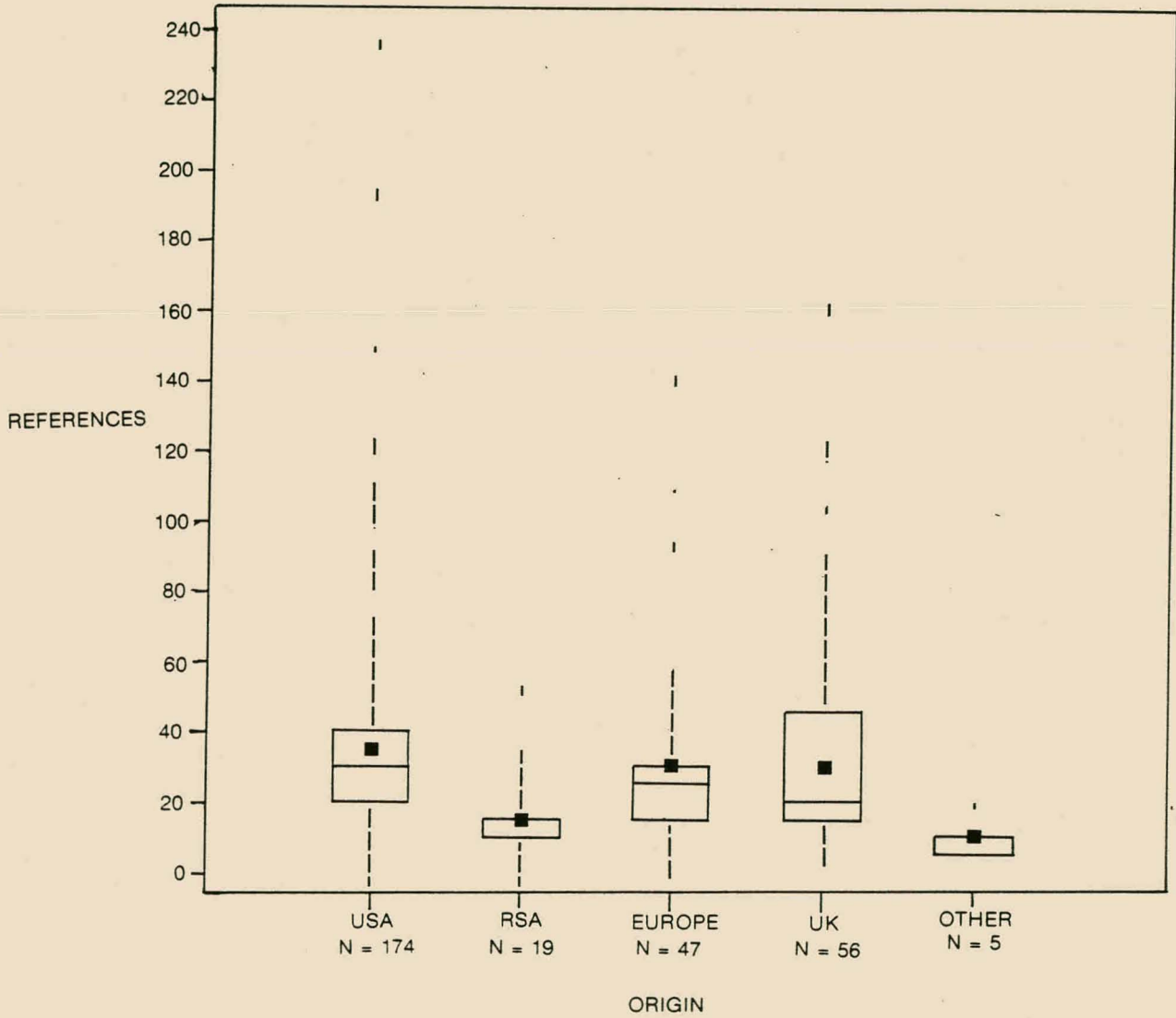


Fig 3.17 *Box-plots of references by origin: SET B*

Relationship between number of references and uncitedness

Many research papers, even those from core journals are never cited. Stern (1990) investigated a stratified sample of biomedical publications that were not cited within eight years of its publication. Several possible variables were analysed, even the price of the source journal, but the only strong correlation was found between the number of authors and the number of references. Stern's results suggest that there is a significantly inverse relationship between the number of authors and references and uncitedness, in other words, an article written by fewer than a critical number of authors and that contains fewer than a critical number of references has an increased likelihood that it will not be cited by later authors.

Uncited articles were found to have approximately 2.5 authors and contain 10 references. By contrast, cited articles have approximately 3 authors and contain 22 references. The articles in SET B are all cited publications and conform to this pattern, reinforcing Stern's findings. It would follow that a percentage of the papers in SET A would be likely to remain uncited. It would therefore be interesting to monitor the cited status of the articles in SET A a few years hence.

Form of publications

The form of scientific publications has been described very thoroughly. There are many studies profiling the type of documents used by scientists in general and biomedical scientists in particular. (Bourne, 1962; Gottschalk, 1962; Price, 1963; Orr & Leeds, 1964; Narin *et al.* 1976).

Scientific literature can be classified according to form, i.e.

- * Books or monographs, or parts thereof.
- * Articles in journals.
- * Personal communications, unpublished reports, papers at meetings.

The proportionate representation of each of these types of documents or communications are clearly attributes of a particular branch of science (Hjerppe, 1978). The present study therefore proposes to ascertain the size and distribution of each of these component categories of the publications cited in the articles that make up SET A.

Kelland (1989), analysed 2971 references in the Zoological literature. He identified 2762 as reference to journals (92.9%) and the rest as monographs (7.1%). Fussler (1949) analysed the literature used by Chemists and Physicists over half a century and found that 94.18% of the references Chemists cited in 1899 and 92.10% in 1946 came from the periodical literature, while in Physics the ratio increased from 87.81% to 92.20% during the same period.

Price (1965) stated that on average, there are about 15 references per paper and, of these, about 12 (i.e. 80%) are to other serial publications rather than to books, theses, reports, and unpublished work. The average only provided part of the picture; about 10% of all these papers contained no references at all, while 50% of the references came from research articles and contained 25 or fewer references apiece.

Results from local study

Data for the analysis of subcategories of references, as discussed in 3.5.3.3.1, 3.5.3.3.2, 3.5.3.3.2.1, 3.5.3.3.2.2 and 3.5.3.3.3 were only available for the articles in SET A.

The references/ citations in SET A were categorized as *Monographs*, *Journals* and *'Other'*.

The proportionate composition of references to journal articles and monographic literature is similar to comparable studies in the literature (Fussler, 1949; Orr & Leeds, 1964; Price, 1965; Kelland, 1989). The results are summarized in Table 3.10.

Table 3.10 *Statistical profile of references cited by South African researchers by form of publication (N = 320).*

	Sum	Mean	Std Dev	Median
References	7158	22.369	16.651	19
Monographs	786	2.456	2.729	2
Journals	6298	19.681	15.897	16
Selfcit	483	1.509	3.022	0
Singles	3682	11.506	7.171	11

3.5.3.3.1 Number of references to monographs

In this study only a small percentage of the citations, 786 (10.98%), referred to monographs, an arithmetic mean of 2.46 per bibliography; 79 bibliographies contained no monograph citations, while one referred to 20 monographs (Fig 3.18).

3.5.3.3.2 Number of references to journal articles

In contrast to the low monograph count, 6298 citations (87.99%) referred to other journal articles. The assumption of the predominant importance of journal literature in documented biomedical communication as argued in the research statement is thus supported. The arithmetic mean number of journals cited per paper was 19.68; 11 articles contained no journal citations while the paper citing the most journal articles, contained 128 such references.

There is a very strong correlation between total number of references and the number of cited journals (0.98404 on the Pearson and 0.96997 on the Spearman correlation coefficients scales respectively). This is to be expected because journals were predominantly cited, 87% of the data set consisted of journal articles. Other journal-related variables coded on the spreadsheet as *singles* (the number of unique journal titles), *selfcit* (the number of citations to previous articles in the source journal), *diffj* (the difference between number of total citations and number of journal citations) and *diffjj* (the difference between number of journal citations and number of journal self-citations) are also shown to have high 'r' values.

3.5.3.3.2.1 Number of references to different journal titles (singles)

It is of interest whether the same journal title is quoted repeatedly or whether there is a diverse citation pattern. The scattering of references was first described mathematically by Bradford (1934, 1948, cited by Narin & Moll, 1977) in what has become known as Bradford's Law. Bradford's Law is based on the distribution of publications (usually journals) in a particular discipline. According to Orr & Leeds (1964), biomedical scientists generally operate under a greater scattering handicap than chemists or physicists. There is, however, a considerable variation among biomedical subfields. A high degree of scatter seems to be prevalent in new areas of research, i.e. where the literature is not yet channeled into 'core' journals.

Local results

This attribute of the articles in SET A was counted and recorded in the spreadsheet column labelled 'Singles'. The analysis revealed a relatively low literature dispersal rate with a median of 16 journal citations and an arithmetic mean of 11 different journal titles. This conservative rate of scatter implies a fairly high percentage of citations to the same journal and further suggests literature with an established character.

3.5.3.3.2.2 Number of references to the source journal

Citation studies often uncover self citation patterns, not only of authors referring to their own previous publications, but also where articles tend to contain repeated references to articles previously published in the same journal. Although the lack of an electronic databank of citations precluded the present study from an author specific citation analysis, it was possible to note journal self-citation patterns.

In the case of these citations, a relatively conservative mean of 1.51 cited the source journal. According to ISI, some 20% of science journal articles contain citations to the source journal. In this case it is only 7.7%. A low incidence is ascribed to generalist as opposed to specialist publications (SCI Journal Citation Reports). A larger, more specific universe of journal citations is required for any justifiable deductions.

3.5.3.3.3 Number of references to other material

Only 74 (1.03%) of the citations referred to material other than monographs or journals, e.g unpublished reports and personal communications. This is a relatively insignificant group and warranted no further analysis.

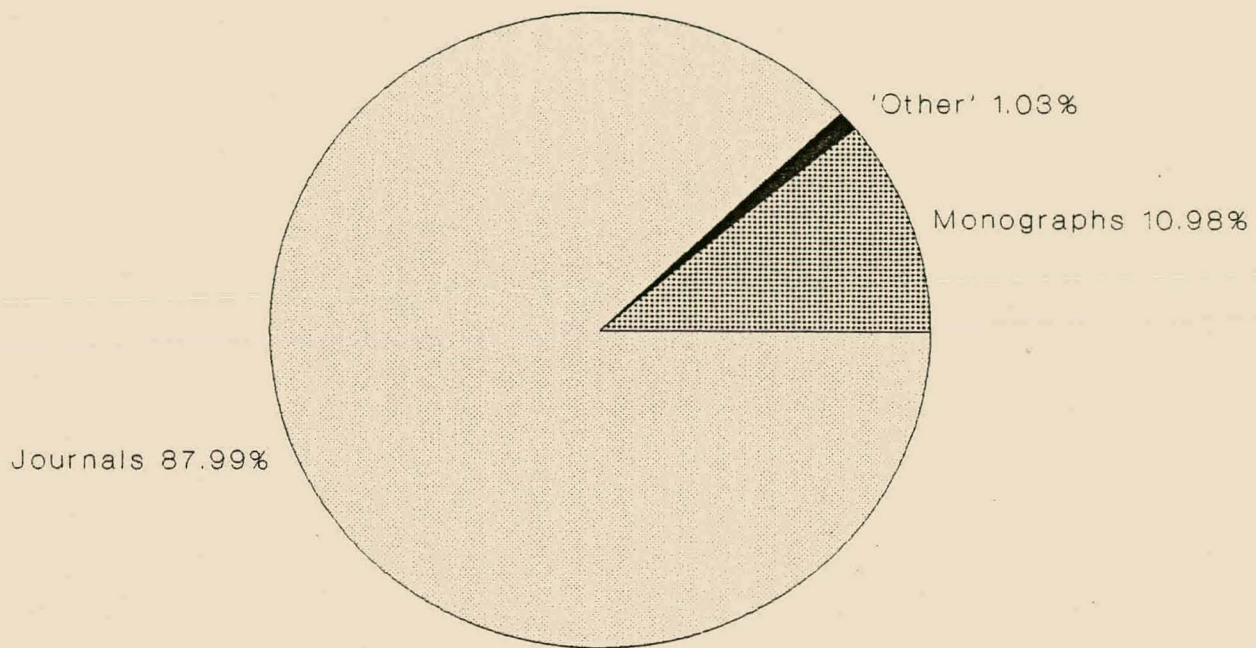


Fig 3.18 *Distribution of references in SET A: Journals, Monographs, 'Other'*

3.5.4 Qualitative criteria

After focusing on the obvious quantifiable elements of science writing, it is perhaps advisable to quote the following paragraph :

"From all the talk of exponential growth and scientific productivity distributions, one might think that scientific papers were produced merely to be counted by deans, administrators, and historians and that the driving force of a scientist should be directed toward producing the maximum number of contributions. This is far from the truth. An almost instinctive reaction away from all this counting nonsense is to agree that each paper represents at least a quantum of useful scientific information and that some single contributions may rise so far above this quantum value that for such a one alone its author would be valued above any random hundred, or above a hundred more prolific writers."

- Price (1963 :56)

Scientific research may be evaluated in various ways. However, most of the methods used to assess other intellectual activities are inadequate in evaluating science (Schubert, Glänzel & Braun, 1986). It is therefore understood that the suggested evaluative indicators are a tentative exploration of implied recognition.

In this study, three indicators were used to add a qualitative element to the assessment of the journal literature of interest to South African biomedical researchers, namely,

- * Whether the source journal is included in the major databases that specialise in biomedical literature (3.5.4.1).
- * Whether the source journal is listed in the PISAL database (3.5.4.2).
- * Whether the source journal has been accorded an SCI Impact Factor, and if so, what it is (3.5.4.3).

3.5.4.1 Inclusion by major indexing services

Margolis (1967:1213) maintains "as a result of the recent expansion of scientific literature, more time and effort are being devoted to the selection of what is to be read than to the actual reading". Most of the effort that goes into the organising of primary literature for retrieval and selection purposes is undertaken by the publishers of the large abstracting and indexing services.

The indexing and abstracting services have specific criteria governing the decision to include material published in a serial or journal in their data base. It can therefore be accepted that such a selection decision at least implies that the journal in question has attained a certain level of acceptability in its subject field. The indexed status of journal titles is seen as an oblique indicator of merit or peer recognition.

Biomedical journal literature enjoys extensive abstracting and indexing by major bibliographical databases. The dispersal factor in medical literature results in a considerable area of overlap between *Biological Abstracts/RRM (BIOSIS)*, *Chemical Abstracts (CAS)*, *Excerpta Medica (EMBASE)*, *Index Medicus (MEDLINE)* and *Science Citation Index (SCISearch)* (Poyer,1984).

In the construction of the SAMED database, the IBC recorded whether journals were indexed by the following services :

- Biological Abstracts/RRM
- Cancer Express
- Chemical Abstracts
- Excerpta Medica
- Index Medicus
- International Cancer Registry
- International Dental Literature
- Popline
- Psychological Abstracts
- Science Citation Index
- Toxline

The indexing data of all these sources were recorded as part of the data collected for SET A. Five of these databases were so dominant, that only the results pertaining to them will be presented, namely *Biological Abstracts (BIOSIS)*, *Chemical Abstracts (CAS)*, *Excerpta Medica (EMBASE)*, *Index Medicus (MEDLINE)*, *Science Citation Abstracts (SCISearch)*.

When collecting the same information for the 307 items in SET B, a different approach was followed. Information on this attribute as included in the different reference works, e.g. *Ulrich's International Periodicals Directory* was found to be inaccurate. The most authoritative documentation on a journal's indexing status is found in recent source lists of each of the bibliographic services, e.g. *Serial Sources for the BIOSIS Previews Database*. Every journal title was therefore checked in each of these lists. The status of a journal can change at any time.

In this part of the project attention was given to two aspects :

- * The extent to which articles with South African authors are represented in the major indexing databases (data from SET A).
- * The extent to which literature cited by South African authors was represented in these databases (data from SET B).

The results of the investigation are summarized in Tables 3.11 and 3.12. The publication origin of the journals covered by these services are shown in Table 3.12.

Table 3.11 *Database coverage of source journals in SET A and SET B*

	BIOSIS	CAS	EMBASE	MEDLINE	SCI
SET A	216	213	224	228	164
%	67.50	66.56	70.00	71.47	51.41
SET B	296	289	284	291	275
%	96.42	94.14	92.51	94.79	89.58

Table 3.12 *Distribution of database coverage according to place of publication in SET B*

% Coverage					
	USA	RSA	EUROPE	UK	'OTHER'
BIOSIS	89.02	45.95	82.93	72.97	33.33
CAS	85.37	45.05	90.24	73.97	8.33
EMBASE	84.15	43.24	95.12	87.84	25.00
MEDLINE	91.46	35.14	95.12	94.52	50.00
SCI	65.85	32.43	70.73	60.27	8.33

The following observations are fairly obvious :

- * Biological Abstracts/RRM offers the most comprehensive coverage of the source journals in SET B.
- * The lower indexing status of the titles in SET A is partly ascribed to the many local publications which are excluded from the international databases. The *SA Journal for Continuing Medical Education (CME)*, which is not internationally indexed was, for instance, the source journal of 42 (13.13%) of the papers.
- * The journals published in the USA, United Kingdom and Europe are consistently better represented in all five the bibliographic databases than those published in South Africa or the 'Other' category.
- * With the exception of *Biosis*, there is a slight bias in favour of publications that originate in Europe.
- * *Index Medicus* offers the best coverage of British publications.
- * The South African published journals are poorly represented in all the bibliographic services.

3.5.4.2 Inclusion by PISAL

The fact that a title is found in PISAL, the national union catalogue of South African periodicals, presupposes the selection thereof, frequently a purchasing decision, by one of the libraries contributing to the interlending scheme. Whether or not a source journal title was found in PISAL, with holdings for the volume of the specific reference was recorded as one of the characteristics of all articles in SET B.

Each item was searched both on the SABINET and the microfiche editions of the PISAL database. Some 293 (95.44%) of the 307 items were traced in one or the other. The analysis of titles found in the PISAL database is presented according to origin of publication in Table 3.13.

Table 3.13 *Titles from SET B listed in PISAL by place of publication*

	USA	RSA	EUROPE	UK	OTHER	TOTAL
Documents	175	19	49	58	6	307
%						
Listed in PISAL	97.71	94.74	93.88	91.38	83.33	95.44

A high percentage of the sample of biomedical journals was located in PISAL. The journals published in the USA was ranked in the first place, above the local publications.

3.5.4.3 SCI Impact Factor

The Impact Factor is a ratio calculated by the Institute for Scientific Information. It is based on the number of times articles from a journal were cited in the preceding two years. This value has gained acceptance as a indicator of scientific merit (Garfield, 1972; Pouris, 1986) and will be used as one of the variables in characterizing the literature used by South African researchers.

In September 1990 the latest available values were those published in the 1988 *SCI Journal Citation Reports*. This list was used for all titles, irrespective of the publication date of the article in the sample. The 307 items included 26 records for which no impact value was given in the 1988 list. This is a relatively low percentage of 8.46 not included by ISI. Several citations refer to journals no longer in print and could therefore not be considered.

A sample of titles were used to compare the 1987 and 1988 Impact Factors. No significant deviation was found. The highest Impact Factor in the data set was 48.3 which was recorded for *Annual Review of Biochemistry*. This is not surprising, as it is a review journal.

The relationship between journals' Impact Factor and whether they were indexed by the major databases was investigated. In all five cases, the titles with lower Impact Factor values were less likely to be indexed.

Table 3.14 *Analysis of mean Impact Factor and indexed status of journal titles*

	BIOSIS	CAS	EMBASE	MEDLINE	SCI
Indexed	4.22	4.30	4.26	4.23	4.30
Not Indexed	1.10	1.68	1.61	0.55	1.41

There is a clear indication that the journals with the higher Citation Impact is more likely to be indexed by the major abstracting services. *Index Medicus* would seem to include some peripheral publications that do not "score" very high, but may well be of interest to medics (Table 3.14).

Fig 3.19 illustrates the relation between Impact Factor and its indexing status with the five major bibliographic data bases by the use of side-by-side box-plots. There is a marked similarity in the 'indexedness' of source journals according to their Impact Factor. This strengthens the case for both parameters as suitable qualitative criteria. All five databases obviously included the title with the highest Impact Factor, i.e. *Annual Review of Biochemistry*. The rest of the profiles are also very evenly distributed.

In Table 3.15 the mean Impact Factor for those journals from SET B which were listed in the 1988 SCI Journal Reports is correlated with their place of publication :

Table 3.15 *Relation of mean Impact Factor of journals with their geographic distribution*

	USA	RSA	EUROPE	UK	OTHER	TOTAL
N=	167	15	41	56	2	281
IMPACT FACTOR	4.91	0.47	2.13	4.6	0.6	4.17

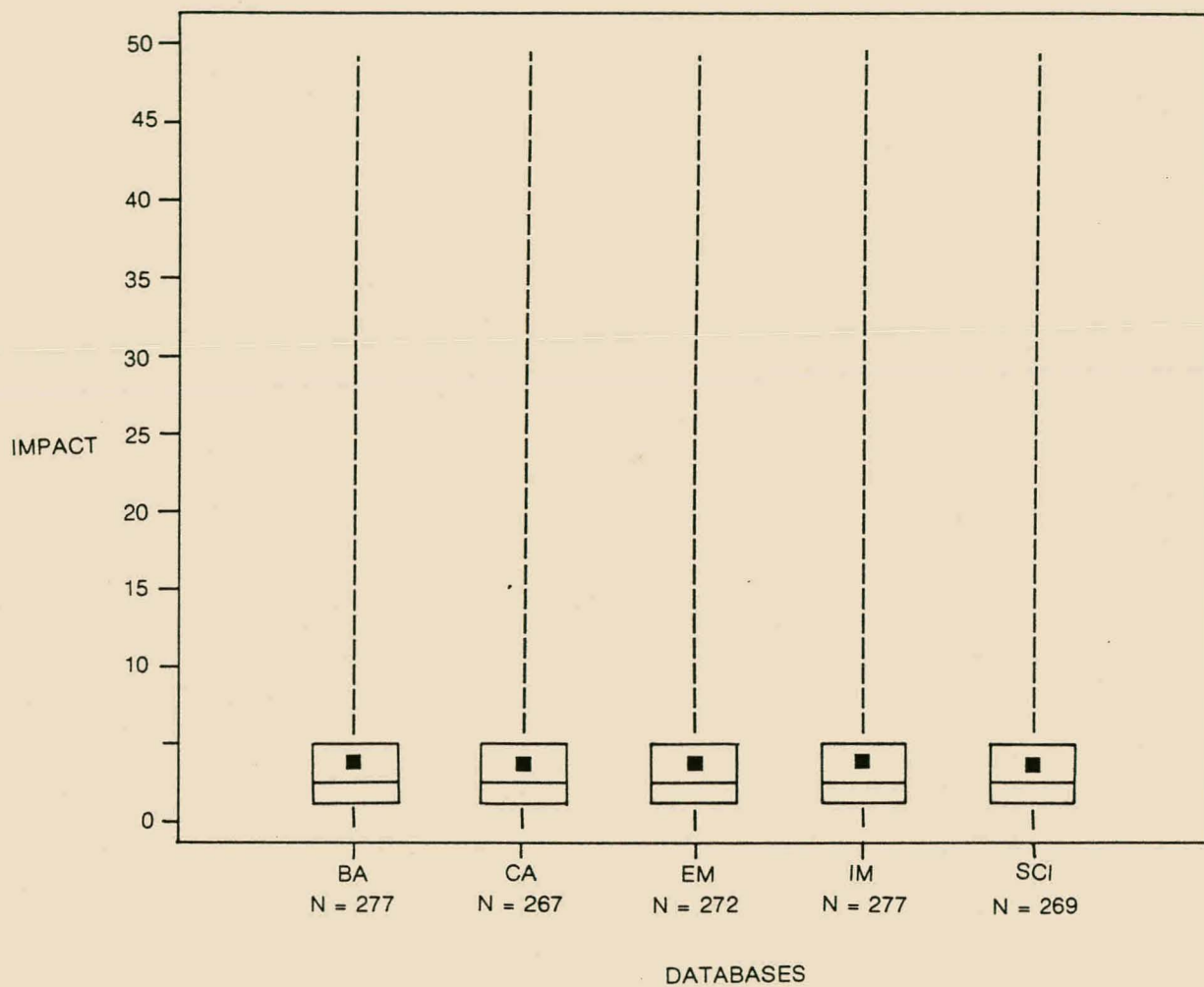


Fig 3.19 *Box-plot illustration of the relation between Impact Factor and indexing status*

3.6 Conclusions

An overview of the attributes that characterize the journal literature produced and used by South African biomedical researchers provides evidence for the following assertions :

- * The research journal is the most important vehicle for the communication and distribution of medical information as it contains almost 90% of the documents referred to in later publications.
- * The literature use patterns of the South African researcher are similar to those of other biomedical scientists in the rest of the world.
- * The similarity in the chronological attributes of references used by South African authors and those of international biomedical scientists, indicates that the researchers are as up to date with the literature as their counterparts overseas.
- * South African biomedical researchers prefer to publish in non-South African journals.
- * The scientometric profile of articles published by South African researchers in South African journals is different from those articles they published elsewhere in the world.
- * The American biomedical literature has a stronger influence on South African researchers than publications from any other region.
- * It would seem that certain subjects or research areas appear to predominate in the journals of a specific geopolitical region, e.g. research on Cardiology and Neurology in American journals and papers on Molecular Biology seem more likely to be published in British journals.
- * The main stream of medical literature is well served by the international abstracting and indexing services.
- * The South African journals, with the exception of *South African Medical Journal*, are poorly represented in these databases.

In summary, the median values of the variables common to both sets of data are given in Table 3.16.

Table 3.16 Summary of median values of attributes occurring in both SET A and SET B according to origin of the source journal

		USA	RSA	EUROPE	UK	OTHER	TOTAL
Number of Documents							
	SET A	83	110	42	73	12	320
	SET B	175	19	49	58	6	307
Publication date							
	* SET A	1989	1989	1989	1989	1989	1989
	SET B	1982	1984	1981	1984.5	1979.5	1982
Authors							
	SET A	4.00	2.00	4.00	3.00	3.00	3.00
	SET B	3.00	2.00	3.00	3.00	2.00	3.00
Pages							
	SET A	6.00	4.00	6.00	6.00	5.00	5.00
	SET B	7.00	4.00	7.00	6.00	4.00	7.00
References							
	SET A	27.00	13.00	23.00	20.00	18.50	19.00
	SET B	28.00	11.00	26.00	22.00	7.00	25.00
Earliest reference							
	SET A	1965	1966	1964	1965	1963	1965
	SET B	1957.5	1959	1956	1952	1971	1956
Most recent reference							
	SET A	1988	1988	1988	1988	1988	1988
	SET B	1981	1982.5	1980	1983	1974	1981
Temporal span (in years)							
	SET A	23	22	24	22	25	22
	SET B	23	28	24.5	24.5	24.5	23.5

* Actual date, not the median

4	THE AVAILABILITY OF BIOMEDICAL RESEARCH JOURNALS IN RSA
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4.8	Conclusions

4.1 Introduction

The scientists of the South African biomedical research community are mainly affiliated to one of the seven Faculties of Medicine in the country. Their information needs are addressed jointly by the Medical Research Council's Institute for Biomedical Communication (IBC) and the libraries serving each Faculty of Medicine.

The IBC's responsibility includes the provision of bibliographical information, i.e. it provides researchers with retrospective bibliographies of relevant publications, as well as offering a current awareness service. These references are mainly derived from the Medline database, although other sources are accessed to a lesser extent. Most of the local medical libraries can also provide this type of information retrieval. The advent of the Medline database on CD-Rom will certainly lead to more end-user searching or self-help bibliographical retrieval.

The Medical Libraries are primarily responsible for the collecting, organising and provision of those documents containing the information required by "their" biomedical researchers, in other words for delivering the documents cited in the bibliographic searches.

No library can attain self-sufficiency when it comes to as expensive a resource as journal literature. In South Africa there is a well established Inter-library Loans (Interlending) system under the auspices of the State Library. Union catalogues like PISAL (Periodicals in Southern African Libraries) and *Joint Catalogue of Monographs* make an efficient national system possible. Both are available electronically on the computerised network SABINET.

4.2 Target group

This study focuses only on the journal literature of interest to biomedicine and is not concerned with those information needs that must undoubtedly be met through the use of monographs and other document types. The two parameters of the investigation are the type of publication, i.e. journal article and the availability status of identified journal articles.

A Document Delivery Test was used to investigate the availability of a representative sample of biomedical research journals at the seven academic medical libraries in South Africa, viz., in alphabetical order :

Medunsa (Medical University of Southern Africa, situated outside Pretoria)
University of Cape Town
University of Natal (Durban campus)
University of Pretoria
University of Stellenbosch (Tygerberg campus)
University of the Orange Free State (Bloemfontein)
University of the Witwatersrand (Johannesburg)

As the objective of the research project is not to compare the performance of the individual libraries, but rather to evaluate the strength of the combined national collection of biomedical research journals, libraries will not be identified hereafter, but simply referred to as Library A, B, etc. (The A to G codes do not follow the sequence used in the list above, i.e. Medunsa is not Library A).

4.3 Methodology

Testing document delivery capability is one of the areas of research in Library and Information Science that has the advantage of standardized methods. The seminal papers were produced by Orr and associates (1968) as a result of an extensive research project undertaken to develop "a number of methodologic tools that will be useful to those responsible for individual libraries and for local, regional, and national library systems." Later contributions came from Buckland *et al.* (1970); Kantor (1976); Line (1973); Saracevic *et al.* (1977) and Wilson (1974; 1977; 1983). Lancaster was responsible for excellent review publications (1977; 1978; 1982; 1988). The methodology was modified for local circumstances and used to collect the data.

4.3.1 Document Delivery Test (DDT)

The testing of a library's document delivery capability by means of a Document Delivery Test (hereafter DDT) requires two basic components :

1. A list of bibliographical items or a *citation pool*
2. A score sheet or *checklist* to record the data.

4.3.1.1 Construction of the citation pool

A citation pool is basically a list of bibliographical items. This list must contain items that are representative of the information needs of the target group, in this case, journal articles required by biomedical researchers.

Such articles could be identified through direct contact with the users : personal interviews, questionnaires or even the diary method are all tested techniques to obtain the objective. In this study, however, the user population is dispersed throughout the country. The logistical problems presented by any one of the methods involving user participation exceeded the resources available to a single researcher. Attempting such a course of action would certainly have jeopardised even the possibility of valid results.

As an alternative to an actual user-articulated citation pool, a list of items can be constructed by collecting examples of citations used in the subject literature. This approach is really a simulation of user requests. The success of the method depends on the selection or availability of a large enough body of suitable literature from which to draw the citations.

The method of constructing a citation pool based on references recently cited in publications by representatives of the user population proved to be a feasible option. A two tier procedure was therefore undertaken :

1. The collection of a viable set of recent articles published by SA biomedical researchers
2. The identification of a sample of journal articles cited in the above. The references collected in this part of the exercise constitute the citation pool.

4.3.1.1.1 Articles published by South African biomedical researchers

The undertaking was greatly simplified by the availability of a comprehensive database of medical literature, SAMED, compiled and maintained by the IBC.

Description of the SAMED database

The SAMED database was designed to provide information about medical literature by South Africans or about South Africa. The publications may appear either in local or in international journals, it may also be by foreign scientists publishing in local journals. The database also identifies publications by scientists receiving support from the MRC and who may be considered for the MRC's Achievement Awards.

Scope of the SAMED database

Recipients of MRC research funding are expected to supply the IBC with a reprint of each publication they produce for inclusion in the SAMED database.

Until recently only three journals were indexed in full. Articles from *South African Journal of Continuing Medical Education*, *South African Journal of Food Science and Nutrition* and *Leech* were included irrespective of whether the contributors were in receipt of MRC support. From this year (1991), the coverage of the database is enlarged considerably. The IBC was contracted by the State Library to index biomedical material for the national database *Index to South African Periodical Articles*. Journals previously indexed on a selective basis, are now indexed from cover to cover.

BRS/Search

The BRS/Search software is used in the construction of the SAMED database, consequently, it is also used for the retrieval of information. It is an interactive, user-oriented system that permits online searching of textual and numeric data. The BRS/Search protocol is short, simple and easy to learn and use. Commands consist entirely of English language words or their abbreviations rather than numeric or code representations.

All Boolean and positional operators can be used with valued parameters to refine search results. This is an especially useful feature when it comes to searching for specific publication dates, a range of dates or specific document codes.

Presentation of search results

The documents retrieved by a search are printed according to the operator's specifications. Individual paragraphs, e.g. TY (document type) or AU (author) are possible, while the FULL RECORD command will result in the printing of all fields of a record.

This database met the criteria for the source of a citation pool :

- * It contains publications written by members of the South African biomedical research fraternity.
- * There is a qualitative element implicit in MRC funding of a project.
- * There are sufficient recent articles to yield a viable set of citations for sampling.

When the citation pool was constructed during July 1990, the database contained 450 items that had been published in 1989. In addition to the standard bibliographical details of each publication, entries also contain such elements as an abstract, subject terms, the research field of the first author, the number of pages and the number of references cited in the bibliography.

The search strategy used to identify the journal articles required for this project is shown in Fig. 4.1 :

1. DC> 890000 AND DC<899999	<i>(Step 1 selects the publication date 1989);</i>
2. 1 AND JN.TY.	<i>(Step 2 specifies the document type journal);</i>
3. 2 AND Y.SM.	<i>(Step 3 limit to MRC supported publications)</i>

FIG 4.1. *Search strategy used to retrieve 1989 journal articles from SAMED database*

The search strategy intentionally excluded monographs or chapters in monographs, theses, conference papers and contributions to peripheral publications a small number of such documents were present in the retrieved set, probably due to input error.

The list was restricted to those items that are linked to MRC funding. MRC support implies a qualitative judgement or tacit approval of the research involved. This fits in with the objective of investigating research output. The printout of 332 references resulting from the above search, was the starting point for the present undertaking. (An example of the printout of references is provided in APPENDIX 1).

The IBC maintains an archival collection of all the publications it indexes. The documents in the archive are accessioned in a chronological sequence e.g. 890001, 890002, etc. Each item is clearly marked and kept in a hanging file system, offering easy access and retrieval of documents.

Each article listed on the SAMED printout was examined to

- * Ensure that it was a research article. Discarded items included articles that had appeared in student publications, e.g. *Leech*, theses, chapters from monographs, a stray monograph, an annual report, letters to the editor, editorials and conference papers.
- * Analyse and record specific bibliographic attributes, e.g page length. (This aspect is discussed in the previous chapter).

The critical examination of documents produced a final or purged list contained 320 journal articles.

Structuring the collection of articles

The bibliographic and other pertinent elements of each item were recorded in spreadsheet format, using the IBC inhouse package 20/20. Every article was identified by its SAMED accession number which was retained as the ID in the spreadsheet. (APPENDIX 2).

4.3.1.1.2 Identifying items for inclusion in a citation pool

After collecting the set of articles written by South African biomedical researchers, the second step in the process of constructing a citation pool is the selection of some 300 journal articles emanating from the articles referred to in these articles. Orr, *et al.*(1968a), reported that with a sample of 300 references, one can be 95% confident that the results from repeated testing, with comparable samples, will not vary more than 5% in either direction.

The 320 papers yielded 7158 citations, including 6298 journal articles (87.99%), 786 monographs (10.98%) and 74 other types of communication, e.g. "unpublished report" (1.03%). This is a substantial population and can be considered substantially representative of biomedical literature.

There should not be a bias in favour of any one subdiscipline within Medicine, nor of any specific institution or geographic area. If any sector of the biomedical community appears to dominate, it would be a result of a proportionately greater number of publications ascribed to its members. This in itself would reinforce the upward spiral of successful research leading to publications, peer recognition, professional rewards and thus perpetuating renewed information needs. It should, however, in no way influence the validity of the citation pool.

4.3.1.2 Sampling to select items for the citation pool

The target was a data set of not less than 300 journal articles. Fixed Unit sampling was applied using a factor of 19 to select sequential citations. Due to this technique any document with 19 or more citations was automatically included in the sample, while the publications with less than 19 citations were included in the sample with a likelihood directly related to the number of citations.

4.3.1.2.1 Identifying a selected citation

The identification of a specific citation is achieved in three steps, as illustrated in Fig 4.2 :

ID	Source	Origin	Authors	Pages	Citations	Cumulative Citations
890149	64	3	6	6	7	2506
890150	56	2	1	8	17	2523
890151	56	2	3	17	23	2546
890152	56	2	1	4	16	2562

FIG 4.2 "Accessioning" citations for sampling purposes

1. Locate the nearest "accession number" in the *Cumcit* column, (e.g. 2509 is clearly part of the bibliography of the document ID 890150)
2. Retrieve the citing document (890150) from the IBC archive
3. Examine the bibliography at the end of the article - as the last item on the bibliography of the previous document was 2506, the first reference in the bibliography of this paper is "Cumulative Citation 2507". Item 2509 is the third reference listed.

A set of 365 items was selected according to this method. Until now, all types of documents were still included in the list. References to books and other publications or communications not recognisable as a journal article, were subsequently discarded. As with the evaluation of articles in the SAMED database, peripheral material such as *letter to editor*, *editorial* or *abstract of a paper* was disregarded.

This procedure reduced the number of items in the provisional citation pool to 332.

Certain journal titles received multiple citations. At this stage of the procedure, there were 196 different journal titles represented in the sample. The journal cited most frequently was *Lancet*, with 17 citations, followed by the *South African Medical Journal* (15 citations). These were provisional observations and further verification of the data was to change the picture significantly, as illustrated in 4.3.1.4 Finalized citation pool.

4.3.1.3 Bibliographic verification of references

The bibliographic details of each reference were copied from its citing publication. Personal experience as a Reference Librarian as well as evidence in the literature makes one aware of the possibility of incorrect citations (De Lacey, Record & Wade, 1985). There are several causes for such mistakes, for instance printing errors. It was necessary to check each of the 332 selected publications to ascertain its bibliographic correctness, and to verify its status as a research article. The following bibliographic elements were checked: journal title, volume, publication date, pagination, as well as the nature of the item. (Again, items found to be *letters to the editor*, *editorials*, *marginal comments*, *abstracts of papers*, were discarded).

Where possible, items were traced in the academic libraries in the Western Cape, and the publications physically examined.

Several printed errors in the dates, volumes, pages of citations could be corrected. Some of the references were incorrect, giving wrong volumes, dates, pagination, etc. In one instance, two references to non-existent volumes of the *South African Medical Journal* proved to have erroneously referred to articles in the *South African Journal of Science* !

The publication date of papers given as *in press* were interpreted as 1989. All the locally available issues of the journals in question were scanned. None of the *in press* articles were found by the middle of August 1990 and had to be excluded from the citation pool.

Items which could not be physically traced were verified through the use of manual and online searches of bibliographical databases such as BIOSIS, CAS, MEDLINE, SCISearch. If a query using author, date and some title keywords confirmed the correctness of a reference, it was included in the citation pool. These articles were examined when found in any of the test libraries. Some half a dozen problem citations did not "add up". These were provisionally retained with the expectation of finding copies of the journals and correcting references during the field trip. This was achieved in several instances.

Bibliographic searches were conducted on the SABINET database, using the ISSN of each journal title. After successfully retrieving an entry, the holdings record was requested.

In some cases, the "zero holdings" response seemed unlikely. These were for journal titles one would expect to be owned by at least some of the South African libraries. All searches that yielded negative results were therefore checked in the 1985 microfiche edition of PISAL, and if still not found, also in all of its supplements. A PISAL query on SABINET does not report holdings if, coincidentally, the record is being amended at that time. Finally, the citation pool consisted of 307 journal articles, which was close to the original aim of 300.

Eight items were obtained through the national interlibrary loan system from non-medical libraries. A further eight items were not traced in South Africa and therefore not examined in the same way as the other 299. The bibliographical details of each of these references were, however, verified in several secondary sources.

The "cleanness" of this constructed or simulated citation pool is one of the factors that distinguishes it and therefore its results from a citation pool consisting of items obtained from actual library users.

All the verification techniques employed are available to patrons of any of these medical libraries. It is, however, a moot point whether these services are fully utilised. Recent research on barriers between the user and sources of information by Haag (1989) would suggest otherwise. Incorrect citations are perceived by librarians to cause a considerable percentage of users' failures to trace publications.

The identified sample was consolidated into a working list. Additional characteristics such as the number of references provided by each article were noted. This aspect of the study is discussed in Chapter 3.

4.3.1.4 Finalized citation pool

The 189 journal titles represented in the purged citation pool are listed in Appendix 6. Several journals were cited more than once. Each reference was treated as a separate document, even when two different authors cited the same article, those references were treated as two citations, albeit identical.

The 23 most cited journals are listed in Table 4.1. (This listing includes all the titles that received counts of 3 and more):

Table 4.1 *The 23 most cited journals in ranked order, with the number of occurrences*

Journal of Biological Chemistry	12
South African Medical Journal	11
Lancet	8
American Journal of Physiology	6
Endocrinology	6
Proceedings of the National Academy of Sciences	6
Journal of Clinical Investigation	5
American Journal of Clinical Nutrition	4
Biochemical Journal	4
British Journal of Surgery	4
British Medical Journal	4
Circulation Research	4
American Heart Journal	3
American Journal of Gastroenterology	3
Annals of Surgery	3
Biochemistry	3
Biochimica et Biophysica Acta	3
Cell	3
European Journal of Biochemistry	3
European Journal of Pharmacology	3
Journal of the American Medical Association	3
Science	3
Surgery	3

4.3.2 Checklist for recording availability data

The main difficulty of this study is that the test population or journal collection belongs to seven independent institutions. Factors such as physical lay-out and organisation of journals, lending policies and service standards affect overall availability. These characteristics are different in each of the test sites and the very diversity of the conditions in the libraries had to be considered in the design of a functional checklist or data sheet. The only solution was to reduce the availability categories to very general common denominators.

Examples of score sheets used in other availability studies, e.g. Orr *et al.* (1968b; 1968c), Wilson (1977), Kantor (1984), were examined and evaluated in terms of the requirements of this project. Useful elements were incorporated into a provisional form which was subjected to a test search for twenty randomly picked items. After some further modifications, and retesting, the form was considered functional.

The final checklist designed to "score" the availability of items in the citation pool for the project is illustrated in Fig 4.3.

Category A recorded whether an item had been accessioned or not.

Category B was only filled in if the item was marked "YES" in Category A. Where an item was found on the shelf, the YES square was ticked and "1" entered in the space on the right hand side of the form, thereby achieving the best score.

In cases where an item owned by the library was not traced on the shelf, the "NO" square was ticked and the form provisionally set aside for further investigation. The eventual outcome or result was then recorded in "Category C. Accessibility".

CHECKLIST

Item no. 5

Title Virology

Vol. 124 : 286 - 299

Date 1983

		Time code
A.	Owned by Medical Library	
	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
	Shelf no. <u>616.01105 VIR</u>	
B.	Availability	
	On shelf <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	1
C.	Accessibility	
C.I	Circulation	
	Found in library	
	(tables, sorting shelves, etc.)	
	Elsewhere on campus	
	In process, available	
	Found during second search	
C.II	National ILL (In Pisal/Sabinet)	
	(includes items not owned or missing, unexplained)	
C.III	International ILL (BLDSC/NLM)	
	(includes items not owned or missing, unexplained)	
C.IV	Items not located in above	

Figure 4.3 Checklist used to record availability data

Four simplified groupings were used to record items not found on the shelf, coded C1, C2, C3 and C4 :

C1 signified any item which could probably be supplied within one week, i.e. items owned by the library, not on the shelf but with known whereabouts, e.g. in circulation, at the bindery, elsewhere on campus or found at a second attempt (allowing for reshelving processes, etc);

C2 provided for items not available in the local system but with holdings in Pisal. Items missing or unaccounted for from a library's own collection were included in this category, if listed in Pisal. * Two to three weeks is a reasonable period in which to obtain items through the national interlending scheme.

C3 was used for items not traced in the standard SA union catalogues with the assumption that it would have to be obtained from overseas, probably from the British Library Document Supply Centre at Boston Spa. * The approximate delivery time from overseas is 3 - 6 weeks.

* **C4** had been envisaged for totally unverified or untraceable citations. There were none and this category was not required.

Each reference was filled in on a separate checklist sheet. The forms were numbered sequentially, from 1 to 307. As the bibliographic correctness of each item had been verified in advance, an abbreviated reference could be used : source, i.e. journal title, volume, date, pagination, etc. A working list with more complete details (e.g. name(s) of authors and title of article) of each item in the citation pool was kept at hand for referral purposes.

* The estimated average waiting time for an item from either the national or international interlending system is arbitrary and based on the author's personal experience as well as consultation with Inter-library loan librarians.

4.3.3 Pretest preparations

The 307 sheets of A4 paper representing the items in the citation pool is a sizable package, weighing 1.5kg. The bulk of paper resulting from a separate set of forms for each library could have impaired mobility during the field trip. As a practical measure, the forms were reused for more than one library. Three instead of seven sets were prepared. The results of Library A and of Library B were recorded on the same set of forms, those of Libraries C, D and E on a second set and those of Libraries F and G on the third set.

Each set was kept carefully separate from the other two sets. The possibility of confusion was minimised by consistently using different colour pens to record the results at the different sites on the same form, e.g Library A was scored in red and Library B in blue.

4.3.3.1 Pilot study

It is always advisable to perform a pilot study to test the proposed investigative procedures in a project of this nature. Before undertaking, as in this case, an extensive field trip, one needs to be confident that the measuring instruments are functional.

The time schedule was therefore adapted to allow several days between performing the DDT at the first library and the other institutions to be visited. This first library was thus seen as an *in vivo* pilot study. Any unforeseen problems with, for instance, the checklist, or the planned action, could still have been corrected at this stage. Sufficient time was allowed for alterations as well as a repeat DDT at the first library.

Fortunately, the procedures worked as planned and the full scale pilot project affirmed the functionality of the test procedures.

It was important to ascertain the approximate duration of the test. According to Orr *et al.* (1968), an exercise of this nature can be done in 4 hours. It is not clear how many participants is referred to and this variable was important, as this project had only one fieldworker.

It was reassuring that the pilot study took approximately the same amount of uninterrupted time, i.e. four hours. In those other studies by Kantor (1984), Orr *et al.* (1968), Wilson (1973), greater, more time consuming detail was recorded. The researcher's familiarity with the library in question probably facilitated and thereby accelerated the test.

4.3.4 Field trip

The collection of data leading up to and during the field trip was done by only one person, the researcher. The advantage of such staffing economy is that it ensures uniform interpretation and decision making. Thus one important variable, that of the level of human competence, remains a constant and cannot influence the results.

The field trip took place from 22 to 31 August 1990. The project was timed to take place during an active part of the academic cycle.

All seven medical libraries were visited and tested in this period. A full day was allowed for conducting the DDT in each library by prior arrangement with the Director of each Library (APPENDIX 8).

Several decisions were required in the interpretation of the different categories on the checklist. The "elsewhere on campus" was interpreted to include not only items held by the main University Library or other branch libraries of the same institution, but where there was a well organised daily delivery service between two institutions, items occurring in the partner's collection were also coded "elsewhere on campus". This seemed reasonable as the objective was not the comparative strengths of individual collections, but the availability of sources.

A daily service is in operation in the case of University of Cape Town and University of Stellenbosch, as well as between Medunsa and the University of Pretoria. The decision applied only to items in the other medical library, not satellites or extensions thereof.

The University of Pretoria Medical Library presented the problem of being split into two collections, in fact housed in different buildings, the Preclinical and Clinical divisions. The buildings are within walking distance and were therefore considered one unit for the purposes of this exercise.

The duration of the test was influenced by several factors :

- * The arrangement of the journals; it is quicker to find journals alphabetically filed by title than sets shelved in classification order.
- * The physical lay-out, as well as the height of shelving, quality of the lighting, the tightness of volumes on the shelves, the general order and correctness of shelving.
- * The availability and accuracy of journal catalogues and other administrative records, such as issue or circulation records, a visible file or other journal accessioning mechanism, as well as up to date binding lists.
- * The order in stacks of older runs of journals.

The exercise emphasised the importance of good housekeeping in academic libraries: a misshelved item is a missing item, as unavailable to the user as if the item had never been acquired by the library. In the case of the only copy in the national collection, this assumes even greater significance.

The set of forms were arranged alphabetically by journal title before starting at a library: in the case of an alphabetical shelf arrangement, the items were immediately located; items not found were then checked in a catalogue or periodicals list; in case of differences in conventions, e.g. Transactions of a Society could be found either under *Transactions*, or under the name of the *Society*.

In the case of a systematic arrangement, each item first had to be located in the catalogue for its classification number. The set would then be reorganised in number order before searching on the shelves could commence.

Most of the libraries store older material in different stacks or store-rooms. Again, as the speed or ease of use was not at issue in this project, no distinction was made. In a specific study to evaluate accessibility from the user's point of view, this would be important, as would lighting between the shelves, the physically accessible and logical arrangement of journals.

The ideal venue contained the entire collection arranged alphabetically by journal title on well-lit shelves of normal human scale. Many of the journals are physically large and a volume may run into tens of thousands of pages in up to 24 parts. Where long runs of unbound sets are tightly packed, it is cumbersome to find a specific page reference.

Information on items sent for binding with estimated return times was found to be a very useful feature at one of the libraries.

Very few items were unaccounted for on the days the tests were conducted. At two of the libraries each of the items owned by the institution was found either on the shelf, or its whereabouts was known. The other five libraries had a combined total of 17 items not accounted for on the day. In these cases, a photocopy of the checklist form of each item not found, was left with a specific member of the staff. A date some five workdays later was established as the time for the follow-up search. These forms were to be returned to the researcher with a simple notation : FOUND ON [DATE] : YES/NO.

Each of the 17 forms were subsequently received; 9 items had been found, 8 not. If affirmative, the item received a code "2" rating, if negative and available elsewhere in RSA, it was marked "3".

4.4 Recording the data

At the different sites, the checklist form for each item was scored manually, including a note on those requiring a second search by a member of the specific library's staff.

Afterwards, all the information gathered was entered into a spreadsheet using the VP-Planner Plus package on a Personal Computer (APPENDIX 5).

Each of the 307 bibliographic items was accorded its own horizontal entry. The different variables were each labelled in a separate column, cryptically identified, as illustrated in Fig 4.4.

ID	LIB A I/S	LIB A	LIB B I/S	LIB B
159	1	1	1	1
160	2	2	1	1
161	1	2	2	1
162	1	1	1	1

LIB A I/S LIBRARY A In Stock	"Score" of LIBRARY A	LIB B I/S LIBRARY B In Stock	"Score" of LIBRARY B
1 = YES 2 = NO	LIB A = 1,2,3 or 4	1 = YES 2 = NO	LIB B = 1,2,3 or 4

Fig 4.4 Spreadsheet extract to record availability data

In addition to the data pertaining to the DDT itself, other relevant characteristics were identified. This aspect is discussed in Chapter 3.

4.5 Analysis of the data

The spreadsheet data was imported into the mainframe computer of the MRC at Parow Valley. (The complete data set is attached as APPENDIX 5). The *Statistical Application Software* (SAS) was used for all calculations and analyses of the data.

4.6 Results of the Document Delivery Tests

The data obtained in the availability exercise can be analysed and interpreted in two different ways, i.e. both methods have been used extensively in previous studies (Lancaster, 1977, 1982, 1988; Mansbridge, 1986). The results of the test conducted at Library A is presented in Tables 4.2 and 4.3 and will be used to illustrate the two methods of interpreting such data.

The Capability Index is a function of time, i.e. a measure of mediacy. The Availability Index, as reflected by a modified Kantor's branching technique, is a measure of immediacy, i.e. the chance ('probability') of finding an article in a periodical at a specific time at a specific library.

In this study, important factors such as library error on the one hand and user error on the other, had all but been eliminated.

Table 4.2 Summary of availability data recorded at Library A

	Number of Items	Category	Composite "Time" Total
On Shelf	232	1	232
Accessible C1	43	2	86
Accessible C2	23	3	69
Accessible C3	9	4	36
TOTALS	307		423

Table 4.3 Analysis of availability data recorded at Library A

	Number	% of Total	% of Acquired
Total Sample	307	100.00	n/a
Acquired by Library	244	79.48	100.00
On Shelf	232	75.57	95.08
Not on Shelf	12	3.91	4.92
Circulation	3	0.98	1.23
Bindery	3	0.98	1.23
Other Section	4	1.30	1.64
Found 2nd Search	1	0.33	0.41
Unaccounted	1	0.33	0.41
Elsewhere on Campus	31	10.10	n/a
National ILL	23	7.49	n/a

Tables containing the data for the other libraries are attached in APPENDICES 9-14. The manager of each library was supplied with those results concerning his/her library.

4.6.1 Orr's Capability Index

The method developed by Orr *et al.* (1968b) calculates the time it would take for each item to become available and expresses the results of a standard document delivery test in terms of the capability index. In the checklist used in this project the time codes categories are C1, C2, C3, C4. The *mean speed* is calculated based on the average performance of the items scored in each category. The capability index is the product of a simple arithmetical formula :

$$\text{Capability Index} = \frac{5 - (\text{mean speed}) \times 100}{4}$$

The capability index is a score on a scale of 100. The highest score for an item is one (1). The highest score a library can achieve is 100. In this case where the citation pool consists of 307 items, the *mean speed* of the best scenario would be $307 \div 307 = 1$. The formula would apply : $(5 - 1) \div 4 \times 100 = 100$. This is a highly improbable scenario in any normal open access library.

4.6.1.1 Capability Index results

The capability index for Library A was calculated from the data provided in Table 4.2 :

Mean speed	=	$423 \div 307$
	=	1.37785
Capability Index	=	$\frac{5 - (\text{mean speed}) \times 100}{4}$
	=	$\frac{5 - 1.37785 \times 100}{4}$
	=	90.55

Fig 4.5 reflects the Capability Index of each of the libraries as well as the hypothetical national collection, coded N. A *national collection*, consisting of the arithmetic mean of the combined holdings of the seven Medical centres, would score 1.487816; i.e. a Capability Index of 87.8. These scores are very high. It is in fact a best case scenario, testing the potential of the collections, rather than actual or individual library performance. As Orr *et al.* (1968a) maintained, any item can be obtained in time.

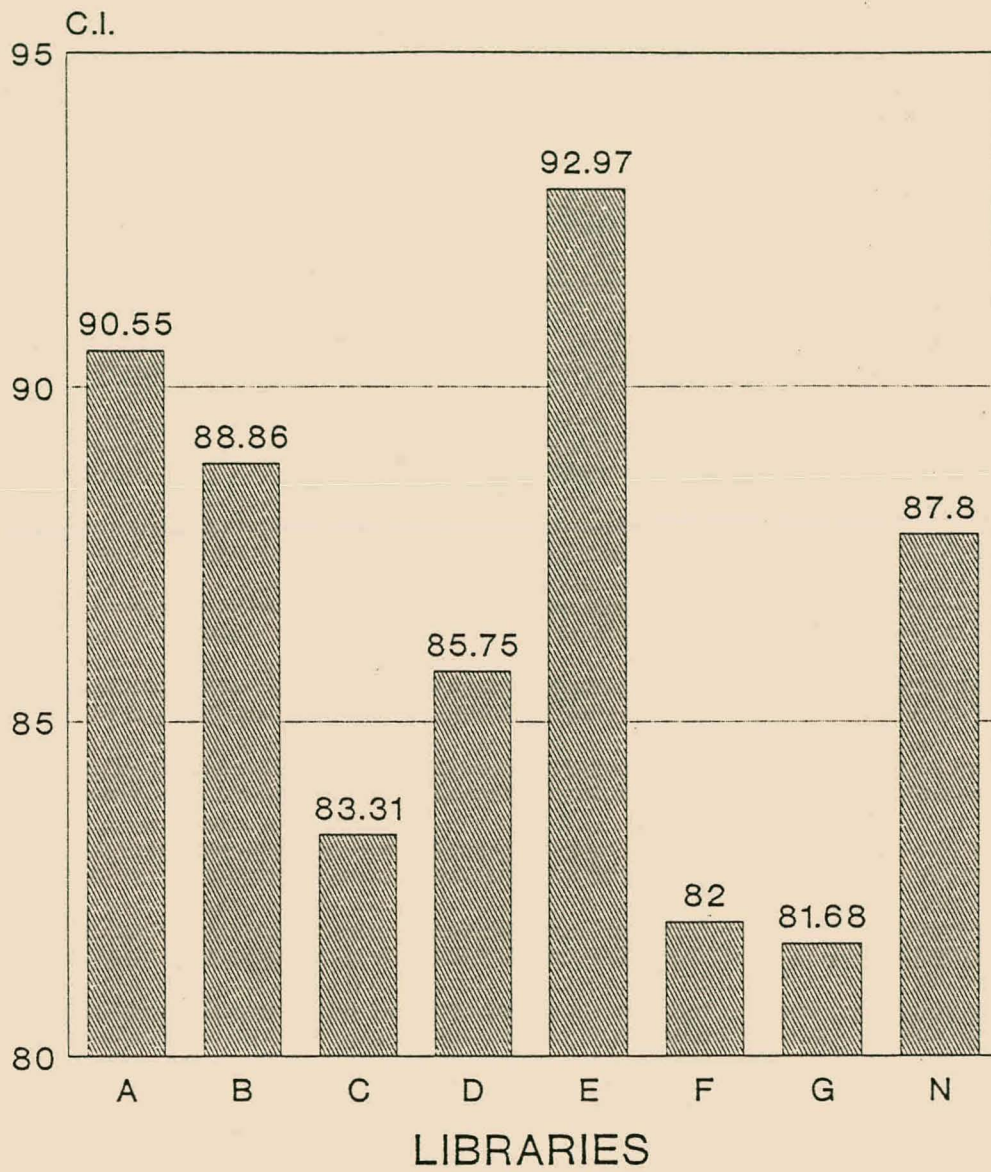


Fig 4.5

Availability of Journals expressed in terms of a Capability Index

According to a review article on the availability of books in libraries (Mansbridge, 1986), overall immediate availability ranged from 8% (De Prospero *et al.*, 1956) to 89% (Bush *et al.*, 1956), with an average availability rate in some 21 comparable studies of 61%. As a general guideline, Mansbridge considers 60% as a reasonable "score" for an open stack library. Kantor (1984) mentions a figure between 50 and 60%.

Most of these studies used either books or a combination of books and journals in their citation pools. Few examples were found of studies based on journal articles exclusively, as is the case in the present study (Piternick, 1972; Murfin, 1980).

The following factors presuppose a bias in favour of the delivery capability of the libraries:

- * "Abnormal" verification of references enhanced retrievability.
- * User error was virtually excluded.
- * Time factors were uniformly and optimistically calculated.
- * Very generous delivery times, e.g. one week for code C1, up to 3 weeks for Code C2 was allowed.
- * Minimal follow up was required: in only 17 cases were items, acquired by a library, unaccounted for, 0.79% of the total sample.

4.6.2 Kantor's branching technique

It was De Prospero *et al.* (1973) who introduced probability theory into the interpretation of the results of an availability study. Kantor (1984) developed the concept further and proposed a branching technique to illustrate the linear relationship between the non-availability categories. This method has gained wide acceptance as a standard test in library research (Mansbridge, 1986).

4.6.2.1 Branching technique results

The analysis of the branching technique is very appropriate for practical follow-up of specific problem areas identified by such an exercise. It is not as suitable where, as in this case, the results are obtained at anonymous libraries and the findings cannot be analysed and discussed in their full context.

The probability of obtaining a journal article in the presence of specific impediments to obtain a journal article is shown in the following example. The results obtained at Library A as reflected in Table 4.3 were used to illustrate the branching technique (Fig 4.6).

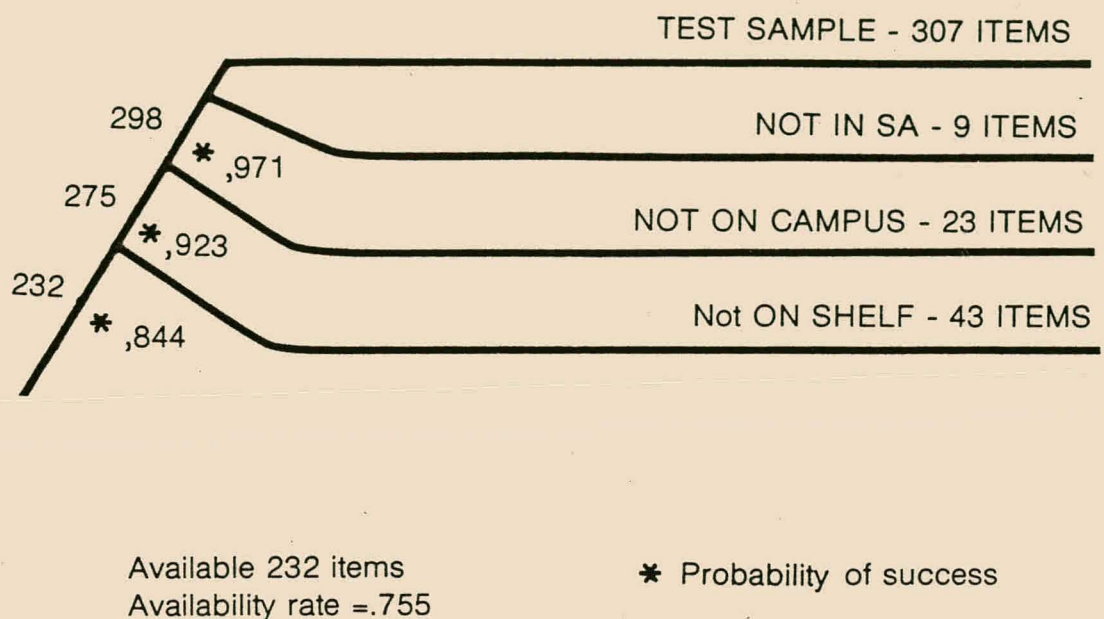


Fig 4.6 *An illustration of the probability of availability at Library A by means of Kantor's branching technique*

The Availability Indices for all seven libraries were calculated to illustrate the difference in interpretation style between the two methods. (Table 4.4).

Table 4.4 *The Availability Index achieved by medical libraries, calculated according to Kantor's branching technique*

LIBRARIES	A	B	C	D	E	F	G
Availability Index	0.756	0.694	0.642	0.593	0.840	0.603	0.635

The strength of the branching technique lies in its ability to test the performance of a library system, whereas the capability index is a more appropriate approach when the emphasis is on the collection itself, as in the present study.

4.6.3 Analysis of journal resources

All libraries rely on outside resources to augment their own collections. The profile and relationship of these reservoir resources drawn on by the different libraries is given in Figs 4.7 - 4.13.

It is clear that the interdependence on each other's collections is not entirely equal. Reciprocity may become a greater issue as library budgets become increasingly tight as the cost of supplying documents to other institutions escalate.

4.7 Findings

4.7.1 Journals not available in South Africa

Status C3 on the checklist was ticked if, according to the PISAL holdings records it was not obtainable from a South African library. Both the microfiche cumulations as well as the online version on SABINET were used. In two cases the only known holding library was one of the seven test sites where the copy was found to be missing or defective. There are likely to be other items recorded as "elsewhere in country" which will upon request prove unavailable. It fell outside the scope of this study to attempt monitoring the availability of items not in a library's own stock. Table 4.5 lists the items not traced in South Africa.

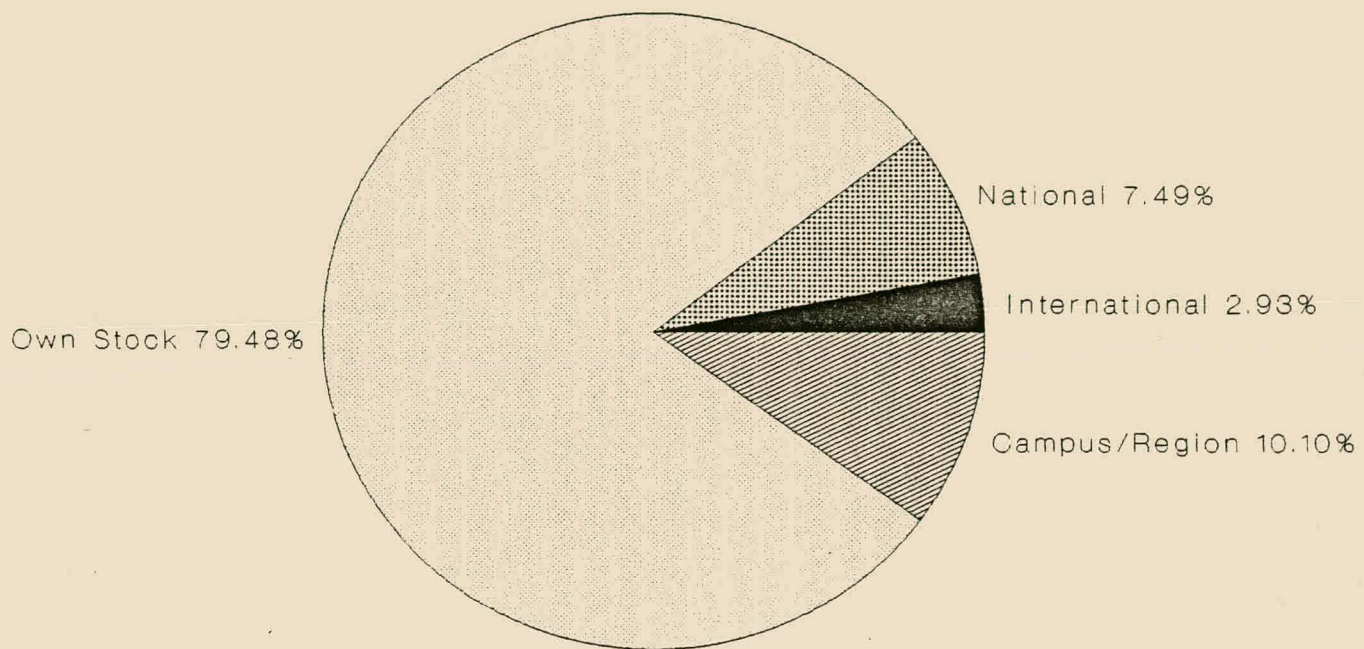


Fig 4.7 *Profile of document supply resources : Library A*

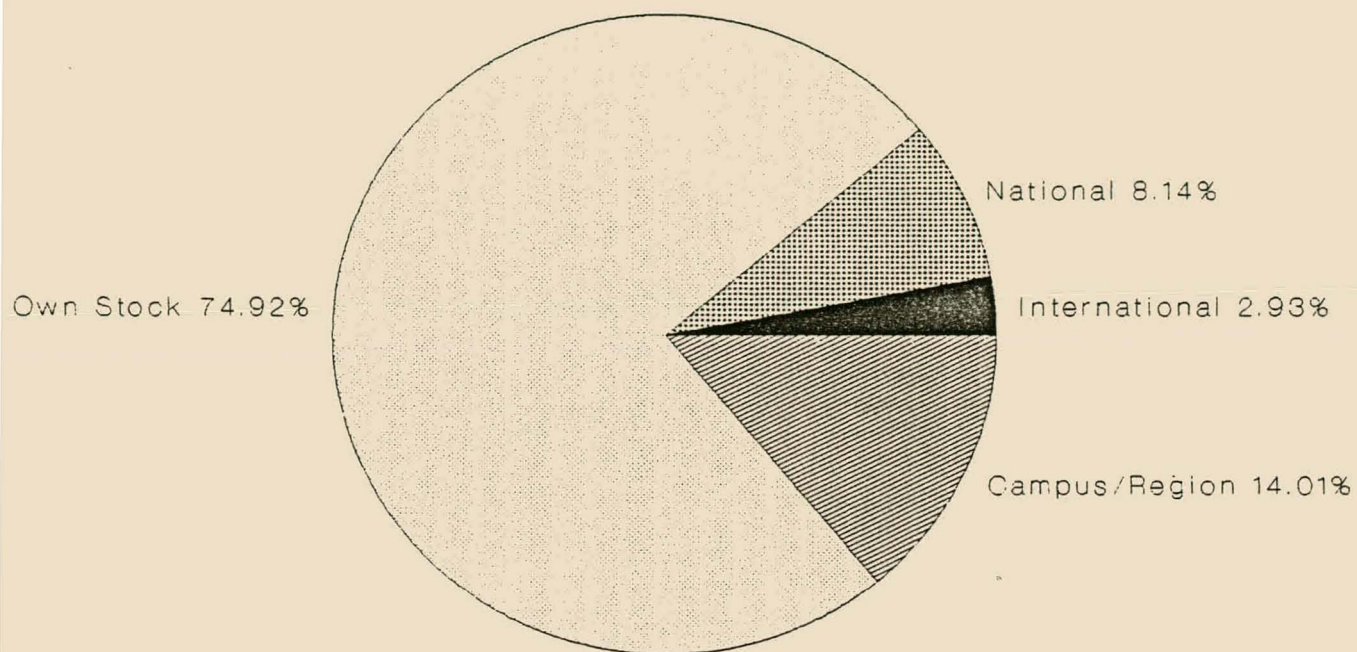


Fig 4.8 *Profile of document supply resources : Library B*

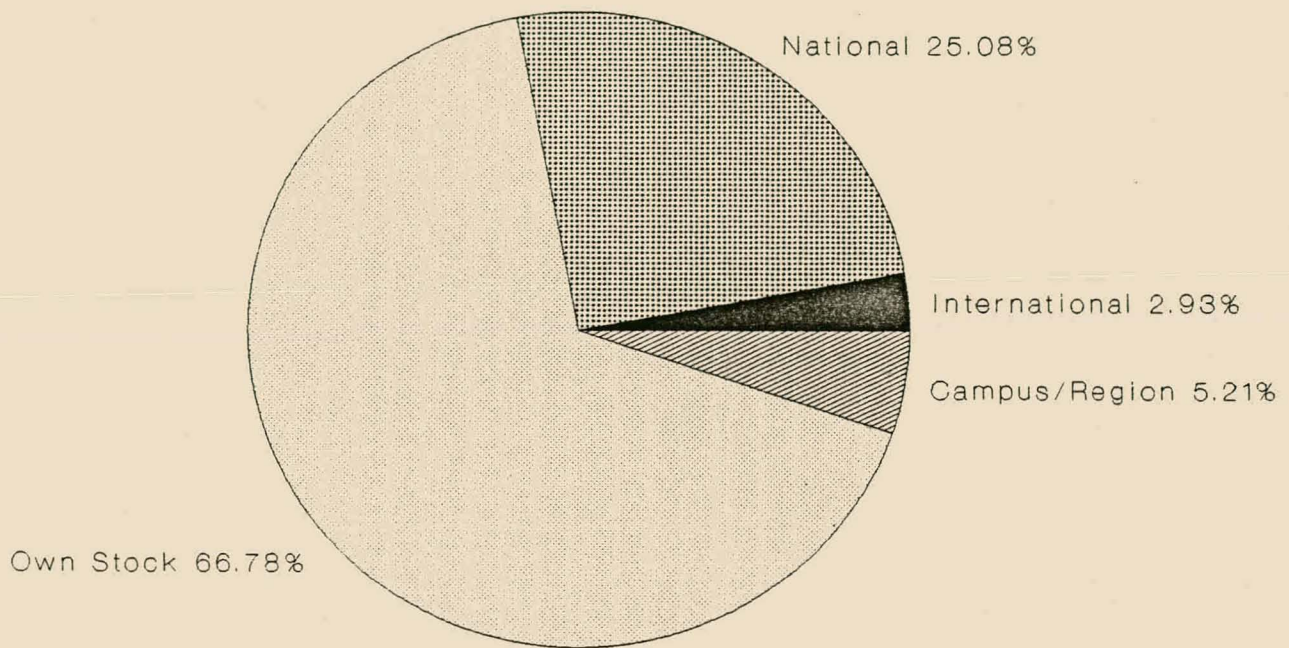


Fig 4.9 *Profile of document supply resources : Library C*

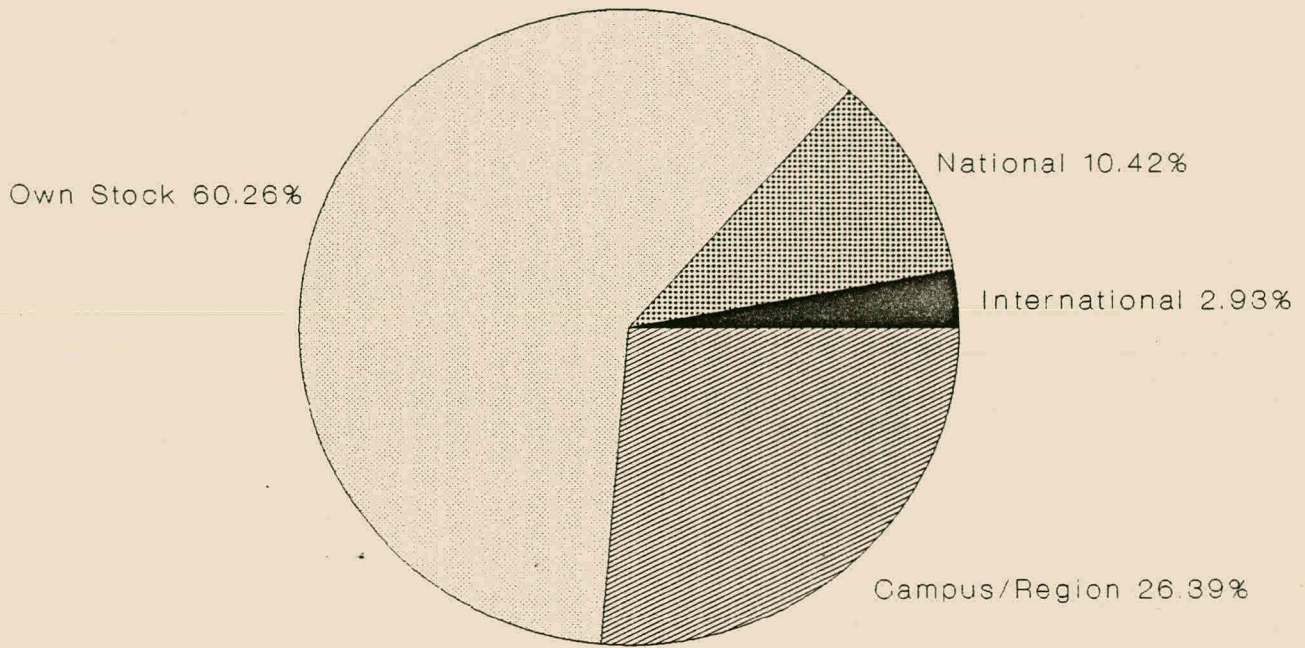


Fig 4.10

Profile of document supply resources : Library D

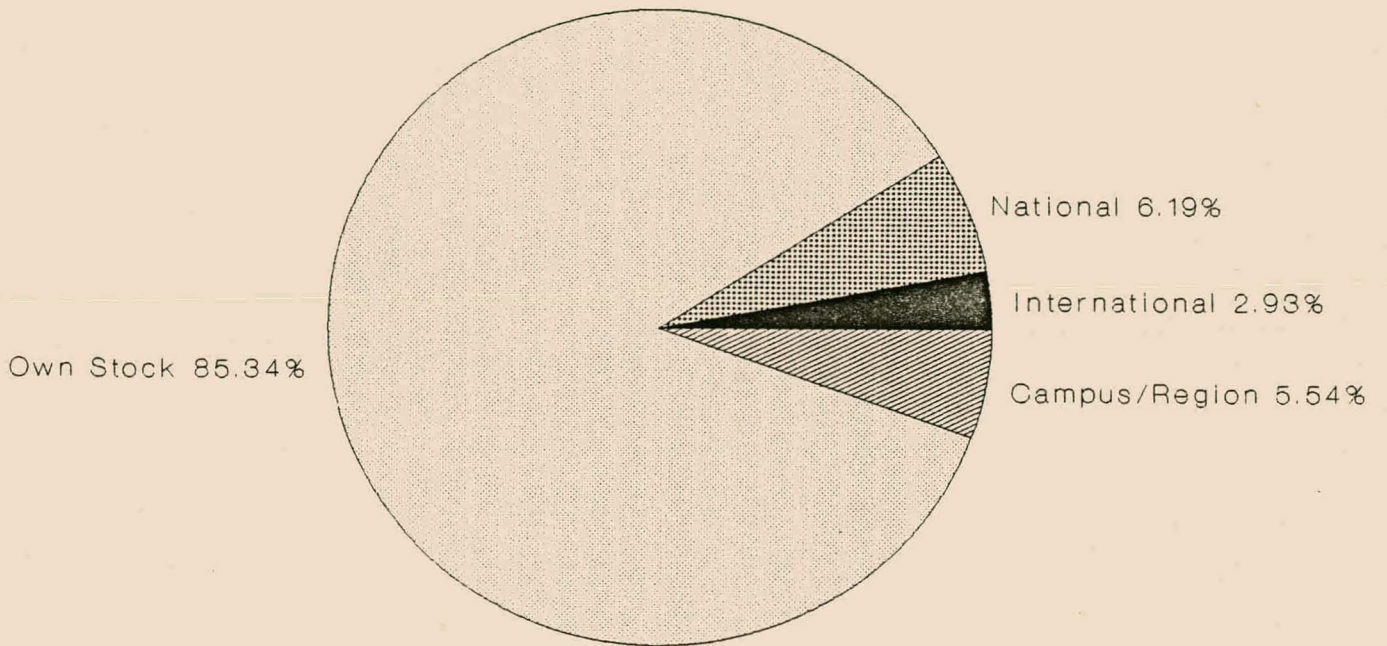


Fig 4.11 *Profile of document supply resources : Library E*

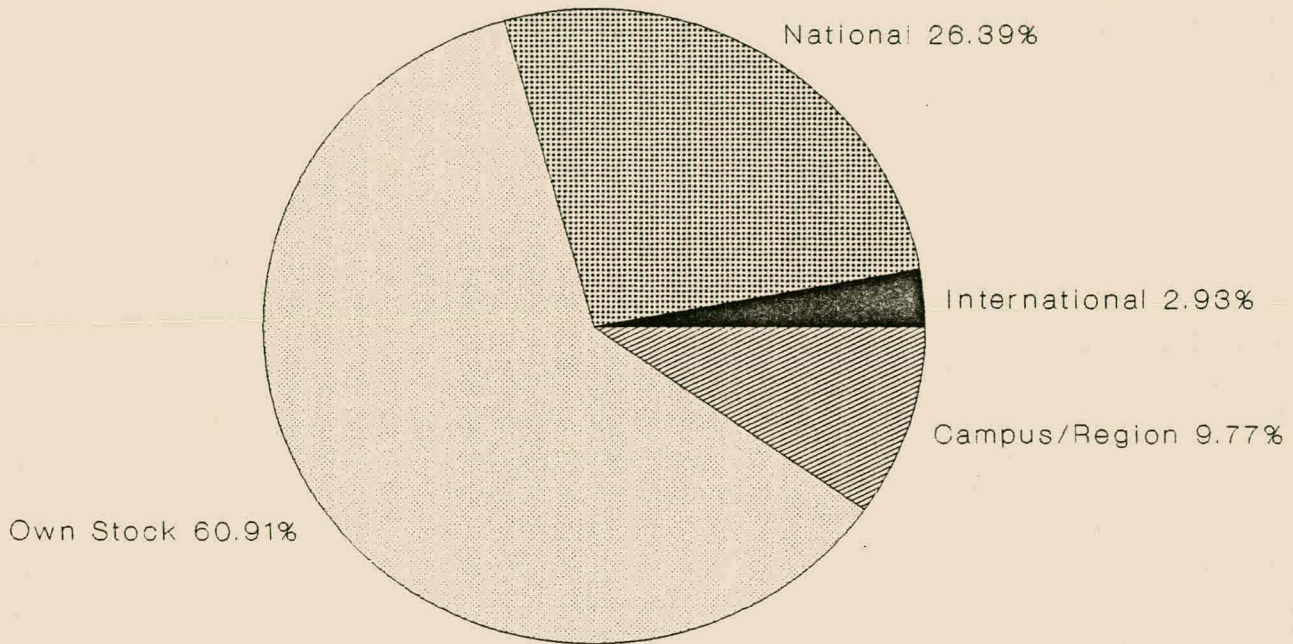


Fig 4.12 *Profile of document supply resources : Library F*

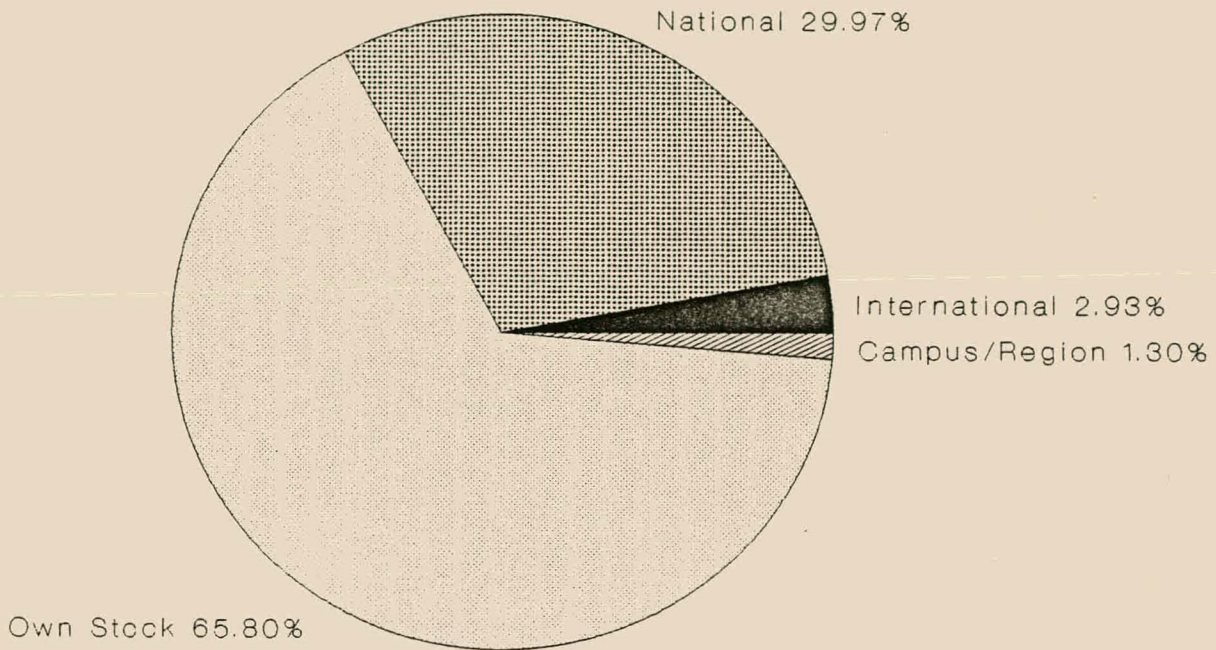


Fig 4.13 *Profile of document supply resources : Library G*

Table 4.5 *Journal articles not traced in South Africa*

Cryo letters 2 :135-144 (1982)
European journal of pediatrics 125 :29-37 (1974)
Indian pediatrician 19 : 353-359 (1982)
Montpellier medicine 21 : 441-444 (1942)
Neuroscience 11 :561-593 (1984)
Ontario dentist 64 :15-17 (1987)
Photochemistry and photobiology 35 : 181-185 (1982)
Phytotherapy research 1 :50-51. (1987)
Protides of the biological fluids 34 :359-362 (1986)

There are two important factors to bear in mind when stating that items "are not available in the country" :

1. There are many informal databases, personal files, etc not consulted or indeed consultable by mainstream libraries and librarians; the fact that these references were provided in the bibliographies of SA researchers presupposes its availability, at least to those individuals;
2. There are many indications that not all items cited by publishing scientists were in fact used by the author. It would seem that relatively often, references are taken unseen from a secondary source without the "cited by" qualification. This phenomenon was researched by the ISI, where the history of repeated incorrect bibliographical citations indicated copying without verification. It would be more difficult to ascertain where correct citations are adopted in this way. A statistical estimation could probably be made, but that falls outside the scope of this research project.

To all intents and purposes, items not found in the PISAL database are "not available in South Africa". Eight of the items in the citation pool that produced negative results despite thorough checking of all microfiche editions of PISAL as well as the database on SABINET (August/September 1990) were in fact located in some of the libraries visited.

4.7.2 Journals held by all seven libraries

Some 31.6% of the items in the test sample were found to be in stock at each of the seven libraries. This represented 97 journal articles from 47 different journal titles. The list of titles is presented in Table 4.6.

TABLE 4.6 *Journals available at all seven medical Libraries*

American heart journal
American journal of cardiology
American journal of clinical nutrition
American journal of epidemiology
American journal of physiology
Annals of internal medicine
Annals of surgery
Annual review of biochemistry
Archives of internal medicine
Biochemical journal
Blood
British journal of anaesthetics
British journal of obstetrics and gynaecology
British journal of ophthalmology
British journal of surgery
British medical journal
Chest
Circulation
Circulation research
Clinica chimica acta
Clinical orthopaedics and related research
Clinical radiology
Clinics in endocrinology and metabolism
Endocrinology
Journal of allergy and clinical immunology
Journal of the American Medical Association
Journal of applied physiology
Journal of biological chemistry
Journal of clinical endocrinology and metabolism
Journal of clinical investigation
Journal of clinical pathology
Journal of laboratory and clinical medicine
Journal of paediatrics
Journal of trauma
Lancet
Nature
Neurology
New England journal of medicine
Pediatrics
Plastic and reconstructive surgery
Proceedings of the National Academy of Sciences
Radiology
Scandinavian journal of clinical and laboratory investigation
Science
South African medical journal
South African journal of science
Surgical clinics in Northern America

4.8. Conclusions

- * The availability rate is remarkably high, individually, as well as collectively. The libraries' ability to account for the whereabouts of all the items in the citation pool was exemplary. This is an indication of sound administrative practices.
- * This kind of citation pool is of necessity some six months to a year older than the actual search by the scientist who cites it in a publication. One surmises that availability of especially newly published items could have been affected by routing, binding practices, greater demand for circulation, postal delays.
- * The most positive interpretation of the results of the availability tests is that the medical libraries provide their users with an excellent document delivery service. One should not lose sight of the fact that there is a distinct bias in favour of items in the collective document pool. One assumes that cited items were in fact found mostly in the national system. Obviously, personal copies and reprints/preprints of otherwise unrepresented documents exist.
- * In the present economic climate in South Africa, one is concerned about the collective journal pool. All the academic medical libraries depend on the State for most of its funds. In 1991, Universities experienced severe cutbacks. The Rector of Medunsa stated in a recent public interview that the very existence of his Institution was threatened due to lack of sufficient funding. Other Universities are all affected to greater or lesser extent. Inevitably, libraries are cutting subscriptions and raising the cost of interlending facilities. Staff resources are in jeopardy as budget cuts cause posts to be frozen and even disestablished. These economic factors must have a negative influence on the national availability of journals.
- * The results of the present study will lose currency very fast. Regular repeat exercises using the same methodology could be used to monitor the state of this vital national resource.

5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Characteristics

5.1.1 Recommendation for further investigation

5.2 Availability

5.2.1 Recommendations for further investigation

5.3 Conclusions

5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study had a dual purpose, namely to describe the journal literature used and published by South African biomedical researchers and secondly, to ascertain the availability of biomedical journal literature in the seven academic medical libraries in the RSA.

5.1 Characteristics

The two sets of data yielded very interesting scientometric information. It was possible to organize the characteristics into three main categories according to chronological, quantitative and qualitative attributes.

The chronological patterns manifested by the references in both sets of data were looked at and compared; as were the influence of the geographic origin of the source journal.

The quantitative attributes include numbers of authors, pages, references per article, etc. A limited citation analysis was done by describing the type of citation, journal self-citation and scattering of journal titles cited.

The attributes considered qualitative were determined by the extent to which the source journals were indexed by the five major secondary bibliographical services; its inclusion in the South African periodicals' joint catalogue, PISAL and its SCI Impact Factor.

The findings on the identified characteristics were very similar to international studies of biomedical literature. This was particularly evident in the pattern that emerged from the chronological attributes of references used by South African and other researchers. The profile of the papers published by South African authors in especially overseas journals is no different from those of authors from other countries. The reported preeminence of American journals in biomedical research literature, was also evident in the local study.

5.1.1 Recommendation for further investigation

The bibliometric information available in the SAMED database facilitates further research on the characterization of biomedical literature emanating from South African research.

1. In the first place, an ongoing diachronous study that correlates research funding with published output would yield more accurate data than merely analysing the publications indexed by SCI, as was done earlier this year by Pouris (1991).
2. The value of any bibliometric exercise could be enhanced by repetition of a specific methodological procedure at different time intervals. The present study used publications from 1989; further studies would provide information that could strengthen the value of these results. Changing trends in the use of biomedical literature could be identified by continually monitoring the available bibliometric data.

5.2 Availability

The journal titles held by the seven medical libraries in the RSA, in addition to the reservoir collections throughout the country as reported in PISAL, was seen as a national resource. In order to assess the availability of a representative sample of journal articles used by South African biomedical researchers, a standardized Document Delivery Test was conducted at each of the seven medical library sites.

The results were expressed in terms of a Capability Index for each individual library, as well as a hypothetical national average. The results achieved were reassuring. At present, South Africa is still well endowed with biomedical journals. Lancaster (1988) discusses the interpretation of capability values obtained during a shelf-availability exercise and suggests an inverse scale of demand and availability rate, i.e. a very high availability may indicate low usage or demand and low availability could signify that the collection is heavily used. Lancaster's perspective was used where all the items in the citation pool were drawn from the library's catalogue, therefore every item had been bought and processed. In the present study, the sample of items were intentionally not specific to any collection. Lancaster's scale would therefore not be validly applied to these results.

A more provocative interpretation of the high correlation between the availability of journals in South African medical libraries and the literature used by researchers is that it reflects the classical nature of research: that run-of-the-mill research projects would require run-of-the-mill literature. Such an interpretation might hypothesize that the recent isolation from international contact and the brain drain precluded the innovative research project which is characterized by a very different interaction between researcher and appropriate resources, e.g. more personal communication and the need for more highly specialized literature.

5.2.1 Recommendations for further investigation

An immediate concern is whether the strength of journal collections can be maintained in the future.

1. It is therefore suggested that a continuous research programme for the monitoring of journal holdings be instituted. The IULC is the most likely coordinating body to take the necessary steps for such a project.
2. More detailed analyses at individual libraries by adapting the checklist would provide valuable management information on the quality of the document delivery. Factors that cause delays in obtaining material and other barriers between the user and the source of information could be identified resulting in improved service.
3. The nature of use is, however, not explored. The significance of the availability or non-availability of publications in terms of the research endeavour is a fruitful area for future research.

5.3 Conclusions

The aftermath of an evaluation exercise needs to reflect on the stated research objectives, the methodological procedures and the value of the findings.

Orr (1973) suggested a checklist of criteria against which research of this nature should be measured. These are considered appropriate and applicable to the research aims and objectives of this project :

1. Appropriateness
2. Informativeness
3. Validity
4. Reproducibility
5. Comparability
6. Practicality

The two facets of the research project will be considered separately. Firstly, to address the attempt to describe the characteristics of journal literature used by SA researchers:

- * The scientometric approach proved very *appropriate* to reveal quantifiable attributes of the collection of publications.
- * The results of the investigation is certainly *informative*, as it provides information about this body of literature not previously described.
- * The *validity* of the results is more difficult to estimate. An indication of the probability of validity can be shown by the remarkably similar patterns uncovered in comparing the results of this study and other international findings.
- * The research design was simple and uncomplicated. One researcher gathered and analysed all the data. The *reproducibility* criterion is therefore claimed with confidence.
- * The rationale for selecting specific parameters for the characterization of journal literature was strongly influenced by previous studies in the subdiscipline. Consequently, *comparability* was almost an inevitable side-effect of the methodology.
- * The final criterion suggested by Orr, *practicality*, was a prerequisite for the successful completion of the present project.

Secondly, the traits of the **availability exercise** could be scrutinized in the light of the same attributes :

- * Regarding *appropriateness*, the DDT has a good track record for the assessment of the availability of library material.
- * The findings on the availability of journals in the seven medical libraries in South Africa is certainly *informative*, especially as no previous exercise of this nature has been undertaken.
- * The *validity* of the results depends on qualified interpretation. The constant awareness of the limitations of the study, e.g. virtual exclusion of both user and LIS error and concentration on the potential capability of the collective national resource should pass muster.
- * The previously proven *reproducibility* of this methodology was one of the main reasons for adopting it in the first place. The bibliographical units from which the items for the citation pool was chosen are constantly added to. A follow-up study would therefore have a source of more recent, but essentially similar items to start from.
- * The results of the availability study is to some extent *comparable* with the much larger research project undertaken in the USA at the end of the sixties (Orr, *et al.*, 1968a; 1968b; 1968c). That investigation also involved a number of medical libraries, not only one specific organization, as is described in most other undertakings. The type of material in most of the studies reported in the literature, was not limited to journal articles, however, as in the present project. Other availability studies concentrated on monograph collections and cannot realistically be compared with the state of journal literature. It can only be hoped that more investigators will give attention to journal collections in future.
- * As with the discussion of the characteristics facet, the proven (comparative) ease with which a single researcher managed to plan and execute the project is sufficient evidence of the *practicality* of the methodology.

Mouton & Marais (1985) refers to different factors that motivate the initiation of research projects. The sense of wonder ("verwondering"), of curiosity, the desire to find out "what makes it tick" was perhaps the strongest driving force in initiating and persevering with this project.

The sense of wonder and intellectual stimulation experienced by the researcher is added as a final personal measure of the success of the undertaking.

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* The 1986 edition contains a full reprint of the original 1963 text of "Little science, big science" as well as contributions from other authors. In the text of the thesis, where this work of Price was cited, 1963 is given as the year of publication to prevent the impression that data quoted was as recent as 1986.

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APPENDIX 1

EXAMPLE OF *SAMED* RECORD

DC 890001
AU Franken DR; Burkman, LJ; Oehninger SC; Coddington CC;
Veeck LL; Kruger TF; Rosenwaks Z; Hodgen G
TI Hemizona assay of using salt-stored human oocytes: Evaluation of
zona pellucida capacity for binding human spermatozoa.
SO Gamete Res 8900 22():15-26
USA
12
RF 23

Document 2

DC 890002
AU Franken DR; Oehninger S; Burkman LJ; Coddington CC;
Kruger TF; Rosenwaks Z; Acosta AA; Hodgen GD
TI The hemizona assay (HZA): a predictor of human sperm fertilizing
potential in in vitro fertilization (IVF) treatment.
SO J In Vitro Fertil Embryo Trans 8900 6(1):44-50
USA
7
RF 28

Document 3

DC 890003
AU De Beer FC
TI Systemic vasculitis.
SO CME 8901 7(1):25-8
L
4
RF 5

Document 4

DC 890004
AU Mody GM
TI Crystal arthropathies.
SO CME 8901 7(1):29-38
L
7
RF 9

Document 5

DC 890005
AU Scher AT; Loxton AJ; Klopper JF
TI Imaging in rheumatology.
SO CME 8901 7(1):57-65
L
7
RF 6

Document 6

DC 890006
AU Straughan J; Klemp P
TI NSAIDs in perspective.
SO CME 8901 7(1):71-6
L

APPENDIX 2

**SPREADSHEET RECORD OF THE DATA PERTAINING TO
ARTICLES PUBLISHED BY SA AUTHORS IN 1989
(SET A)**

O B S	I D	S O U R C E	O R I G I N	A U T H O R S	P A G E S	C I T A T	C O M M E N T	M N G R P H S	J N L S	S I N G L E S	S E L F C I T	E A R L I E S T	L A T E S T	S U B J E C T	A I M Y N	B A Y N	C A Y N	E M Y N	C X P Y N	I C R Y N	I D L Y N	I M Y N	S C I Y N	P O P Y N	P A Y N	T O Y Y N		
49	890057	156	2	1	7	39	925	6	33	15	0	1948	1988	22	2	2	2	2	2	2	2	2	2	2	2	2	2	
50	890058	147	1	3	11	29	954	2	27	13	2	1969	1988	2	2	1	1	1	1	1	1	2	1	1	2	2	2	
51	890059	149	2	5	3	24	978	0	22	13	3	1982	1988	9	2	1	1	1	2	2	2	1	2	2	2	2	2	
52	890060	91	1	6	6	29	1007	3	26	18	0	1963	1988	11	2	2	1	1	2	2	2	1	1	2	2	2	2	
53	890061	82	3	1	6	38	1045	2	36	14	0	1978	1988	11	2	2	1	1	2	2	2	1	1	2	2	2	2	
54	890062	42	1	1	2	14	1059	0	14	11	2	1971	1988	11	2	1	1	1	2	2	2	1	2	2	2	2	2	
55	890063	56	2	1	6	25	1084	0	25	18	0	1978	1988	15	2	2	2	2	2	2	2	2	2	2	2	2	2	
56	890064	4	3	6	3	14	1098	1	13	10	0	1962	1989	13	2	2	1	2	2	2	2	2	2	2	2	2	2	
57	890070	56	2	1	5	9	1107	1	8	7	0	1942	1987	23	2	2	2	2	2	2	2	2	2	2	2	2	2	
58	890071	56	2	3	9	16	1123	0	16	7	0	1980	1988	8	2	2	2	2	2	2	2	2	2	2	2	2	2	
59	890072	56	2	1	4	0	1123	0	0	0	0	.	.	10	2	2	2	2	2	2	2	2	2	2	2	2	2	
60	890073	149	2	3	2	9	1132	2	7	7	1	1929	1986	2	2	1	1	1	2	2	2	1	1	2	2	2	2	
61	890074	36	4	4	3	9	1141	0	9	8	1	1956	1987	2	1	1	1	1	1	1	1	2	1	1	2	2	2	
62	890075	49	1	4	7	31	1172	1	30	20	2	1946	1987	15	1	1	1	1	1	1	1	2	1	1	2	2	2	
63	890076	114	1	3	7	15	1187	2	13	9	4	1972	1986	7	2	1	1	2	2	2	2	1	1	2	2	2	2	
64	890077	53	4	2	2	3	1190	0	3	3	0	1978	1987	2	2	1	1	1	2	2	2	1	1	2	2	2	2	
65	890078	137	3	5	4	20	1210	3	17	12	1	1962	1986	18	2	1	1	1	2	2	2	1	1	2	2	2	2	
66	890079	158	1	4	6	24	1234	0	24	15	0	1973	1986	14	1	1	1	1	1	1	1	2	1	1	2	2	2	
67	890080	127	1	3	16	40	1274	0	40	21	0	1963	1986	10	2	1	1	1	2	2	2	1	2	2	2	2	2	
68	890081	44	3	5	5	11	1285	6	5	5	1	1956	1988	7	2	1	1	1	2	2	1	1	1	2	2	2	2	
69	890082	149	2	2	3	18	1303	2	16	14	0	1966	1987	16	2	1	1	1	2	2	2	1	1	2	2	2	2	
70	890083	71	4	6	4	27	1330	0	27	17	1	1963	1988	16	2	1	1	1	2	2	2	1	2	2	2	2	2	
71	890084	155	2	1	5	5	1335	0	4	4	0	1951	1979	9	2	1	1	2	2	2	2	2	2	2	2	2	2	
72	890089	153	2	5	6	32	1367	8	23	12	0	1973	1989	19	2	2	2	2	2	2	2	2	2	2	2	2	2	
73	890090	153	2	5	7	31	1398	8	22	10	1	1955	1989	19	2	2	2	2	2	2	2	2	2	2	2	2	2	
74	890093	81	5	3	8	62	1460	9	53	28	0	1947	1989	19	2	2	1	2	2	2	2	2	2	2	2	2	2	
75	890094	89	1	2	6	30	1490	1	29	12	8	1923	1988	8	2	1	1	1	2	2	2	1	2	2	2	2	2	
76	890096	105	4	2	13	46	1536	4	42	22	3	1951	1986	1	2	1	1	1	2	2	2	1	1	2	2	2	2	
77	890097	65	1	5	6	30	1566	2	28	16	3	1969	1987	10	2	1	1	1	1	1	1	2	1	1	2	2	2	
78	890098	157	1	2	4	25	1591	5	20	10	9	1955	1986	11	2	1	1	1	2	2	2	1	1	2	2	2	2	
79	890100	56	2	2	8	7	1598	5	2	2	0	1975	1987	20	2	2	2	2	2	2	2	2	2	2	2	2	2	
80	890103	56	2	1	8	15	1613	2	13	7	1	1962	1987	17	2	2	2	2	2	2	2	2	2	2	2	2	2	
81	890105	56	2	1	4	0	1613	0	0	0	0	.	.	10	2	2	2	2	2	2	2	2	2	2	2	2	2	
82	890106	132	1	3	3	0	1613	0	0	0	0	.	.	18	2	1	1	1	2	2	2	1	1	2	2	2	2	2
83	890107	149	2	4	2	7	1620	2	5	3	0	1968	1985	3	2	1	1	1	2	2	2	1	1	2	2	2	2	
84	890110	94	1	3	3	18	1638	0	18	12	5	1950	1988	16	2	1	1	1	2	2	2	1	1	2	2	2	2	
85	890111	23	3	2	9	45	1683	4	41	22	0	1951	1986	2	2	1	1	1	2	2	2	1	1	2	2	2	2	
86	890112	21	1	7	8	58	1741	4	53	27	6	1977	1988	1	2	2	1	1	2	2	2	1	2	2	2	2	2	
87	890115	68	3	4	6	17	1758	6	11	7	0	1983	1988	16	2	1	1	1	2	2	2	2	2	2	2	2	2	
88	890116	45	4	2	8	20	1778	1	19	16	1	1951	1988	20	2	2	1	2	2	2	2	1	2	2	2	2	2	
89	890117	159	4	2	4	21	1799	8	10	7	0	1948	1989	22	2	1	1	1	2	2	2	1	1	2	2	2	2	
90	890118	61	1	6	11	50	1849	3	47	18	17	1971	1988	8	1	1	1	1	1	1	1	2	1	1	1	2	2	
91	890119	149	2	4	2	15	1854	0	5	2	4	1988	1989	6	2	1	1	1	2	2	2	1	1	2	2	2	2	
92	890120	149	2	3	4	15	1869	2	13	8	5	1959	1988	6	2	1	1	1	2	2	2	1	1	2	2	2	2	
93	890121	149	2	3	2	0	1869	0	0	0	0	.	.	6	2	1	1	1	2	2	2	1	1	2	2	2	2	
94	890122	163	2	3	4	13	1882	3	8	5	0	1966	1988	22	2	2	2	2	2	2	2	2	2	2	2	2	2	
95	890123	19	4	3	5	14	1896	1	13	8	0	1965	1986	21	2	2	2	1	2	2	2	1	2	2	2	2	2	
96	890124	53	4	2	3	11	1907	2	9	8	1	1962	1987	15	2	1	1	1	2	2	2	1	1	2	2	2	2	

OBS	ID	SOURCE	ORIGIN	AUTHORS	PAGES	CITATIONS	CUMULATIVE	MGRPHS	JNLS	SINGLE	SELF	EARLY	LAST	SUBJECT	AIM	BA	CA	EM	XP	IC	IDL	IM	SCIP	POPA	TOX
97	890125	140	4	16	9	10	1917	4	5	5	0	1969	1988	2	2	1	1	1	2	2	2	1	1	2	2
98	890127	27	3	5	5	18	1935	2	16	16	12	1969	1988	13	2	1	1	1	1	1	2	1	1	2	2
99	890128	6	1	1	5	33	1968	8	25	16	1	1933	1986	19	1	1	1	1	2	2	2	1	1	2	2
100	890129	18	1	1	15	104	2072	1	103	30	27	1939	1989	14	1	1	1	1	1	1	2	1	1	2	2
101	890130	149	2	3	4	24	2096	12	11	10	2	1967	1988	5	2	1	1	1	2	2	2	1	1	2	2
102	890132	86	3	4	5	26	2122	5	21	16	1	1962	1988	19	2	1	1	1	2	2	2	1	1	2	2
103	890133	117	1	8	9	40	2162	4	36	23	1	1933	1989	13	1	1	1	1	1	1	2	1	1	2	2
104	890134	111	1	1	3	22	2184	7	14	7	0	1925	1988	3	2	1	1	1	2	2	1	1	2	2	2
105	890135	88	4	2	8	17	2201	1	16	11	2	1965	1986	20	2	1	1	1	2	2	2	1	1	2	2
106	890136	63	3	4	10	26	2227	1	25	14	4	1973	1987	1	2	1	1	1	2	2	2	1	1	2	2
107	890137	32	4	1	6	6	2233	1	5	4	0	1958	1985	9	2	1	1	1	2	2	2	1	1	2	2
108	890138	90	1	3	6	39	2272	2	37	14	11	1966	1989	1	2	1	1	1	1	1	2	1	1	2	2
109	890139	114	1	2	7	11	2283	2	9	7	0	1966	1986	7	2	1	1	2	2	2	2	1	1	2	2
110	890141	101	1	4	8	35	2318	6	29	19	2	1932	1988	19	1	1	1	1	2	2	2	1	1	2	2
111	890142	149	2	4	5	18	2336	3	15	10	2	1975	1988	19	2	1	1	1	2	2	2	1	1	2	2
112	890143	161	5	6	6	51	2387	8	41	27	0	1920	1988	19	2	2	2	2	2	2	2	1	2	2	2
113	890144	161	5	4	4	33	2420	1	27	19	2	1960	1988	19	2	2	2	2	2	2	2	1	2	2	2
114	890145	11	1	4	7	27	2447	0	27	22	2	1972	1987	19	1	1	1	1	1	1	2	1	1	1	2
115	890146	103	1	3	5	15	2462	3	12	7	0	1979	1987	25	2	1	1	1	2	2	2	1	1	2	2
116	890147	149	2	4	3	11	2473	3	8	7	2	1973	1986	3	2	1	1	1	2	2	2	1	1	2	2
117	890148	143	1	1	6	26	2499	3	23	17	0	1938	1985	4	2	1	1	1	1	2	2	1	2	2	2
118	890149	64	3	6	6	7	2506	0	7	4	0	1979	1987	19	2	1	1	1	2	2	2	1	1	2	2
119	890150	56	2	1	8	17	2523	5	12	8	0	1952	1989	22	2	2	2	2	2	2	2	2	2	2	2
120	890151	56	2	3	17	23	2546	9	14	11	0	1965	1988	15	2	2	2	2	2	2	2	2	2	2	2
121	890152	56	2	1	4	16	2562	0	16	10	0	1955	1988	23	2	2	2	2	2	2	2	2	2	2	2
122	890155	56	2	1	6	5	2567	2	3	3	0	1981	1988	23	2	2	2	2	2	2	2	2	2	2	2
123	890160	150	2	2	3	22	2589	1	21	16	1	1951	1988	2	2	2	2	2	2	2	2	2	2	2	2
124	890174	124	4	5	1	9	2598	0	9	7	0	1977	1988	23	2	2	2	2	2	2	2	2	2	2	2
125	890175	151	2	1	2	32	2630	5	27	16	0	1954	1987	19	2	1	1	1	2	2	2	1	2	2	2
126	890177	56	2	1	6	12	2642	0	12	9	1	1981	1985	6	2	2	2	2	2	2	2	2	2	2	2
127	890178	56	2	2	7	12	2654	0	12	5	0	1982	1989	17	2	2	2	2	2	2	2	2	2	2	2
128	890182	90	1	4	6	50	2704	7	43	22	12	1966	1989	12	2	1	1	1	2	2	2	1	1	2	2
129	890183	96	4	3	8	11	2715	0	11	5	4	1976	1988	25	2	1	1	1	1	1	2	1	1	2	2
130	890184	149	2	3	2	8	2723	0	8	4	0	1960	1987	12	2	1	1	1	2	2	2	1	1	2	2
131	890185	102	4	2	3	7	2730	0	7	5	0	1977	1988	12	2	1	1	1	2	2	2	1	1	2	2
132	890186	110	4	5	7	23	2753	3	18	6	4	1970	1988	3	2	2	1	1	2	2	2	1	1	2	2
133	890187	30	4	5	21	56	2809	3	53	24	2	1966	1988	19	1	1	2	1	2	2	2	1	2	2	2
134	890190	43	4	2	7	30	2839	0	30	15	1	1951	1987	18	2	1	1	1	2	2	2	1	2	2	2
135	890191	60	4	7	6	35	2874	3	32	13	0	1972	1988	12	2	2	1	2	2	2	2	1	1	2	2
136	890192	10	1	3	4	4	2878	2	2	2	0	1971	1988	12	2	1	2	1	2	2	2	1	1	2	2
137	890193	54	3	4	9	23	2901	1	22	14	1	1949	1987	12	2	1	1	1	2	2	2	1	1	2	2
138	890194	47	5	2	4	9	2910	1	8	6	0	1964	1989	12	2	1	2	1	2	2	2	1	2	2	2
139	890195	51	3	4	10	23	2933	2	21	14	3	1957	1986	19	2	1	1	1	2	2	2	1	1	2	2
140	890196	123	1	4	4	24	2957	5	19	18	0	1964	1987	20	2	1	1	1	2	2	2	1	1	2	2
141	890197	95	4	11	16	33	2990	1	32	15	1	1971	1988	19	2	1	1	1	2	2	2	1	1	2	2
142	890198	77	1	2	19	5	2995	1	4	2	3	1974	1983	20	2	1	1	1	2	2	2	1	2	2	2
143	890199	83	4	7	4	14	3009	3	11	5	0	1959	1989	7	2	1	2	1	2	2	2	1	1	2	2
144	890202	116	4	6	13	19	3028	1	18	10	4	1962	1986	1	2	1	1	1	1	1	2	1	1	2	2

OBS	ID	SOURC	ORIGIN	AUTHORS	PAGES	CITAT	CUMCIT	MGRP	JNL	SINGLES	SELCIT	EARLIES	LATES	SUBJECT	AIM	BAY	CAY	EM	CX	ICR	IDL	IM	SCJ	POP	PA	TOX
145	890203	26	4	4	11	63	3091	5	58	36	1	1955	1988	1	2	1	1	1	1	1	2	1	1	2	1	
146	890207	25	4	7	7	48	3139	4	44	20	2	1974	1987	12	2	1	1	1	1	1	2	1	1	2	2	
147	890208	62	3	2	8	34	3173	3	31	11	1	1928	1986	19	2	1	1	1	2	2	2	1	1	2	2	
148	890209	51	3	4	10	23	3196	0	23	14	3	1956	1987	19	2	1	1	1	2	2	2	1	1	2	2	
149	890210	34	4	3	6	28	3224	3	24	13	3	1970	1986	15	2	1	1	1	2	2	2	1	2	2	2	
150	890211	103	1	3	4	20	3244	2	18	13	0	1979	1988	25	2	1	1	1	2	2	2	1	1	2	2	
151	890213	56	2	1	4	0	3244	0	0	0	0			10	2	2	2	2	2	2	2	2	2	2	2	
152	890214	125	2	4	3	5	3249	0	5	3	0	1980	1986	8	2	2	2	2	2	2	2	2	2	2	2	
153	890215	42	1	3	2	6	3255	0	6	4	0	1988	1988	11	2	1	1	2	2	2	2	2	2	2	2	
154	890216	73	5	1	7	27	3282	9	15	11	1	1966	1988	16	2	1	2	2	2	2	2	2	2	2	2	
155	890217	154	2	4	2	26	3308	2	24	13	0	1966	1988	12	2	1	1	1	2	2	2	2	1	2	2	
156	890218	154	2	1	2	19	3327	9	9	8	0	1956	1988	18	2	1	1	1	2	2	2	2	1	2	2	
157	890220	56	2	1	4	6	3333	1	5	5	0	1861	1987	15	2	2	2	2	2	2	2	2	2	2	2	
158	890223	56	2	1	8	13	3346	7	2	2	0	1973	1987	18	2	2	2	2	2	2	2	2	2	2	2	
159	890224	164	5	4	3	16	3362	2	13	11	0	1970	1988	9	2	1	2	1	2	2	2	1	1	2	2	
160	890226	154	2	4	2	26	3388	2	24	13	0	1966	1988	14	2	1	1	1	2	2	2	2	1	2	2	
161	890227	12	1	1	5	14	3402	2	12	7	2	1965	1988	13	1	1	1	1	2	2	2	1	2	2	2	
162	890028	149	2	4	3	16	3418	1	13	6	2	1980	1988	6	2	1	1	1	2	2	2	1	1	2	2	
163	890029	50	1	5	8	32	3450	3	29	12	6	1932	1989	11	1	1	1	1	2	2	2	1	1	2	2	
164	890230	149	2	3	4	6	3456	2	3	2	2	1968	1987	6	2	1	1	1	2	2	2	1	1	2	2	
165	890232	35	4	2	3	11	3467	0	11	7	0	1959	1987	13	2	1	2	1	2	2	2	1	1	2	2	
166	890233	66	4	2	9	38	3505	3	35	17	0	1898	1989	13	2	1	2	1	2	2	2	1	2	2	2	
167	890234	129	4	3	10	50	3555	1	49	27	1	1964	1988	2	2	1	1	1	1	1	2	1	2	2	2	
168	890238	56	2	1	7	40	3595	4	36	19	0	1922	1987	10	2	2	2	2	2	2	2	2	2	2	2	
169	890243	56	2	2	4	46	3641	2	44	25	0	1967	1987	7	2	2	2	2	2	2	2	2	2	2	2	
170	890246	48	4	3	7	8	3649	0	8	6	0	1966	1987	22	2	2	2	2	2	2	2	2	2	2	2	
171	890250	139	5	3	8	16	3665	1	15	14	0	1963	1987	11	2	2	2	2	2	2	2	2	2	2	2	
172	890251	145	2	3	3	0	3665	0	0	0	0			5	2	2	2	2	2	2	2	2	2	2	2	
173	890252	152	2	3	5	17	3682	6	11	8	0	1937	1987	5	2	2	2	2	2	2	2	2	2	2	2	
174	890253	70	2	3	8	33	3715	8	22	13	0	1937	1985	5	2	2	2	2	2	2	2	2	2	2	2	
175	890255	57	2	2	4	12	3727	5	7	3	0	1980	1989	6	2	2	2	2	2	2	2	2	2	2	2	
176	890257	89	1	4	6	30	3757	6	24	19	1	1938	1987	3	2	1	1	1	2	2	2	1	2	2	2	
177	890258	78	1	2	6	37	3794	1	36	16	7	1963	1988	13	2	1	1	1	1	1	2	1	1	2	2	
178	890259	78	1	3	6	27	3821	3	24	15	4	1970	1987	16	2	1	1	1	1	1	2	1	1	2	2	
179	890261	45	4	6	11	31	3852	0	31	13	0	1973	1988	1	2	2	1	2	2	2	2	1	2	2	2	
180	890262	96	4	1	6	8	3860	0	8	3	5	1985	1989	25	2	1	1	1	1	1	2	1	1	2	2	
181	890263	149	2	3	2	10	3870	0	10	10	0	1967	1987	12	2	1	1	1	2	2	2	1	1	2	2	
182	890264	76	3	3	4	29	3899	1	28	14	2	1966	1988	12	2	1	1	1	1	1	2	1	2	2	2	
183	890265	107	3	1	4	29	3928	6	23	12	2	1965	1987	7	2	1	1	1	2	2	1	1	1	2	2	
184	890266	33	4	5	6	28	3956	0	28	21	1	1965	1987	10	2	1	1	1	1	1	2	1	1	2	2	
185	890267	54	3	4	10	36	3992	9	27	20	2	1857	1987	12	2	1	1	1	2	2	2	1	1	2	2	
186	890268	165	4	3	10	15	4007	1	14	7	0	1964	1987	24	2	2	2	1	2	2	2	1	2	2	2	
187	890269	120	4	4	4	24	4031	1	23	13	0	1977	1988	11	1	1	1	1	1	1	2	1	1	1	2	
188	890270	149	2	4	3	6	4037	0	6	4	3	1975	1985	6	2	1	1	1	2	2	2	1	1	2	2	
189	890271	149	2	5	3	24	4061	1	23	15	0	1957	1988	10	2	1	1	1	2	2	2	1	1	2	2	
190	890272	118	1	4	8	28	4089	4	24	19	1	1966	1988	10	2	1	2	1	2	2	2	1	2	2	2	
191	890273	39	1	2	7	19	4108	11	8	7	0	1964	1985	2	2	1	2	1	2	2	2	1	2	2	2	
192	890274	149	2	3	4	31	4139	6	25	14	5	1971	1989	6	2	1	1	1	2	2	2	1	1	2	2	

O B S	I D	S O U R C E	O R I G I N	A U T H O R S	P A G E S	C I T A T E	C U M M U L A T E	M N G R A P H S	J N L S	S I N G L E S	S E L F C I T	E A R L I E S T	L A T E S T	S U B J E C T	A I M Y N	B A Y N	C A Y N	E M Y N	C X P Y N	I C R Y N	I D L Y N	I M Y N	S C I Y N	P O P Y N	P A Y N	T O X Y N
193	890275	149	2	3	4	28	4167	3	22	12	11	1963	1989	6	2	1	1	1	2	2	2	1	1	2	2	.
194	890276	25	4	5	3	20	4187	1	19	13	0	1980	1988	1	2	1	2	1	1	1	2	1	1	2	2	.
195	890277	140	4	5	3	4	4191	0	4	3	0	1982	1987	2	2	1	1	1	2	2	2	1	1	2	2	.
196	890278	74	3	3	4	26	4217	1	25	18	1	1956	1988	1	2	1	1	1	2	2	2	1	2	2	2	.
197	890279	85	4	1	5	10	4227	0	9	5	0	1965	1987	2	2	1	1	1	2	2	2	1	2	2	2	.
198	890280	74	3	6	5	19	4246	0	19	15	1	1962	1987	8	2	1	1	1	2	2	2	1	2	2	2	.
199	890281	149	2	2	4	8	4254	2	6	5	0	1902	1988	18	2	1	1	1	2	2	2	1	1	2	2	.
200	890282	149	2	2	3	26	4280	3	21	14	0	1967	1989	22	2	1	1	1	2	2	2	1	1	2	2	.
201	890283	80	3	4	7	25	4305	0	25	15	2	1968	1987	15	2	1	1	1	2	2	2	1	1	2	2	.
202	890284	106	1	4	7	24	4329	2	22	14	1	1965	1989	3	1	2	2	1	2	2	1	1	2	2	2	.
203	890285	80	3	4	7	19	4348	0	19	11	1	1969	1987	15	2	1	1	1	2	2	2	1	1	2	2	.
204	890286	29	3	4	14	44	4392	5	38	30	0	1963	1989	3	2	1	1	1	2	2	2	1	2	2	2	.
205	890287	74	3	1	6	20	4412	2	18	16	1	1941	1987	8	2	1	1	1	2	2	2	1	2	2	2	.
206	890289	102	4	1	5	7	4419	3	4	4	1	1959	1988	12	2	1	1	1	2	2	2	1	1	2	2	.
207	890290	8	1	9	6	36	4455	3	33	19	0	1963	1985	10	2	1	1	1	1	1	2	1	1	2	2	.
208	890292	54	3	3	5	8	4463	0	8	6	1	1964	1987	12	2	1	1	1	2	2	2	1	1	2	2	.
209	890293	141	4	3	9	9	4472	0	9	7	0	1975	1989	12	2	2	1	1	2	2	2	1	2	2	2	.
210	890301	56	2	2	7	20	4492	1	19	14	0	1949	1988	4	2	2	2	2	2	2	2	2	2	2	2	.
211	890304	136	1	4	5	31	4523	3	28	13	0	1951	1988	18	2	1	1	1	2	2	2	1	1	2	2	.
212	890305	130	2	1	17	44	4567	5	39	14	6	1903	1989	22	2	2	2	2	2	2	2	2	2	2	2	.
213	890308	126	5	1	2	0	4567	0	0	0	0	.	.	11	2	2	2	2	2	2	2	2	2	2	2	.
214	890311	154	2	4	4	14	4581	3	11	7	0	1952	1989	14	2	1	1	1	2	2	2	2	2	2	2	.
215	890312	154	2	3	4	10	4591	2	8	6	0	1981	1988	16	2	1	1	1	2	2	2	2	2	2	2	.
216	890313	28	1	2	7	18	4609	11	6	6	0	1969	1989	2	2	1	2	2	2	2	2	1	2	2	2	.
217	890314	58	5	2	3	9	4618	2	7	7	0	1937	1987	12	2	2	2	1	2	2	2	2	2	2	2	.
218	890318	50	1	1	14	93	4711	2	91	21	21	1960	1989	11	1	1	1	1	2	2	2	1	1	2	2	.
219	890319	90	1	8	6	16	4727	1	15	11	3	1957	1988	13	2	1	2	1	1	1	2	1	1	2	2	.
220	890320	31	3	4	3	13	4740	0	13	9	4	1974	1989	18	2	1	1	1	2	2	2	1	1	2	1	.
221	890321	20	3	4	3	23	4763	2	21	12	0	1966	1988	12	2	2	2	1	1	1	2	1	1	2	2	.
222	890322	71	4	2	4	19	4782	1	18	16	0	1936	1988	20	2	1	1	1	2	2	2	1	2	2	2	.
223	890323	149	2	2	4	12	4794	3	9	5	2	1966	1988	24	2	1	1	1	2	2	2	1	1	2	2	.
224	890324	62	3	2	6	37	4831	0	37	22	2	1933	1989	8	2	1	1	1	2	2	2	1	1	2	2	.
225	890325	62	3	3	4	14	4845	1	13	10	0	1960	1988	8	2	1	1	1	2	2	2	1	1	2	2	.
226	890326	2	1	4	4	16	4861	1	15	11	1	1927	1989	7	2	2	2	2	2	2	1	2	2	2	2	.
227	890327	19	4	2	6	18	4879	3	15	10	0	1971	1988	20	2	2	2	1	2	2	2	1	2	2	2	.
228	890328	19	4	2	7	19	4898	2	17	10	0	1975	1985	13	2	2	2	1	2	2	2	1	2	2	2	.
229	890329	128	3	5	8	39	4937	1	38	20	1	1976	1989	8	2	1	1	1	2	2	2	1	2	2	2	.
230	890330	136	1	5	4	18	4955	0	18	12	2	1981	1989	18	2	1	1	1	2	2	2	1	1	2	2	.
231	890331	136	1	4	5	14	4969	1	13	10	3	1951	1989	18	2	1	1	1	2	2	2	1	1	2	2	.
232	890332	149	2	2	3	16	4985	2	14	10	0	1952	1988	13	2	1	1	1	2	2	2	1	1	2	2	.
233	890333	112	3	2	8	20	5005	1	19	11	4	1968	1988	3	2	1	1	1	2	2	1	1	1	2	2	.
234	890334	136	1	6	4	13	5018	1	12	8	3	1979	1988	18	2	1	1	1	2	2	2	1	1	2	2	.
235	890335	20	3	4	5	23	5041	3	20	11	0	1930	1988	9	2	2	2	1	1	1	2	1	1	2	2	.
236	890338	149	2	2	3	0	5041	0	0	0	0	.	.	6	2	1	1	1	2	2	2	1	1	2	2	.
237	890339	149	2	4	4	19	5060	1	18	13	0	1955	1986	14	2	1	1	1	2	2	2	1	1	2	2	.
238	890340	149	2	5	3	24	5084	0	22	13	3	1892	1988	9	2	1	1	1	2	2	2	1	1	2	2	.
239	890341	92	1	3	4	22	5106	5	17	13	2	1931	1988	8	1	1	1	1	1	1	2	1	1	2	2	.
240	890342	116	4	5	6	16	5122	1	15	10	1	1970	1988	8	2	1	1	1	1	1	2	1	1	2	2	.

OB S	ID	S O U R C E	O R I G I N	A U T H O R S	P A G E S	C I T A T	C U M U L A T	M N G R P H S	J N L S	S I N G L E S	S E L F C I T	E A R L I E S T	L A T E S T	S U B J E C T	A I M - Y N	B A - Y N	C A - Y N	E M - Y N	X P - Y N	C R - Y N	I D - Y N	I M - Y N	S C I - Y N	P O P - Y N	P A - Y N	T O X - Y N
241	890343	61	1	5	9	36	5158	4	32	15	1	1971	1988	8	1	1	1	1	1	1	2	1	1	1	2	.
242	890344	114	1	4	4	8	5166	3	5	4	0	1958	1985	7	2	1	1	2	2	2	1	1	1	2	2	.
243	890345	27	3	4	6	32	5198	0	32	19	2	1966	1988	1	2	1	1	1	1	1	2	1	1	2	2	.
244	890346	25	4	6	6	24	5222	1	23	10	1	1951	1988	13	2	1	1	1	1	1	2	1	1	2	2	.
245	890347	84	4	2	6	39	5261	8	31	25	1	1928	1989	18	2	1	1	2	2	2	2	1	2	2	1	.
246	890348	149	2	4	3	8	5269	0	8	6	0	1956	1987	1	2	1	1	1	2	2	2	1	2	2	2	.
247	890349	99	1	6	8	30	5299	0	30	19	6	1951	1988	13	1	1	1	1	1	1	2	1	1	2	2	.
248	890350	37	4	5	4	15	5314	3	12	9	0	1952	1987	13	2	1	2	1	2	2	2	1	2	2	2	.
249	890351	25	4	3	6	36	5350	2	34	17	5	1974	1989	1	2	1	1	1	1	1	2	1	1	2	2	.
250	890352	159	4	2	3	5	5355	2	3	2	0	1979	1988	22	2	1	1	1	2	2	2	1	1	2	2	.
251	890353	19	4	6	7	19	5374	2	17	10	0	1975	1985	22	2	2	2	1	2	2	2	1	2	2	2	.
252	890354	56	2	1	5	7	5381	2	5	1	0	1942	1989	6	2	2	2	2	2	2	2	2	2	2	2	.
253	890355	56	2	3	6	15	5396	3	12	8	0	1983	1989	6	2	2	2	2	2	2	2	2	2	2	2	.
254	890362	42	1	1	14	102	5498	3	99	27	6	1963	1988	11	2	1	1	2	2	2	2	2	2	2	2	.
255	890363	115	4	5	3	27	5525	2	25	19	1	1975	1989	19	2	2	2	1	2	2	2	1	2	2	2	.
256	890364	24	1	2	8	135	5660	7	128	55	7	1954	1988	14	2	1	1	1	2	2	2	1	1	2	2	.
257	890365	153	2	5	4	16	5676	4	12	6	0	1966	1986	7	2	2	2	2	2	2	2	2	2	2	2	.
258	890366	142	1	4	5	35	5711	3	32	18	5	1971	1989	14	2	1	1	1	1	1	2	1	1	2	2	.
259	890367	109	1	2	4	7	5718	0	7	6	0	1958	1985	16	1	1	1	1	1	1	2	1	1	2	2	.
260	890368	149	2	6	4	15	5733	0	14	11	1	1981	1987	20	2	1	1	1	2	2	2	1	1	2	2	.
261	890369	149	2	5	2	11	5744	1	10	5	2	1975	1989	13	2	1	1	1	2	2	2	1	1	2	2	.
262	890373	153	2	4	5	48	5792	1	47	22	0	1953	1989	19	2	2	2	2	2	2	2	2	2	2	2	.
263	890375	56	2	2	4	5	5797	1	4	3	0	1977	1988	23	2	2	2	2	2	2	2	2	2	2	2	.
264	890377	56	2	1	3	12	5809	4	8	3	0	1975	1988	23	2	2	2	2	2	2	2	2	2	2	2	.
265	890382	149	2	3	2	11	5820	0	11	9	2	1977	1986	14	2	1	1	1	2	2	2	1	1	2	2	.
266	890383	104	4	3	10	16	5836	4	12	8	2	1971	1987	9	2	1	1	1	2	2	2	1	1	2	2	.
267	890384	154	2	1	5	33	5869	15	14	9	0	1962	1989	6	2	1	1	1	2	2	2	2	1	2	2	.
268	890386	18	1	3	7	29	5898	0	29	12	4	1973	1989	14	1	1	1	1	1	1	2	1	1	2	2	.
269	890387	22	5	1	7	21	5919	3	18	13	0	1971	1988	9	2	2	2	2	2	2	2	1	2	2	2	.
270	890388	144	1	3	22	77	5996	7	70	37	0	1914	1989	11	2	1	1	2	2	2	2	1	2	2	2	.
271	890389	90	1	4	7	39	6035	5	34	20	3	1972	1988	8	2	1	1	1	1	1	2	1	1	2	2	.
272	890390	149	2	2	2	22	6057	0	22	10	0	1955	1986	11	2	1	1	1	2	2	2	1	1	2	2	.
273	890391	149	2	7	4	32	6089	9	23	16	0	1946	1988	1	2	1	1	1	2	2	2	1	1	2	2	.
274	890392	3	4	1	14	35	6124	4	30	21	0	1955	1988	23	2	2	1	1	2	2	2	1	2	2	2	.
275	890393	16	1	6	10	47	6171	4	43	15	3	1957	1987	11	1	1	1	1	2	2	2	1	1	2	2	.
276	890394	16	1	9	11	27	6198	3	24	16	2	1967	1987	11	1	1	1	1	2	2	2	1	1	2	2	.
277	890395	149	2	3	4	15	6213	0	15	8	0	1969	1987	11	2	1	1	1	2	2	2	1	1	2	2	.
278	890396	134	3	5	6	38	6251	1	37	23	4	1971	1989	13	2	1	1	1	1	1	2	1	1	2	2	.
279	890397	99	1	6	8	30	6281	0	30	19	6	1951	1988	13	1	1	1	1	1	1	2	1	1	2	2	.
280	890398	7	1	6	3	24	6305	5	18	13	1	1960	1989	19	2	1	1	1	1	1	2	1	1	2	2	.
281	890399	119	4	3	8	40	6345	6	34	20	0	1963	1987	7	2	1	1	1	2	2	2	1	1	2	2	.
282	890400	15	1	4	7	48	6393	2	46	21	12	1944	1987	13	1	1	1	1	2	2	2	1	1	2	2	.
283	890401	148	3	3	16	34	6427	2	31	23	2	1895	1988	1	2	2	2	2	2	2	2	1	2	2	2	.
284	890402	75	1	1	12	61	6488	1	60	21	1	1908	1988	14	2	2	2	2	2	2	2	2	2	2	2	.
285	890403	88	4	3	6	20	6508	4	16	10	3	1841	1988	17	2	1	1	1	2	2	2	1	1	2	2	.
286	890404	134	4	2	4	24	6532	3	21	13	1	1965	1989	1	2	1	1	1	1	1	2	1	1	2	2	.
287	890405	25	4	4	8	40	6572	1	39	21	1	1976	1988	1	2	1	.	1	1	1	2	1	1	2	2	.
288	890407	55	1	5	5	6	6578	1	1	1	0	1987	1988	18	2	1	1	1	2	2	2	1	2	2	2	.

OBS	ID	SOURCE	ORIGIN	AUTHORS	PAGES	CITATIONS	CUMULATIVE	MNGRPHS	JNLS	SIGNLES	SELF-CIT	EARLIES	LATEST	SUBJECT	AIM	BAY	CAY	EM	EXP	ICR	IDL	IM	SCI	POP	PA	TOX
289	890408	147	1	2	14	47	6625	1	46	21	7	1967	1988	2	2	1	1	1	1	1	2	1	1	2	2	.
290	890409	55	1	5	9	11	6636	1	10	8	1	1976	1988	18	2	1	1	1	2	2	2	1	2	2	2	.
291	890410	131	1	9	5	7	6643	2	5	5	0	1980	1989	18	2	2	2	2	2	2	2	1	2	2	2	.
292	890411	138	2	3	5	13	6656	3	10	10	0	1934	1985	22	2	1	1	2	2	2	2	1	2	2	2	.
293	890412	161	5	4	5	34	6690	6	26	20	0	1979	1989	19	2	2	2	2	2	2	2	1	2	2	2	.
294	890413	46	4	2	7	59	6749	3	55	22	0	1958	1989	17	2	2	2	2	2	2	2	.	2	2	2	.
295	890415	90	1	4	7	31	6780	1	30	11	14	1967	1988	12	2	1	1	1	1	1	2	1	2	2	2	.
296	890416	79	1	7	6	36	6816	4	32	22	2	1930	1988	16	2	2	1	1	2	2	2	1	2	2	2	.
297	890417	93	1	4	8	37	6853	2	35	16	0	1975	1989	1	1	1	1	1	1	1	2	1	1	2	2	.
298	890418	1	3	2	5	14	6867	2	12	7	0	1969	1988	16	2	2	1	1	2	2	2	1	2	2	2	.
299	890419	162	4	2	4	13	6880	8	4	4	0	1963	1987	9	2	2	2	2	2	2	2	2	2	2	2	.
300	890420	163	2	3	4	14	6894	10	3	3	0	1855	1987	9	2	2	2	2	2	2	2	2	2	2	2	.
301	890421	48	4	3	9	22	6916	2	19	13	0	1973	1988	9	2	1	1	1	2	2	2	2	2	1	2	.
302	890422	59	2	3	2	2	6918	0	2	2	0	1985	1988	17	2	2	2	2	2	2	2	2	2	2	2	.
303	890423	17	4	3	4	22	6940	1	21	13	7	1951	1981	24	2	1	1	1	2	2	2	1	1	2	2	.
304	890424	149	2	4	3	20	6960	2	18	15	1	1949	1989	24	2	1	1	1	2	2	2	1	1	2	2	.
305	890426	64	3	3	11	17	6977	1	16	11	1	1966	1982	14	2	1	1	1	2	2	2	1	1	2	2	.
306	890428	97	4	1	6	11	6988	1	10	6	0	1959	1988	22	2	1	1	1	2	2	2	1	1	2	2	.
307	890430	84	4	2	4	14	7002	3	11	10	0	1945	1989	18	2	1	1	2	2	2	2	1	2	2	1	.
308	890431	122	2	2	5	30	7032	0	30	20	1	1962	1988	22	2	1	2	2	2	2	2	2	2	2	2	.
309	890432	14	1	3	2	14	7046	2	12	8	0	1973	1988	9	1	1	1	1	2	2	2	1	2	1	2	.
310	890435	160	2	1	3	4	7050	2	2	2	0	1974	1988	18	2	2	2	2	2	2	2	2	2	2	2	.
311	890437	130	1	3	6	8	7058	0	8	5	2	1951	1986	22	2	1	2	2	2	2	2	2	2	2	2	.
312	890438	154	2	4	2	13	7071	2	11	6	0	1974	1989	1	2	1	1	1	2	2	2	2	2	2	2	.
313	890439	154	2	2	3	2	7073	1	1	1	0	1981	1985	9	2	1	1	1	2	2	2	2	2	2	2	.
314	890440	108	1	5	6	16	7089	2	14	11	0	1970	1987	14	2	1	2	2	2	2	2	2	1	2	2	.
315	890441	70	2	3	2	4	7093	3	1	1	0	1980	1987	20	2	2	2	2	2	2	2	2	2	2	2	.
316	890442	154	2	2	3	21	7114	3	18	12	0	1941	1985	7	2	1	1	1	2	2	2	2	2	2	2	.
317	890445	135	5	4	5	13	7127	1	12	8	0	1889	1987	9	2	1	2	2	2	2	2	2	2	2	2	.
318	890448	1	3	1	3	0	7127	0	0	0	0	.	.	16	2	2	1	1	2	2	2	1	2	2	2	.
319	890449	19	4	3	8	31	7158	1	29	13	1	1965	1986	16	2	2	2	1	2	2	2	1	2	2	2	.
320	890450	32	4	1	6	0	7158	0	0	0	0	.	.	9	2	1	1	1	2	2	2	1	1	2	2	1

APPENDIX 3

LIST OF JOURNAL TITLES REPRESENTED IN SET A

Acta leprologica
Advances in dental research
Adverse drug reactions and acute poisoning reviews
AIFO
Alcohol and alcoholism
American journal of clinical nutrition
American journal of gastroenterology
American journal of hematology
American journal of human genetics
American journal of medical genetics
American journal of obstetrics and gynecology
American journal of ophthalmology
American journal of psychiatry
American journal of public health
American review of respiratory diseases
Anesthetics and analgesics
Annals of rheumatic diseases
Annals of surgery
Annals of tropical paediatrics
Anticancer research
Arteriosclerosis
Australian and New Zealand journal of ophthalmology
Basic research in cardiology
Biochemical journal
Biochemistry
Biochemical pharmacology
Biochimica et biophysica acta
Boletín sanitario Panama
Bone and mineral
Brain
Brain research
British journal of dermatology
British journal of haematology
British journal of industrial medicine
British journal of ophthalmology
British journal of radiology
British journal of rheumatology
British medical journal
Bulletin of the PanAmerican Health Organization
Carcinogenesis
Cardiovascular drugs and therapy
Cardiovascular research
Caries research
Cell differentiation and development
Cellular signalling
Central African journal of medicine
Chemosphere
Circulation
Clinica chimica acta
Clinical endocrinology
Clinical and experimental dermatology
Clinical genetics

Clinical neuropharmacology
Curationis
Dysmorphology and clinical genetics
Embo journal
Endocrinology
European journal of applied physiology
European journal of cell biology
European surgical research
Experimental hematology
Eye
FEBS letters
FEMS microbiology letters
Gamete research
Geneeskunde
Genitourinary medicine
Geriatrics
Health education research
Hormone and metabolic research
HPB surgery
Human genetics
Immunological investigations
Infection and immunity
Intensive care
International archives of allergy and applied immunology
International clinical nutrition reviews
International journal of cardiology
International journal of epidemiology
International journal of neuroscience
International journal of radiation applications & instrumentation. Part B
International journal of vitamin and nutrition research
Journal of the American Dietetic Association
Journal of anatomy
Journal of applied physiology
Journal of biological chemistry
Journal of cardiovascular pharmacology
Journal of clinical endocrinology and metabolism
Journal of clinical investigation
Journal of clinical microbiology
Journal of comparative pathology
Journal of general virology
Journal of helminthology
Journal of hepatology
Journal of immunology
Journal of in vitro fertilization & embryo transplantation
Journal of laboratory and clinical medicine
Journal of medical genetics
Journal of medical virology
Journal of microscopy
Journal of molecular and cellular cardiology
Journal of oral and maxillofacial surgery
Journal of oral pathology and medicine
Journal of parenteral and enteral nutrition
Journal of pediatrics
Journal of pediatric gastroenterology and nutrition

Journal of periodontology
Journal of periodontological research
Journal of pharmacological and experimental therapy
Journal of prosthetic dentistry
Journal of the Royal Society of Health
Journal of steroid biochemistry
Journal of thoracic and cardiovascular surgery
Journal of vascular surgery
Laboratory animals
Lancet
Medical and veterinary entomology
Medical hypotheses
Medical science research
Medical technology in South Africa
Medicine international
Methods in enzymology
Molecular brain research
Molecular immunology
Mosquito systematics
Movement disorders
Muscle and nerve
Mutation research
Mycological research
Neurochemistry research
Neuropediatrics
Onderstepoort journal
Pediatrics exercise science
Physics in medicine and biology
Prenatal diagnosis
Proceedings of the National Academy of Sciences of the USA
Proceedings of the Society for Experimental and Biological Medicine
Proceedings of the Electron Microscopy Society of South Africa
Progress in cardiovascular disease
Psigiatriese insig
Quarterly journal of experimental physiology
Radiation research
Radiotherapy and oncology
South African journal of botany
South African Journal of continuing medical education
South African journal of epidemiological infection
South African journal of ethnology
South African journal food science and nutrition
South African journal of science
South African journal of zoology
South African Medical Journal (SAMJ)
Statistics in medicine
Stroke
Surgery
Transactions of the Royal Society of Tropical Medicine and Hygiene
Trauma
Tropical gastroenterology
Water science and technology
Water SA

APPENDIX 4

CORRELATION TABLES: SET A

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	AUTHORS	PAGES	CITAT	MNGRPHS	JNLS	SINGLES	SELFCIT
AUTHORS	1.00000 0.0 320	0.04537 0.4186 320	0.07491 0.1813 320	-0.05354 0.3397 320	0.08746 0.1184 320	0.15212 0.0064 320	0.05798 0.3012 320
PAGES	0.04537 0.4186 320	1.00000 0.0 320	0.51675 0.0001 320	0.18133 0.0011 320	0.51124 0.0001 320	0.43895 0.0001 320	0.27847 0.0001 320
CITAT	0.07491 0.1813 320	0.51675 0.0001 320	1.00000 0.0 320	0.35952 0.0001 320	0.98404 0.0001 320	0.88537 0.0001 320	0.47607 0.0001 320
MNGRPHS	-0.05354 0.3397 320	0.18133 0.0011 320	0.35952 0.0001 320	1.00000 0.0 320	0.19230 0.0005 320	0.23670 0.0001 320	-0.01344 0.8107 320
JNLS	0.08746 0.1184 320	0.51124 0.0001 320	0.98404 0.0001 320	0.19230 0.0005 320	1.00000 0.0 320	0.88810 0.0001 320	0.50203 0.0001 320
SINGLES	0.15212 0.0064 320	0.43895 0.0001 320	0.88537 0.0001 320	0.23670 0.0001 320	0.88810 0.0001 320	1.00000 0.0 320	0.30705 0.0001 320
SELFCIT	0.05798 0.3012 320	0.27847 0.0001 320	0.47607 0.0001 320	-0.01344 0.8107 320	0.50203 0.0001 320	0.30705 0.0001 320	1.00000 0.0 320
EARLIEST	0.12695 0.0256 309	-0.13027 0.0220 309	-0.20832 0.0002 309	-0.25100 0.0001 309	-0.17343 0.0022 309	-0.22758 0.0001 309	-0.03217 0.5731 309
LATEST	0.09585 0.0926 309	0.02218 0.6977 309	0.22698 0.0001 309	0.12849 0.0239 309	0.21037 0.0002 309	0.18849 0.0009 309	0.12204 0.0320 309
RANGCIT	-0.12117 0.0332 309	0.13160 0.0207 309	0.22196 0.0001 309	0.25871 0.0001 309	0.18608 0.0010 309	0.23890 0.0001 309	0.03952 0.4889 309
DIF	0.00452 0.9358 320	-0.02506 0.6551 320	0.03925 0.4841 320	0.29040 0.0001 320	-0.05221 0.3519 320	-0.03100 0.5805 320	-0.02429 0.6651 320
DIFJ	0.02991 0.5939 320	0.49403 0.0001 320	0.92223 0.0001 320	0.13509 0.0156 320	0.94543 0.0001 320	0.68987 0.0001 320	0.57303 0.0001 320
DIFJJ	0.08314 0.1378 320	0.49848 0.0001 320	0.97188 0.0001 320	0.21195 0.0001 320	0.98388 0.0001 320	0.90249 0.0001 320	0.33926 0.0001 320

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	EARLIEST	LATEST	RANGCIT	DIF	DIFJ	DIFJJ
AUTHORS	0.12695 0.0256 309	0.09585 0.0926 309	-0.12117 0.0332 309	0.00452 0.9358 320	0.02991 0.5939 320	0.08314 0.1378 320
PAGES	-0.13027 0.0220 309	0.02218 0.6977 309	0.13160 0.0207 309	-0.02506 0.6551 320	0.49403 0.0001 320	0.49848 0.0001 320
CITAT	-0.20832 0.0002 309	0.22698 0.0001 309	0.22196 0.0001 309	0.03925 0.4841 320	0.92223 0.0001 320	0.97188 0.0001 320
MNGRPHS	-0.25100 0.0001 309	0.12849 0.0239 309	0.25871 0.0001 309	0.29040 0.0001 320	0.13509 0.0156 320	0.21195 0.0001 320
JNLS	-0.17343 0.0022 309	0.21037 0.0002 309	0.18608 0.0010 309	-0.05221 0.3519 320	0.94543 0.0001 320	0.98388 0.0001 320
SINGLES	-0.22758 0.0001 309	0.18849 0.0009 309	0.23890 0.0001 309	-0.03100 0.5805 320	0.68987 0.0001 320	0.90249 0.0001 320
SELFCIT	-0.03217 0.5731 309	0.12204 0.0320 309	0.03952 0.4889 309	-0.02429 0.6651 320	0.57303 0.0001 320	0.33926 0.0001 320
EARLIEST	1.00000 0.0 309	0.02883 0.6136 309	-0.99819 0.0001 309	0.00035 0.9951 309	-0.11318 0.0468 309	-0.18187 0.0013 309
LATEST	0.02883 0.6136 309	1.00000 0.0 309	0.03134 0.5831 309	0.08525 0.1348 309	0.19715 0.0005 309	0.20303 0.0003 309
RANGCIT	-0.99819 0.0001 309	0.03134 0.5831 309	1.00000 0.0 309	0.00478 0.9333 309	0.12503 0.0280 309	0.19408 0.0006 309
DIF	0.00035 0.9951 309	0.08525 0.1348 309	0.00478 0.9333 309	1.00000 0.0 320	-0.06025 0.2826 320	-0.05176 0.3560 320
DIFJ	-0.11318 0.0468 309	0.19715 0.0005 309	0.12503 0.0280 309	-0.06025 0.2826 320	1.00000 0.0 320	0.90984 0.0001 320
DIFJJ	-0.18187 0.0013 309	0.20303 0.0003 309	0.19408 0.0006 309	-0.05176 0.3560 320	0.90984 0.0001 320	1.00000 0.0 320

Correlation Analysis

Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	AUTHORS	PAGES	CITAT	MNGRPHS	JNLS	SINGLES	SELFCIT
AUTHORS	1.00000 0.0 320	0.02313 0.6802 320	0.20684 0.0002 320	-0.01962 0.7266 320	0.24323 0.0001 320	0.22895 0.0001 320	0.23938 0.0001 320
PAGES	0.02313 0.6802 320	1.00000 0.0 320	0.48673 0.0001 320	0.25413 0.0001 320	0.47234 0.0001 320	0.41406 0.0001 320	0.25488 0.0001 320
CITAT	0.20684 0.0002 320	0.48673 0.0001 320	1.00000 0.0 320	0.40959 0.0001 320	0.96997 0.0001 320	0.90863 0.0001 320	0.37145 0.0001 320
MNGRPHS	-0.01962 0.7266 320	0.25413 0.0001 320	0.40959 0.0001 320	1.00000 0.0 320	0.22932 0.0001 320	0.22743 0.0001 320	-0.01334 0.8121 320
JNLS	0.24323 0.0001 320	0.47234 0.0001 320	0.96997 0.0001 320	0.22932 0.0001 320	1.00000 0.0 320	0.93443 0.0001 320	0.40526 0.0001 320
SINGLES	0.22895 0.0001 320	0.41406 0.0001 320	0.90863 0.0001 320	0.22743 0.0001 320	0.93443 0.0001 320	1.00000 0.0 320	0.36449 0.0001 320
SELFCIT	0.23938 0.0001 320	0.25488 0.0001 320	0.37145 0.0001 320	-0.01334 0.8121 320	0.40526 0.0001 320	0.36449 0.0001 320	1.00000 0.0 320
EARLIEST	0.12083 0.0337 309	-0.10521 0.0647 309	-0.31156 0.0001 309	-0.23963 0.0001 309	-0.27730 0.0001 309	-0.33426 0.0001 309	-0.06685 0.2414 309
LATEST	0.05347 0.3489 309	0.04731 0.4072 309	0.24206 0.0001 309	0.13809 0.0151 309	0.21537 0.0001 309	0.17066 0.0026 309	0.10346 0.0693 309
RANGCIT	-0.11500 0.0434 309	0.10199 0.0734 309	0.33580 0.0001 309	0.25422 0.0001 309	0.29903 0.0001 309	0.35308 0.0001 309	0.07376 0.1960 309
DIF	0.03482 0.5348 320	0.01065 0.8494 320	0.09405 0.0931 320	0.24944 0.0001 320	-0.03125 0.5775 320	-0.04032 0.4723 320	-0.04255 0.4482 320
DIFJ	0.22000 0.0001 320	0.45551 0.0001 320	0.88932 0.0001 320	0.18488 0.0009 320	0.92268 0.0001 320	0.73950 0.0001 320	0.39290 0.0001 320
DIFJJ	0.22120 0.0001 320	0.46307 0.0001 320	0.95743 0.0001 320	0.23965 0.0001 320	0.98343 0.0001 320	0.92683 0.0001 320	0.27773 0.0001 320

Correlation Analysis

Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	EARLIEST	LATEST	RANGCIT	DIF	DIFJ	DIFJJ
AUTHORS	0.12083 0.0337 309	0.05347 0.3489 309	-0.11500 0.0434 309	0.03482 0.5348 320	0.22000 0.0001 320	0.22120 0.0001 320
PAGES	-0.10521 0.0647 309	0.04731 0.4072 309	0.10199 0.0734 309	0.01065 0.8494 320	0.45551 0.0001 320	0.46307 0.0001 320
CITAT	-0.31156 0.0001 309	0.24206 0.0001 309	0.33580 0.0001 309	0.09405 0.0931 320	0.88932 0.0001 320	0.95743 0.0001 320
MNGRPHS	-0.23963 0.0001 309	0.13809 0.0151 309	0.25422 0.0001 309	0.24944 0.0001 320	0.18488 0.0009 320	0.23965 0.0001 320
JNLS	-0.27730 0.0001 309	0.21537 0.0001 309	0.29903 0.0001 309	-0.03125 0.5775 320	0.92268 0.0001 320	0.98343 0.0001 320
SINGLES	-0.33426 0.0001 309	0.17066 0.0026 309	0.35308 0.0001 309	-0.04032 0.4723 320	0.73950 0.0001 320	0.92683 0.0001 320
SELFCIT	-0.06685 0.2414 309	0.10346 0.0693 309	0.07376 0.1960 309	-0.04255 0.4482 320	0.39290 0.0001 320	0.27773 0.0001 320
EARLIEST	1.00000 0.0 309	0.07584 0.1836 309	-0.99470 0.0001 309	0.01428 0.8026 309	-0.17739 0.0017 309	-0.28323 0.0001 309
LATEST	0.07584 0.1836 309	1.00000 0.0 309	0.00462 0.9356 309	0.13224 0.0201 309	0.22591 0.0001 309	0.20144 0.0004 309
RANGCIT	-0.99470 0.0001 309	0.00462 0.9356 309	1.00000 0.0 309	-0.00453 0.9368 309	0.19801 0.0005 309	0.30417 0.0001 309
DIF	0.01428 0.8026 309	0.13224 0.0201 309	-0.00453 0.9368 309	1.00000 0.0 320	-0.02470 0.6598 320	-0.02945 0.5997 320
DIFJ	-0.17739 0.0017 309	0.22591 0.0001 309	0.19801 0.0005 309	-0.02470 0.6598 320	1.00000 0.0 320	0.90316 0.0001 320
DIFJJ	-0.28323 0.0001 309	0.20144 0.0004 309	0.30417 0.0001 309	-0.02945 0.5997 320	0.90316 0.0001 320	1.00000 0.0 320

APPENDIX 5

**SPREADSHEET RECORD OF THE DATA PERTAINING TO
ARTICLES PUBLISHED BY SA AUTHORS IN 1989
(SET B)**

OBS	ID	SOURCE	ORIGIN	DATE	A U T H O R S	P A G E S	R E F S	A R L I E S T	L A T E S T	S I M I				I M P A C T	P I S A L	L I B A I S	L I B I B A	L I B B I S	L I B L I B	L I B C I S	L I B D I S	L I B E I S	L I B E I B E	L I B F I S	L I B F I B F	L I B G I S	L I B G		
										B	A	E	M																
49	52	307	3	1963	1	44	106	1812	1962	1	1	1	1	1	1.6	1	1	1	1	2	3	2	2	1	1	2	3	1	3
50	53	240	1	1954	3	2	0	.	.	1	1	1	1	1	5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	
51	54	259	1	1982	3	6	18	1955	1981	1	1	2	1	1	0.5	1	1	1	2	2	3	1	1	1	1	2	2	3	
52	56	193	4	1973	2	3	10	1939	1973	1	1	1	1	1	1.6	1	1	1	1	1	1	1	1	1	1	1	1	1	
53	58	189	1	1981	2	4	8	1955	1979	1	1	1	1	1	6.8	1	1	1	1	2	1	1	1	1	1	1	1	1	
54	59	303	3	1980	6	4	18	1949	1980	1	1	1	1	1	4.7	1	1	1	1	1	1	2	1	1	2	3	1	1	
55	60	241	1	1978	3	12	9	1971	1971	1	1	1	1	1	2.3	1	1	1	2	2	1	1	2	3	1	2	3	1	
56	61	194	4	1979	3	3	8	1951	1978	1	1	1	1	1	1.0	1	2	2	1	1	1	1	1	1	2	1	1	1	
57	62	149	2	1983	2	4	16	1977	1983	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	
58	63	6	1	1984	4	8	20	1932	1984	1	1	1	1	1	2.5	1	1	1	1	1	1	1	1	1	1	1	1	1	
59	64	153	2	1989	5	6	32	1972	1989	2	1	2	2	2	.	2	2	2	3	2	3	2	2	1	2	3	2	3	
60	65	149	2	1974	1	13	9	1939	1971	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	
61	66	208	4	1960	2	8	10	1947	1960	1	1	1	1	1	0.6	1	1	1	1	1	1	1	1	1	1	1	1	1	
62	68	172	1	1972	5	6	23	1953	1971	1	1	1	1	1	0.4	1	1	1	1	1	1	1	1	1	1	1	1	1	
63	69	292	4	1923	2	37	46	1898	1923	1	1	1	1	1	1.7	1	2	2	1	1	1	1	2	1	1	1	1	1	
64	70	243	1	1977	3	5	17	1951	1976	1	1	1	1	1	6.4	1	1	1	1	1	1	1	1	1	1	2	2	1	
65	71	199	1	1983	3	6	51	1960	1983	1	1	1	1	2	1.4	1	1	1	2	2	1	1	2	2	1	2	3	1	
66	72	65	1	1985	5	7	39	1951	1985	1	1	1	1	1	2.7	1	2	2	1	1	1	1	1	1	2	3	2	3	
67	73	175	1	1984	1	9	13	1950	1983	1	1	1	1	1	2.3	1	1	1	1	1	2	2	1	1	1	2	2	2	
68	74	290	1	1955	4	8	0	.	.	1	1	1	1	1	.	1	1	1	2	2	1	1	2	3	2	3	1	2	
69	75	269	5	1977	1	4	3	1971	1974	1	1	1	1	1	1.2	1	1	1	1	1	1	1	1	1	1	1	1	2	
70	76	207	1	1980	2	13	29	1925	1979	1	1	1	1	1	0.6	1	1	1	1	1	1	1	1	1	1	1	1	1	
71	77	283	5	1984	2	3	5	1972	1981	1	1	1	1	1	.	1	1	1	2	2	1	1	2	2	1	2	3	1	
72	78	202	1	1977	4	13	43	1959	1975	1	1	1	1	1	4.8	1	1	1	1	1	1	1	2	2	1	1	1	1	
73	79	293	4	1979	2	28	115	1966	1978	1	1	2	1	1	5.4	1	2	3	2	3	1	1	2	3	2	3	2	3	
74	80	168	1	1984	3	5	14	1967	1983	1	1	1	1	1	1.8	1	1	1	1	1	1	1	1	1	1	1	1	1	
75	81	203	1	1978	4	3	18	1960	1977	1	1	1	1	1	1.9	1	1	2	1	1	1	1	1	1	1	2	3	1	
76	82	21	3	1978	3	4	23	1951	1977	1	1	1	1	1	4.5	1	1	1	1	1	1	1	2	2	1	1	1	1	
77	83	232	3	1982	2	11	34	1956	1980	1	1	1	2	1	0.6	1	2	3	2	2	2	2	3	2	3	2	2	3	
78	84	61	1	1987	2	7	40	1976	1986	1	1	1	1	1	4.2	1	1	1	1	1	1	1	1	1	1	2	3	1	
79	85	272	1	1983	2	16	38	1968	1982	1	1	1	1	1	2.9	1	2	3	2	3	2	3	2	2	2	3	2	3	
80	86	272	1	1978	2	20	30	1964	1978	1	1	1	1	1	2.9	1	2	3	2	3	2	3	2	3	2	2	3	2	
81	87	154	2	1984	1	4	10	1938	1980	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	
82	88	167	1	1978	1	32	116	1946	1978	1	1	2	1	1	.	1	1	1	1	1	1	1	2	2	1	2	2	3	
83	89	149	2	1981	1	4	52	1932	1979	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	
84	91	271	1	1972	4	14	39	1942	1972	1	1	1	1	1	2.9	1	1	1	1	1	1	1	1	1	2	2	1	1	
85	92	228	3	1981	27	9	42	1877	1981	1	1	1	1	1	4.9	1	1	1	1	1	2	3	2	2	1	1	2	3	
86	93	18	1	1961	3	14	21	1936	1961	1	1	1	1	1	2.6	1	1	1	1	1	1	1	1	1	1	1	1	1	
87	94	193	4	1988	5	3	16	1939	1987	1	1	1	1	1	1.6	1	1	1	1	2	1	1	1	1	1	2	3	1	
88	95	224	1	1988	2	4	8	1981	1988	1	2	1	1	1	2.4	1	1	1	1	2	1	1	2	2	1	1	1	2	
89	96	193	4	1986	4	6	17	1934	1984	1	1	1	1	1	1.6	1	1	1	1	1	1	1	1	1	1	1	1	1	
90	97	6	1	1975	4	4	28	1950	1974	1	1	1	1	1	2.5	1	1	1	1	1	1	1	1	1	1	1	1	1	
91	98	305	1	1981	3	4	11	1955	1979	1	1	1	1	1	2.9	1	1	2	1	2	1	1	2	2	1	1	1	1	
92	99	250	3	1981	3	2	2	1950	1976	1	1	1	1	1	2.1	1	1	1	2	2	1	1	1	1	1	1	2	3	
93	100	188	1	1986	3	20	43	1954	1985	1	1	1	1	1	2.5	1	2	2	2	3	2	3	1	1	2	2	3	2	
94	101	21	3	1983	3	13	36	1944	1981	1	1	1	1	1	4.5	1	1	2	1	1	1	1	1	2	2	1	1	1	
95	102	142	1	1978	5	5	32	1964	1978	1	1	1	1	1	10.0	1	1	1	1	1	1	1	1	1	1	2	2	1	
96	103	24	1	1981	4	5	30	1966	1980	1	1	1	1	1	4.0	1	1	1	1	1	1	1	2	2	1	1	2	3	

OB S	ID	S O U R C E	OR I G I N	DA T E	A U T H O R S	P A G E S	R E F S	A R L I E S T	L A T E S T	B A	C A	E M	I M	S C I	I M P A C T	P I S A L	L I B A I S	L I B B I S	L I B L I B S	L I B C I S	L I B D I S	L I B E I S	L I B E S	L I B F I S	L I B G I S	L I B G S
97	104	243	1	1982	2	4	11	1962	1981	1	1	1	1	1	6.4	1	1	2	1	1	1	1	1	1	1	1
98	105	190	4	1982	1	4	46	1912	1981	1	1	2	1	1	0.6	1	1	1	1	1	2	3	1	1	2	3
99	106	245	3	1988	2	7	25	1932	1988	1	1	1	1	1	1.4	1	2	2	2	1	1	1	1	2	3	1
100	107	177	1	1988	2	10	111	1950	1985	1	2	1	1	2	0.4	1	1	1	2	2	1	1	1	1	2	3
101	108	7	1	1987	2	4	34	1920	1985	1	1	1	1	1	1.4	1	1	1	1	1	2	2	1	1	2	3
102	110	120	4	1987	1	5	35	1904	1981	1	1	1	1	1	14.4	1	1	1	1	1	1	1	1	1	1	1
103	111	149	2	1984	5	2	11	1968	1984	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1
104	112	203	1	1972	3	4	12	1957	1972	1	1	1	1	1	1.9	1	1	1	1	1	1	1	1	2	3	1
105	113	120	4	1986	14	5	22	1971	1986	1	1	1	1	1	14.4	1	1	1	1	1	1	1	1	1	1	1
106	114	149	2	1973	2	4	8	1962	1979	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1	1
107	115	243	1	1985	2	4	23	1951	1983	1	1	1	1	1	6.4	1	1	1	1	2	2	1	1	1	1	1
108	116	263	1	1983	5	32	28	1950	1982	1	1	1	1	1	0.5	1	2	2	1	1	1	1	2	2	3	2
109	117	221	3	1985	3	3	8	1963	1984	2	1	1	2	2	1	2	2	2	3	2	3	2	3	2	3	2
110	118	47	5	1987	1	4	7	1974	1986	1	2	1	1	2	0.0	1	1	1	1	1	1	1	1	2	3	1
111	120	173	1	1982	5	4	13	1937	1981	1	1	2	1	1	2.1	1	2	2	1	1	1	1	1	1	1	1
112	121	102	4	1985	5	12	63	1906	1985	1	1	1	1	1	1.8	1	1	1	1	1	2	2	1	1	2	3
113	122	243	1	1987	4	7	44	1970	1987	1	1	1	1	1	6.4	1	1	1	1	2	2	1	1	1	1	1
114	123	187	1	1973	2	6	12	1955	1973	1	1	1	1	1	3.1	1	1	1	1	1	1	1	1	1	2	3
115	124	276	1	1982	1	6	25	1901	1982	1	1	1	1	1	2.9	1	1	1	1	1	2	2	1	1	1	1
116	125	257	1	1979	1	8	23	1954	1978	1	1	1	1	1	2.5	1	1	1	1	1	1	1	1	1	1	1
117	126	179	1	1988	2	6	22	1967	1988	1	1	1	1	1	6.0	1	2	2	1	2	3	1	1	1	1	1
118	127	166	3	1982	2	19	27	1970	1982	1	1	1	1	1	1.0	1	1	1	2	2	1	1	2	2	1	2
119	128	255	3	1981	4	14	35	1962	1981	1	1	1	1	1	1.3	1	1	1	2	2	1	1	2	2	1	2
120	129	172	1	1981	1	6	14	1952	1981	1	1	1	1	1	0.4	1	1	1	1	1	1	1	1	1	1	1
121	130	93	1	1963	4	16	32	1930	1962	1	1	1	1	1	7.5	1	1	1	1	2	3	1	1	1	1	1
122	131	181	1	1984	3	32	236	1968	1984	1	1	1	1	1	48.3	1	1	1	1	1	1	1	1	1	1	1
123	132	243	1	1980	6	6	34	1968	1980	1	1	1	1	1	6.4	1	1	1	1	1	1	1	1	1	2	1
124	133	10	1	1987	2	8	20	1958	1986	1	2	1	1	1	2.1	1	1	2	1	1	1	1	1	1	2	3
125	135	27	3	1967	1	7	21	1942	1965	1	1	1	1	1	2.2	1	1	1	1	2	3	2	2	1	2	3
126	136	209	1	1986	2	12	38	1937	1985	2	2	2	1	2	0.1	1	2	3	2	3	2	3	2	2	3	2
127	137	236	1	1986	7	7	40	1967	1985	1	1	1	1	1	3.1	1	2	2	1	1	1	2	2	1	2	3
128	138	252	1	1986	7	8	27	1968	1985	1	1	1	1	1	0.6	1	2	2	2	2	3	1	1	1	2	3
129	139	262	4	1986	3	7	12	1951	1985	1	1	1	1	1	1.1	1	1	1	2	2	1	1	1	1	2	3
130	140	182	1	1977	4	7	34	1951	1976	1	1	1	1	1	2.2	1	1	1	2	2	1	1	2	2	1	2
131	141	181	1	1976	2	28	194	1942	1976	1	1	1	1	1	48.3	1	1	1	1	1	1	1	1	1	1	1
132	142	189	1	1984	5	7	20	1959	1984	1	1	1	1	1	6.8	1	1	1	1	2	1	1	1	1	1	1
133	143	175	1	1981	1	9	30	1967	1980	1	1	1	1	1	2.3	1	1	1	1	1	1	1	1	1	2	3
134	144	218	3	1974	4	9	.	.	.	1	2	1	1	1	1.0	2	2	4	2	4	2	4	2	4	2	4
135	145	24	1	1980	3	6	28	1963	1979	1	1	1	1	1	4.0	1	1	1	1	1	1	2	2	1	2	3
136	146	172	1	1934	2	7	6	1922	1932	1	1	1	1	1	0.4	1	1	1	1	1	2	3	2	2	1	2
137	147	270	1	1983	4	4	19	1967	1983	1	1	1	1	1	1.4	1	2	2	1	1	1	1	2	3	2	3
138	148	172	1	1979	2	9	40	1951	1978	1	1	1	1	1	0.4	1	1	1	1	1	1	1	1	1	1	1
139	149	171	1	1980	3	7	15	1966	1979	1	1	1	1	1	3.1	1	1	1	1	1	1	1	1	1	1	1
140	150	236	1	1988	3	4	30	1975	1987	1	1	1	1	1	3.1	1	2	2	1	2	1	1	2	2	3	1
141	151	51	3	1986	3	7	7	1978	1984	1	1	1	1	1	1.3	1	1	1	1	1	1	1	1	1	1	1
142	152	196	3	1985	4	2	0	.	.	1	2	1	1	2	.	1	2	3	2	3	1	2	1	1	2	3
143	153	300	1	1984	5	4	23	1969	1984	1	1	1	1	1	16.4	1	1	1	1	1	1	1	1	1	1	1
144	154	301	2	1986	1	7	0	.	.	2	1	2	2	2	.	1	2	2	2	2	2	3	2	2	3	2

OBS	ID	SOURCE	ORIGIN	DATE	AUTHORS	PAGES	REFS	ARL	LIST	LA	BA	CA	EM	IM	SCI	IMPACT	PI	LIBS	LIBS	LIBS	LIBS	LIBS	LIBS	LIBS	LIBS	LIBS	LIBS	LIBS	LIBS		
241	259	229	3	1986	8	7	32	1956	1984	1	1	1	1	1	2.0	1	1	1	2	2	2	3	2	2	1	1	1	1	2	3	
242	260	78	1	1985	4	7	30	1957	1983	1	1	1	1	1	3.2	1	1	1	2	2	1	1	1	1	1	1	1	2	1	1	
243	261	233	1	1988	2	5	78	1975	1986	1	1	1	1	1	4.4	2	2	2	1	1	2	3	1	1	2	2	2	3	1	1	
244	262	142	1	1984	5	5	75	1967	1983	1	1	1	1	1	10.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
245	263	243	1	1988	3	6	26	1976	1988	1	1	1	1	1	6.4	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	
246	264	248	1	1954	4	8	12	1941	1953	1	1	1	1	1	11.8	1	1	1	1	1	2	3	2	2	1	1	1	1	1	1	
247	265	142	1	1988	4	5	23	1938	1987	1	1	1	1	1	10.0	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	
248	266	220	3	1986	5	3	26	1966	1985	1	1	1	1	1	1.1	1	2	2	1	1	2	2	1	1	2	2	1	1	1	1	
249	267	204	1	1987	4	4	17	1963	1986	1	1	1	1	1	0.7	1	2	3	2	3	2	3	2	3	2	3	2	3	1	1	
250	268	254	1	1960	2	83	147	1911	1959	1	1	1	1	1	2.7	1	1	1	1	1	2	2	3	1	1	1	1	1	1	1	
251	269	230	4	1986	2	10	66	1940	1985	1	2	1	2	2	0.4	1	1	2	2	2	2	3	1	2	2	2	2	3	2	3	
252	270	211	3	1977	1	30	141	1960	1977	1	1	2	1	1	1.9	1	1	3	2	3	1	1	2	2	1	1	2	3	2	3	
253	271	210	4	1982	2	10	9	.	.	1	1	2	2	1	0.8	2	2	4	2	4	2	4	2	4	2	4	2	4	2	4	
254	272	120	4	1988	2	2	7	1985	1988	1	1	1	1	1	14.4	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	
255	273	18	1	1981	8	10	37	1955	1981	1	1	1	1	1	2.6	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	
256	274	228	3	1987	8	6	28	1957	1986	1	2	1	1	1	4.9	1	1	1	1	1	2	3	1	1	1	1	1	1	2	3	
257	275	35	4	1985	5	6	15	1947	1984	1	1	1	1	1	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
258	276	297	3	1980	5	16	24	1963	1979	1	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
259	277	216	3	1969	1	6	21	1955	1968	1	1	1	1	1	3.1	1	1	1	1	1	2	2	2	2	1	1	2	3	2	3	
260	278	23	3	1978	4	11	31	1934	1977	1	1	1	1	1	0.8	1	1	1	2	2	1	1	2	2	1	1	2	3	2	3	
261	279	243	1	1986	5	8	51	1963	1986	1	1	1	1	1	6.4	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	
262	280	27	3	1976	2	7	29	1959	1974	1	1	1	1	1	2.2	1	1	1	1	1	1	1	1	2	2	1	1	2	3	1	1
263	281	168	1	1977	4	9	51	1913	1974	1	1	1	1	1	1.8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
264	282	92	1	1977	3	13	32	1958	1976	1	1	1	1	1	4.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
265	283	285	1	1986	3	8	20	1966	1984	1	1	1	1	1	2.6	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
266	284	288	4	1987	2	1	2	2	2	.	2	2	4	2	4	2	4	2	4	2	4	2	4	2	4	4
267	285	198	1	1987	3	6	28	1969	1986	1	1	2	1	1	1.0	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1
268	286	144	1	1982	6	26	97	1907	1982	1	1	1	1	1	2.9	1	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1
269	287	316	4	1986	5	7	18	1970	1985	1	1	1	1	1	1.9	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
270	288	165	4	1987	2	13	9	1970	1986	1	2	1	1	2	1.2	1	2	2	2	3	1	1	1	1	1	1	1	2	3	1	1
271	289	170	1	1977	2	8	25	1968	1977	1	1	1	1	1	2.6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
272	290	231	3	1978	4	7	12	1930	1977	1	1	1	1	1	3.0	1	1	1	2	2	2	3	2	2	1	1	1	1	1	2	3
273	291	123	4	1985	1	13	37	1960	1984	1	2	1	1	1	0.4	1	1	1	1	1	2	3	1	1	1	1	1	1	1	1	1
274	293	265	4	1975	2	4	40	1937	1974	1	1	1	1	1	0.2	1	1	1	1	1	1	1	1	2	3	2	3	2	3	2	3
275	294	247	1	1982	4	4	11	1953	1978	1	1	1	1	1	2.8	1	1	1	2	2	2	3	1	1	1	1	2	2	2	3	
276	295	241	1	1976	4	6	17	1966	1976	1	1	1	1	1	2.3	1	1	2	2	2	2	3	2	2	1	1	2	3	1	1	
277	296	38	4	1977	2	3	32	1953	1977	1	1	1	1	1	3.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
278	297	101	1	1985	6	7	36	1958	1984	1	1	1	1	1	1.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
279	298	296	3	1986	3	11	26	1959	1984	1	1	1	1	1	0.3	1	1	1	2	2	2	3	2	3	2	3	1	1	1	1	1
280	299	307	3	1987	4	8	44	1960	1985	1	1	1	1	1	1.6	1	1	1	1	1	1	1	2	2	1	1	2	3	1	1	1
281	300	266	1	1979	2	5	23	1964	1978	1	1	1	1	1	5.1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1
282	301	264	1	1986	5	5	30	1913	1984	1	1	1	1	1	1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
283	302	158	4	1988	4	9	36	1972	1987	2	1	1	1	1	1.7	2	1	1	1	2	1	1	1	1	1	1	1	2	3	1	1
284	303	315	1	1961	3	5	8	1930	1960	1	1	1	1	1	1.9	1	1	1	1	1	2	3	1	1	1	1	1	1	1	1	1
285	304	299	3	1988	2	2	8	1982	1985	1	1	1	1	1	0.4	1	1	1	2	2	1	2	2	2	1	1	2	3	1	1	1
286	305	61	1	1979	3	6	22	1959	1979	1	1	1	1	1	4.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
287	307	201	1	1983	3	8	28	1975	1983	1	1	1	1	1	23.9	1	1	1	2	2	1	3	2	2	1	1	1	1	2	3	
288	308	154	2	1987	3	3	8	1936	1985	1	1	1	1	2	0.4	1	1	1	1	1	2	2	1	1	1	1	2	2	1	1	1

APPENDIX 6

LIST OF JOURNAL TITLES REPRESENTED IN SET B

Acta neurologica Scandinavica
Advances in enzymology
American heart journal
American journal of anatomy
American journal of cardiology
American journal of clinical nutrition
American journal of epidemiology
American journal of gastroenterology
American journal of medical genetics
American journal of physiology
American journal of roentogology
American review of respiratory disease
Analyst
Analytical biochemistry
Annals of clinical biochemistry
Annals of emergency medicine
Annals of internal medicine
Annals of neurology
Annals of the New York Academy of Science
Annals of surgery
Annual review of biochemistry
Archives of biochemistry and biophysics
Archives of internal medicine
Archives of neurology and psychiatry
Archives of ophthalmology
Archives of oral biology
Archives of surgery
Atherosclerosis
Basic research in cardiology
Biochemical and biophysical research communications
Biochemistry
Biochemical journal
Biochimica et biophysica acta
Biology of reproduction
Blood
Brain research
British dental journal
British journal of anaesthetics
British journal of cancer
British journal of haematology
British journal of obstetrics and gynaecology
British journal of ophthalmology
British journal of surgery
British medical bulletin
British medical journal
Bulletin for environmental contamination and toxicology
Bulletin of the International Union against Tuberculosis
Bulletin of the World Health Organization
Canadian journal of anaesthetics
Canadian journal biochemistry and cell biology
Cancer surveys
Cardiovascular and drugs therapy

Cell
Central African journal of medicine
Chest
Circulation
Circulation research
Clinica chimica acta
Clinical chemistry
Clinical and experimental hypertension Part A
Clinical immunology and immunopathology
Clinical orthopaedics and related research
Clinical radiology
Clinics in endocrinology and metabolism
Clinics in haematology
Clinics in sport medicine
Computers in biology and medicine
Cryo-letters
Current topics in microbiology and immunology
Cytogenetics and cellular genetics
Diabetic medicine
Diabetologia
Endocrinology
European heart journal
European journal of biochemistry
European journal of haematology
European journal of pediatrics
European journal of pharmacology
Experientia
Experimental hematology
Forstarchiv
Gamete research
Garcia de Orta Series Zoology
Gastroenterology
Gastrointestinal endoscopy
General and comparative endocrinology
Genetica
Genitourinary medicine
Genomics
Hepatology
Histochemistry
Human nutrition : Applied nutrition
Human genetics
Hydrobiologica
Hypertension
Immunology
Indian pediatrics
Infection and immunity
International journal of cancer
International urology and nephrology
Journal of allergy and clinical immunology
Journal of the American College of Cardiologists
Journal of the American Medical Association (JAMA)
Journal of antimicrobial chemotherapy
Journal of applied physiology
Journal of biological chemistry

Journal of chromatography
Journal of clinical endocrinology and metabolism
Journal of clinical investigation
Journal of clinical pathology
Journal of dental research
Journal of experimental medicine
Journal of general physiology
Journal of immunological methods
Journal of immunology
Journal of the Indian Medical Association
Journal of laboratory and clinical medicine
Journal of medical genetics
Journal of medical primatology
Journal of medical virology
Journal of molecular biology
Journal of molecular and cellular cardiology
Journal of the National Cancer Institute
Journal of the neurological sciences
Journal of neurology
Journal of pediatrics
Journal of periodontology
Journal of prosthetic dentistry
Journal of rheumatology
Journal of the South African Veterinary Medical Association
Journal of steroid biochemistry
Journal of toxicology and clinical toxicology
Journal of trauma
Journal of tropical and medical hygiene
Laboratory investigation
Lancet
Life sciences
Lipids
Medical hypothesis
Medical journal of Australia
Medicine and science in sports and exercise
Medicine
Molecular and cellular biology
Molecular and cellular endocrinology
Montpellier medicine
Nature
Neurochemical research
Neurology
Neuroscience
New England journal of medicine
Nucleic acid research
Nutrition and cancer
Ontario dentist
Oral surgery oral medicine oral pathology
Pathology
Pediatric infectious disease journal
Pediatrics
Photochemistry and photobiology
Phytophylactica
Phytotherapy research

Plastic and reconstructive surgery
Proceedings of the National Academy of Sciences of the USA
Proceedings of the Staff Meetings of the Mayo Clinic
Progress in cardiovascular disease
Protides of the biological fluids
Quarterly journal of medicine
Quarterly review of biophysics
Radiology
Respiration
Scandinavian journal of clinical and laboratory investigation
Scandinavian journal of gastroenterology
Scandinavian journal urology & nephrology
Science
South African journal of food science and nutrition
South African journal of science
South African medical journal
Spectrum (Pretoria)
Statistics in medicine
Surgery
Surgical clinics in North America
Thrombosis and haemostasis
Transactions of the American Society of Artificial Internal Organs
Transplantation
Transvaal medical journal
Virchow archiv A. Pathological anatomy and histopathology
Virology
West African medical journal
World health statistics quarterly

APPENDIX 7

CORRELATION TABLES: SET B

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	ID	SOURCE	ORIGIN	DATE	AUTHORS	PAGES	REFS	EARLIEST	LATEST
ID	1.00000 0.0 307	0.12683 0.0263 307	0.04307 0.4521 307	0.05175 0.3662 307	0.07606 0.1874 302	0.01728 0.7649 302	-0.00107 0.9852 301	0.08336 0.1561 291	0.04017 0.4949 291
SOURCE	0.12683 0.0263 307	1.00000 0.0 307	-0.01226 0.8305 307	-0.07916 0.1665 307	-0.07366 0.2018 302	0.08257 0.1523 302	-0.02543 0.6604 301	0.01503 0.7985 291	-0.04789 0.4157 291
ORIGIN	0.04307 0.4521 307	-0.01226 0.8305 307	1.00000 0.0 307	-0.02488 0.6642 307	-0.00152 0.9790 302	-0.03552 0.5386 302	-0.07242 0.2103 301	-0.08431 0.1514 291	-0.04938 0.4013 291
DATE	0.05175 0.3662 307	-0.07916 0.1665 307	-0.02488 0.6642 307	1.00000 0.0 307	0.16380 0.0043 302	-0.16112 0.0050 302	0.11357 0.0490 301	0.42227 0.0001 291	0.98979 0.0001 291
AUTHORS	0.07606 0.1874 302	-0.07366 0.2018 302	-0.00152 0.9790 302	0.16380 0.0043 302	1.00000 0.0 302	-0.07082 0.2198 302	-0.05636 0.3298 301	0.07084 0.2283 291	0.15487 0.0081 291
PAGES	0.01728 0.7649 302	0.08257 0.1523 302	-0.03552 0.5386 302	-0.16112 0.0050 302	-0.07082 0.2198 302	1.00000 0.0 302	0.66337 0.0001 301	-0.27333 0.0001 291	-0.22254 0.0001 291
REFS	-0.00107 0.9852 301	-0.02543 0.6604 301	-0.07242 0.2103 301	0.11357 0.0490 301	-0.05636 0.3298 301	0.66337 0.0001 301	1.00000 0.0 301	-0.16586 0.0046 291	0.09511 0.1054 291
EARLIEST	0.08336 0.1561 291	0.01503 0.7985 291	-0.08431 0.1514 291	0.42227 0.0001 291	0.07084 0.2283 291	-0.27333 0.0001 291	-0.16586 0.0046 291	1.00000 0.0 291	0.42648 0.0001 291
LATEST	0.04017 0.4949 291	-0.04789 0.4157 291	-0.04938 0.4013 291	0.98979 0.0001 291	0.15487 0.0081 291	-0.22254 0.0001 291	0.09511 0.1054 291	0.42648 0.0001 291	1.00000 0.0 291

Correlation Analysis

Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	ID	SOURCE	ORIGIN	DATE	AUTHORS	PAGES	REFS	EARLIEST	LATEST
ID	1.00000 0.0 307	0.12152 0.0333 307	0.04167 0.4669 307	0.06264 0.2739 307	0.14518 0.0115 302	0.02509 0.6640 302	0.05847 0.3120 301	0.06814 0.2465 291	0.04234 0.4718 291
SOURCE	0.12152 0.0333 307	1.00000 0.0 307	-0.00613 0.9149 307	-0.06121 0.2850 307	-0.13334 0.0205 302	-0.00667 0.9081 302	-0.09834 0.0885 301	0.05620 0.3394 291	-0.06805 0.2472 291
ORIGIN	0.04167 0.4669 307	-0.00613 0.9149 307	1.00000 0.0 307	0.01813 0.7517 307	-0.06948 0.2287 302	-0.10192 0.0770 302	-0.13026 0.0238 301	-0.04836 0.4112 291	-0.00461 0.9376 291
DATE	0.06264 0.2739 307	-0.06121 0.2850 307	0.01813 0.7517 307	1.00000 0.0 307	0.18088 0.0016 302	-0.14492 0.0117 302	0.13264 0.0213 301	0.37730 0.0001 291	0.97131 0.0001 291
AUTHORS	0.14518 0.0115 302	-0.13334 0.0205 302	-0.06948 0.2287 302	0.18088 0.0016 302	1.00000 0.0 302	-0.00769 0.8942 302	0.04656 0.4209 301	0.19371 0.0009 291	0.18515 0.0015 291
PAGES	0.02509 0.6640 302	-0.00667 0.9081 302	-0.10192 0.0770 302	-0.14492 0.0117 302	-0.00769 0.8942 302	1.00000 0.0 302	0.57246 0.0001 301	-0.19618 0.0008 291	-0.13847 0.0181 291
REFS	0.05847 0.3120 301	-0.09834 0.0885 301	-0.13026 0.0238 301	0.13264 0.0213 301	0.04656 0.4209 301	0.57246 0.0001 301	1.00000 0.0 301	-0.14729 0.0119 291	0.16762 0.0041 291
EARLIEST	0.06814 0.2465 291	0.05620 0.3394 291	-0.04836 0.4112 291	0.37730 0.0001 291	0.19371 0.0009 291	-0.19618 0.0008 291	-0.14729 0.0119 291	1.00000 0.0 291	0.39670 0.0001 291
LATEST	0.04234 0.4718 291	-0.06805 0.2472 291	-0.00461 0.9376 291	0.97131 0.0001 291	0.18515 0.0015 291	-0.13847 0.0181 291	0.16762 0.0041 291	0.39670 0.0001 291	1.00000 0.0 291

APPENDIX 8

EXAMPLE OF LETTER TO DIRECTORS OF LIBRARIES



University Libraries

Rondebosch 7700 South Africa
Telephone (021) 650-3097 · Telex 5-20327
Fax (021) 650-3714

University Librarian and Director · A S C Hooper

3 August 1990

The Director
University Library
University of the Witwatersrand
P.O. WITS. 2050

Dear Professor Musiker

I am researching the availability of biomedical journals. Originally the study focused on the Western Cape, but the validity of my conclusions will be enhanced if I can extend the investigation to all the large academic Medical libraries in South Africa.

With your permission, I would therefore appreciate an opportunity to visit JuMed to conduct a so-called 'Document Delivery Test': basically the checking of a sample of some 325 citations. One ascertains whether a library owns an item, whether it is found on the shelf, whether it is out on circulation, at the bindery, etc.

The procedure should cause your staff and patrons minimal disturbance, as I only need basic information on the catalogue(s), locations, circulation, binding records. At most, I should require assistance in the form of a follow-up search of items unaccounted for at the time of my visit. All the information gathered at the library will, of course, be at your disposal.

It is possible for me to do this exercise on Thursday, 30 August. Will it suit the Medical Library?

Your co-operation would be greatly appreciated.

Yours sincerely

S. Steynberg (Ms)
Chief Librarian
for University Librarian

SS/meo

APPENDIX 9 RESULTS OF DDT OBTAINED AT LIBRARY B

Table 1 Summary of availability data recorded at Library B

	Number of items	Category	Composite time Total
On shelf	213	1	213
Accessible C1	60	2	120
Accessible C2	25	3	75
Accessible C3	9	4	36
TOTALS	307		444

Capability Index = 88.86

Table 2 Analysis of availability data recorded at Library B

	Number of items	% of Total	% of Acquired
Total sample	307	100.00	n/a
Acquired by Library	230	74.92	100.00
On shelf	213	69.38	92.61
Not on shelf	17	5.54	7.39
Circulation	5	1.63	2.17
Bindery	4	1.30	1.74
Other section	3	0.98	1.30
Found 2nd search	3	0.98	1.30
Unaccounted	2	0.65	0.87
Elsewhere on Campus	43	14.01	
National ILL	25	8.14	

Availability Index = 0.694

APPENDIX 10 RESULTS OF DDT OBTAINED AT LIBRARY C**Table 1 Summary of availability data recorded at Library C**

	Number of items	Category	Composite time Total
On shelf	197	1	197
Accessible C1	24	2	48
Accessible C2	77	3	221
Accessible C3	9	4	36
TOTALS	307		502

Capability Index = 83.31

Table 2 Analysis of availability data recorded at Library C

	Number of items	% of Total	% of Acquired
Total sample	307	100.00	n/a
Acquired by Library	205	66.78	100.00
On shelf	197	64.17	96.10
Not on shelf	8	2.61	3.90
Circulation	2	0.65	0.98
Bindery			
Other Section			
Found 2nd search	2	0.65	0.98
Unaccounted	4	1.30	1.95
Elsewhere on Campus	16	5.21	
National ILL	77	25.08	

Availability Index = 0.642

APPENDIX 11 RESULTS OF DDT OBTAINED AT LIBRARY D**Table 1 Summary of availability data recorded at Library D**

	Number of items	Category	Composite time Total
On shelf	182	1	182
Accessible C1	84	2	168
Accessible C2	32	3	96
Accessible C3	9	4	36
TOTALS	307		482

Capability Index = 85.75

Table 2 Analysis of availability data recorded at Library D

	Number of items	% of Total	% of Acquired
Total sample	307	100.00	n/a
Acquired by Library	185	60.26	100.00
On shelf	182	59.28	98.38
Not on shelf	3	0.98	1.62
Circulation			
Bindery	1	0.33	0.54
Other Section			
Found 2nd search	1	0.33	0.54
Unaccounted	1	0.33	0.54
Elsewhere on Campus	81	26.39	
National ILL	32	10.42	

Availability Index = 0.593

APPENDIX 12 RESULTS OF DDT OBTAINED AT LIBRARY E**Table 1 Summary of availability data recorded at Library E**

	Number of items	Category	Composite time Total
On shelf	258	1	258
Accessible C1	21	2	42
Accessible C2	19	3	57
Accessible C3	9	4	36
TOTALS	307		393

Capability Index = 92.97

Table 2 Analysis of availability data recorded at Library E

	Number of items	% of Total	% of Acquired
Total sample	307	100.00	n/a
Acquired by Library	262	85.34	100.00
On shelf	258	84.04	98.47
Not on shelf	4	1.30	1.53
Circulation	2	0.65	0.76
Bindery	2	0.65	0.76
Other Section			
Found 2nd search			
Unaccounted			
Elsewhere on Campus	17	5.54	
National ILL	19	6.19	

Availability Index = 0.840

APPENDIX 13 RESULTS OF DDT OBTAINED AT LIBRARY F**Table 1 Summary of availability data recorded at Library F**

	Number of items	Category	Composite time Total
On shelf	185	1	185
Accessible C1	32	2	64
Accessible C2	81	3	243
Accessible C3	9	4	36
TOTALS	307		528

Capability Index = 82

Table 2 Analysis of availability data recorded at Library F

	Number of items	% of Total	% of Acquired
Total sample	307	100.00	n/a
Acquired by Library	187	60.91	100.00
On shelf	185	60.26	98.93
Not on shelf	2	0.65	1.07
Circulation	2	0.65	1.07
Bindery			
Other Section			
Found later			
Unaccounted			
Elsewhere on Campus	30	9.77	
National ILL	81	26.39	

Availability Index = 0.603

APPENDIX 14 RESULTS OF DDT OBTAINED AT LIBRARY G**Table 1 Summary of availability data recorded at Library G**

	Number of items	Category	Composite time Total
On shelf	195	1	195
Accessible C1	8	2	16
Accessible C2	95	3	285
Accessible C3	9	4	36
TOTALS	307		532

Capability Index = 81.68

Table 2 Analysis of availability data recorded at Library G

	Number of items	% of Total	% of Acquired
Total sample	307	100.00	n/a
Acquired by Library	202	65.80	100.00
On shelf	195	63.52	96.53
Not on shelf	7	2.28	3.47
Circulation	3	0.98	1.49
Bindery	2	0.65	0.99
Other Section			
Found 2nd search	2	0.65	0.99
Unaccounted			
Elsewhere on Campus	4	1.30	
National ILL	92	29.97	

Availability Index = 0.635