

## THE FIRST 20 YEARS OF RADIOCARBON DATING

### An Annotated Bibliography, 1948-68; a pilot study

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**ABSTRACT.** A bibliography of the radiocarbon dating literature for the years 1948-68, which is in the process of compilation, is examined and a format is proposed. A survey of literature growth has also been undertaken. This enables projections of the numbers of publications referring to radiocarbon dating to be made. The estimated number of publications for the year 1978 is compared to literature retrieval obtained by interrogating eight relevant computer data bases. It is concluded that computer information retrieval is not satisfactory. Bibliographic control of radiocarbon dating literature would be best achieved by a bibliography dedicated to the subject and updated at regular intervals.

#### *Purpose of the bibliography*

Although the technique of radiocarbon dating has been established and used as a research tool in a wide variety of fields since the late 1940's and is still being developed, refined and expanded, very few efforts at compiling a comprehensive bibliography of the literature devoted to radiocarbon dating and its applications have been attempted. Indeed the few early efforts at bibliographic compilation were very selective or dealt with specific areas of application (eg, Levi, 1955; 1957; Johnson, 1959; Fagan, 1961-1966; Deacon, 1966). Johnson, whose bibliography appeared in the first issue of *Radiocarbon*, notes the difficulty of compiling such a listing because of the multi-disciplinary aspect of the subject. This crossing of scientific fields results in the dispersal of the literature in a very large number of periodicals, not counting the monographs, reports, proceedings, etc (table 1). Indexing of radiocarbon literature is, therefore, also scattered in a variety of indexing and abstracting services, each dealing with a particular field of science. This makes searching for literature on the subject very cumbersome, to say the least. The field is also not static. New applications are continuously proposed, old applications are checked and improved. The subject and, therefore, the literature covering it are in a dynamic state of growth. As a consequence, researchers are finding it increasingly difficult to select from the volume of information that which is relevant to their work, in particular when they are about to undertake new projects. A perusal of current literature shows that early works are still widely referred to, indicating their importance as a foundation and framework for new research.

Radiometric dating appears as an indexed subject only since about 1965 and the computer data bases offer retrospective searching only back to the early 1970's (INSPEC-PHYSICS, 1969; CA Search [Chemical Abstracts], 1970; Geoarchive, 1969; SCI Search, 1974). Thus the selected date range of this bibliography, 1948 (the beginning of usage of naturally produced  $^{14}\text{C}$  as a scientific research tool) to 1968, fills the gap not covered by indexing services or computer information retrieval.

TABLE I  
Fields of research and application, types of publication in  
which radiocarbon dating literature appears

## Twenty years of radiocarbon dating 1948–1968

### An annotated bibliography

#### Fields of Research and Applications

Electronics	Dendrochronology
Instrumentation	Physics
Geochronology	Oceanography
Glacial Geology	Geo-Cosmo-Physics
Atmospheric Circulation	Archaeology
Water Circulation	Meteorology
Paleoclimatology	Biology-Chemistry
Paleoecology	Astronomy
Paleozoology	Prehistory
Paleobotany	Quaternary Geology
Paleopedology	Geochemistry
Limnology	Geophysics
Palynology	Astrophysics

#### Monographs and Proceedings

Thesis  
Monographs  
University research papers  
Museum research papers  
U.S. Atomic Energy Commission Reports  
Geological Survey papers  
Conference – Great Lakes Research  
Conference on Cosmic Rays  
INQUA Congresses  
International C-14 and H<sup>3</sup> Dating Conferences  
Royal Society Proceedings  
International Conference on the Peaceful Use  
of Atomic Energy  
International Congress of Americanists  
Nobel Symposium  
Conference of Nuclear Processes in Geological  
Settings  
Oxford Radioisotope Conference  
International Geological Congress  
International Symposium on Arctic Geology  
Symposium on the Use of Isotopes in  
Hydrology  
Pan-African Congress on Prehistory  
Conference on Radioecology  
Glaciological Conference  
International American Congress  
International Congress on Soil Science  
Symposium on Arctic Geology  
International Conference on Palynology  
International Congress of Anthropological  
and Ethnological Science

#### Periodicals in which the literature is published 400+

Arctic  
Antiquity  
British Journal of Applied Physics  
Current Anthropology  
Deep Sea Research  
Ecology  
Florida Anthropologist  
Geochemica et Cosmochemica Acta  
Helvetica Chimica Acta  
International Journal of Applied Radiation  
and Isotopes  
Journal of Geophysical Research  
Kansas Anthropological Association  
Newsletter  
Limnology and Oceanography  
Man  
Nature  
Nucleonics  
Oceania  
Quaternaria  
Review of Scientific Instruments  
Science  
South African Archaeological Bulletin  
Tellus  
United States Geological Survey Bulletin  
Wisconsin Archaeologist  
Yale Science Magazine  
Zeitschrift für Naturforschung

*Scope and limitations of the bibliographical pilot study*

All efforts have been made to be as comprehensive as is practically possible. Included are not only theoretical literature, dating techniques and research aimed at improving accuracy, enlarging the fields of application and extending the date range further into the past, but also literature of the many low-level (natural) radiocarbon fields of application. Such applications include, for example: climatology, glaciology, oceanography, soil and earth sciences, geochemistry, palaeobotany, palaeomagnetism, palynology, anthropology, and archaeology-prehistory, to name but a few (table 1).

The bibliography does not include high count-rate  $^{14}\text{C}$  tracer studies in their applications to such fields as biology, medicine, and industry. The language is restricted to English, though a few significant works in German and French have been included when they are original and relate to methods and basic research.

*Method of compilation*

The method of compilation is based mainly on search of cited references. The initial source was the extensive reprint collection of the Radiocarbon Dating Laboratory of the Australian National University, Canberra. From this, all relevant references were indexed and checked. The major monographs dealing with the subject were also examined for references and indexed in depth. The main periodicals in which the literature appears were determined and comprehensively indexed. Each reference was then sighted in order to extract a pertinent annotation which is not a copy of the given abstract, but stresses the use and applications of radiocarbon dating.

*Structure of the bibliography*

The bibliography is divided into 14 chapters as shown in table 2. Within each chapter, the arrangement is in alphabetical order by title. The selection of titles for inclusion within a chapter was done by assigning each title entry a number of descriptors (key words). The compiler then grouped the most appropriate entries into relevant chapters. Each entry is listed only once.

Three indexes offer access to the material by author, subject and place (where relevant). This arrangement was chosen because it offers access at two levels: 1) browsing level, arranged by chapters which enable the user to go directly to the area required, scanning clearly set out titles which convey the desired information, 2) specific retrieval level through the subject and author indexes.

The format of the entries has been chosen for clarity (table 2), the bibliographic description is provided in full without abbreviations of journal names. The annotations (which are not abstracts) are informative and refer to that part of the article which makes specific use of radiocarbon. The bibliography as presented at this Conference is a pilot study containing approximately 1000 entries, which represents less than a third of the material so far located. The basis for selection for inclu-

sion in this pilot bibliography is quite arbitrary, omissions or inclusions are not a judgment of quality but depended entirely on accessibility of reference material to the compiler. The author index is a straight alphabetical listing of authors' and co-authors' names without cross-references (table 2). The subject index is also a plain alphabetical listing with no attempt at structuring and cross-referencing. It is intended that the subject index for the complete bibliography will include 'see' and 'see also' references for more complete access. A place index will be included should this work be extended.

### *Survey of literature growth and literature retrieval*

During this compilation, a survey of literature growth has also been made. Using the actual number of items cited, a projection of publica-

TABLE 2  
Structure of the bibliography, author index and format  
of individual entry

### Structure

01. Bibliographical Works
02. Theory and Theoretical Research
03. Techniques and Instrumentation
04. General Geology
05. Glacial Geology
06. Ocean Studies
07. Pleistocene
08. Archaeology - Africa
09. Archaeology - America
10. Archaeology - Asia
11. Archaeology - Europe
12. Archaeology - Oceania
13. Conference and Symposia
14. Date Lists

### Format of individual entry

Chapter heading	
Chapter No.	02. THEORY AND THEORETICAL RESEARCH
Item No.	02.002
Title	ACCURACY OF RADIOCARBON DATES
Author	Libby, Willard F.
Bibliographical description	<i>Science</i> , v.109, n.2827, 4 Mar. 1959: 227-228
Annotation	The world-wide uniformity of the radiocarbon assay in the present time results in the logical assumption that this would have been true in ancient times. This leads to dating of the half-life of C-14. A verification test was conducted on wood samples from ancient Egyptian tombs.

### Author index

Labeyrie, Jean 03.042, 043; 04.032, 053  
 Laborel, Jacques 05.118  
 Lagomarsino, E.J. 02.116  
 Laird, W.M. 07.042  
 Lal, D. 02.010; 03.167; 06.022  
 La Marche, V.C. 05.006  
 Lamb, H.H. 04.126  
 Langford-Smith, Trevor 04.104  
 Langway, Chester C. 03.144, 162  
 Lansen, James A. 04.077  
 Lassalle, Pierre 05.101  
 Leakey, L.S.B. 08.002  
 Lee, Abel 03.126  
 Lee, Hubert 05.049; 07.030  
 Leger, Concele 03.037  
 Leighton, Morris M. 05.014, 025, 042, 044, 103, 07.049  
 Lembe, R.W. 07.042  
 Leonard, J. Byron 07.043  
 Leopold, Estelle B. 04.069; 07.040  
 Levi, Hilde 01.004, 005  
 Libby, Willard F. 02.002, 003, 005, 038, 061, 081, 084, 088, 091, 093, 100, 106; 03.002, 065, 080, 089, 092, 127, 128, 142; 04.004, 024, 118  
 Long, Austin 02.055; 03.062, 174; 07.006  
 Smith, W.G. 04.101  
 Snell, William G. 04.050; 06.002  
 Sobering, S. 03.164  
 Spaulding, A.C. 03.165  
 Stager, John K. 05.125  
 Stenborg, Allan 02.103, 126  
 Stevens, N.P. 04.040  
 Stipp, Jerry J. 03.032, 070  
 Stuckenrath, Robert 03.024, 105  
 Stuiver, Minze 02.024, 074, 122, 123; 03.041, 103, 139; 04.005, 029, 058, 082, 100, 102, 120; 07.012; 08.015  
 Suess, Hans E. 02.017, 018, 025, 052, 057, 062, 064, 082, 087, 097, 101, 109, 113; 03.017, 066, 093; 04.078; 05.001; 06.009, 013, 014, 018, 024  
 Takashima, Y. 03.008  
 Tamers, Murray A. 02.118; 03.027, 037, 070, 077, 159; 04.038, 075  
 Tamm, O.C. 05.109  
 Tauber, Henrik 02.066, 078, 124; 03.049; 05.116  
 Taylor, Dwight D. 02.083; 04.117  
 Taylor, R.E. 02.088, 089; 03.055, 146  
 Terasmae, Jaan 05.037, 068; 07.020, 038



tion numbers can be made (fig 1). According to this conservative projection, the number of items published between 1968 and 1978 (10 years) would exceed the numbers published between 1948 and 1968 (20 years). In order to test the effectiveness of computer information retrieval for radiocarbon literature, searches on eight data bases available from the Lockheed information system DIALOG were made for the year 1978. The following data bases were interrogated: SCI Search (Science Citation Index) is a multi-disciplinary index to the literature of science and technology; SSCI Search (Social Science Citation Index) is a multi-disciplinary data base indexing social science literature; NTIS is a data base for USA government sponsored research; Meteorological and Geostrophical Abstracts covers meteorology, astrophysics and oceanography; SPIN (Searchable Physics Information) provides abstracts in the fields of physics, astronomy and geophysics; CA Search (Chemical Abstracts) deals with scientific and technical literature in chemistry and related fields; Geoarchive covers the various fields of geoscience; and INSPEC-Physics is the data base of Physics Abstracts. Variations of the same query were used for all data bases according to the language used by each of them. Total retrieval was 566 items (table 3), of which 265 were not applicable

TABLE 3  
Analysis of the retrieval performance of 8 computer based  
bibliographical data bases

Data base	Retrieved No.	N.A. %	Useful Items No.	Disciplines (No. of items)					Ratings (5 grades)
				Theory Techniques	Date lists	Archeol.	Geosc.	Other	
S.C.I. (Science Citation Index)	128	29.5%	90	30	31	4	21	*****	
C.A. SEARCH (Chemical Abstracts)	161	54.0%	55	34	2	1	18	***	
INSPEC (Physics Abstracts +)	121	71.8%	34	16		4	14	**	
S.S.C.I. (Social Science Citation Index)	47	10.7%	42	7	13	12	6	***	
Geoarchive	74	1.4%	73	7	17	6	43	*****	
Met/Geoastro	15	93.0%	1				1	*	
NTIS (Gov. Sponsored Research)	13	76.9%	3	1			2	*	
SPIN (Physics)	6	50.0%	3				3	*	
<b>Total Retrieval</b>	<b>566</b>	<b>46.9%</b>	<b>301</b>	<b>95</b>	<b>63</b>	<b>27</b>	<b>108</b>	<b>8</b>	
Less 83 duplicates			218	60	41	23	86	8	
%			100	27.5	17.8	10.6	44.0	0.1	
							Rating	80-100 items retrieved 5*	
								60-79 " " 4*	
								40-59 " " 3*	
								20-39 " " 2*	
								0-19 " " 1*	

— a fairly high percentage of noise (46.8). The best retrieval was from the multi-disciplinary SCI data base and the second best was from Geomorphology, although this was understandably slanted towards geosciences. The only data base to retrieve a significant number of archaeological items was SSCI. There was, however, a fair amount of duplication (83 duplicates), which brings the total number of unique items to 218 (38.5% of the total retrieval). Three of the data bases, NTIS, Meteorological and Geophysical abstracts and SPIN retrieved only five new items between them and could easily be omitted.

In order to compare the result of these searches with expected publication production, an actual count was made of the numbers of publications for the years 1963, 1964, and 1965, distributed under four major headings (Theory and Technique, Date Lists, Archaeology, and Geology). Calculation of the percentage of total for three years gives the distribution of the items between the four main headings (table 4A). This distribution was then applied (table 4B) to the number of publications projected for 1978 (fig 1) and compared to the numbers retrieved by computer searches (table 3). Three observations can be made: 1) total retrieval is only half of the expected (projected) number of items, 2) retrieval for the areas of technique/theory, date lists and geology is quite acceptable, approximately 2/3 to 3/4 of the expected number, 3) retrieval of archaeological material is very poor, less than 1/6 of the expected numbers. A closer look at the items retrieved also reveals that conference proceedings are not covered by the data bases used. Other data bases, such as INIS Atomindex and Conference Papers Index, would have to

TABLE 4  
A. Evaluation of % distribution within major disciplines  
based on average of 1963-1965 data  
B. Comparison of projected and computer retrieved  
no. of publications for 1978

A — Year	Theory & technique		Date lists		Archaeology		Geology		Total No. for year
	No.	%	No.	%	No.	%	No.	%	
1963	48	22.7	20	9.5	81	38.4	62	29.4	211
1964	32	16.6	29	15	73	37.8	59	30.6	193
1965	67	25.5	34	12.5	72	27.4	90	34.3	263
Average % Distribution $\pm$ SD for 1963-1965									
	21.6 $\pm$ 4.5		12.3 $\pm$ 2.8		34.5 $\pm$ 6.2		31.4 $\pm$ 2.6		
B — 1978									
No. projected (1)	98		55		151		140		445
No. retrieved (2) (computer search)	60		41		23		86		218
% retrieved	61%		74.5%		15.2%		61.4%		49%

(1) No. of expected publications for 1978 read from graph — fig 1

(2) No. of publications retrieved by computer for year 1978 — table 3

be searched for this type of material. The result of this exercise suggests that computer information retrieval for radiocarbon literature is not adequate. Neither is it easy, as many data bases have to be searched and, consequently, it is expensive.

#### CONCLUSION

This pilot study was undertaken to point out the need for bibliographical control specifically adapted to the literature of radiocarbon dating. It is the opinion of the author that a well researched bibliography, updated at regular intervals, is required to serve this vast interdisciplinary field. The greatest need appears to be in the field of archaeology, where retrieval is poor.

The pilot study of 1000 entries, 40 copies of which were presented at the Xth International Radiocarbon Conference, shows what a bibliography can offer. It is the result of over three years of spare time effort by the author. Its aims are to canvas opinion as to its general usefulness and attract comments on how it could be improved. Should there be a general feeling that this bibliographical study ought to be completed (*ie*, include in excess of 3000 entries collected so far), then support to do so must be found.

#### Errata

Some errors have crept in during manual compilation. These can be eliminated through computer processing should the completion of the bibliography be undertaken.

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