

# RADIOCARBON

Editor: MINZE STUIVER

Managing Editor: RENEE S KRA

Published by

## THE AMERICAN JOURNAL OF SCIENCE

Editors: JOHN RODGERS, JOHN H OSTROM, AND PHILIP M ORVILLE

Managing Editor: MARIE C CASEY

Published three times a year, in Winter, Spring, and Summer, at Yale University, New Haven, Connecticut 06520.

Subscription rate \$45.00 (for institutions), \$30.00 (for individuals), available only in whole volumes.

All correspondence and manuscripts should be addressed to the Managing Editor, RADIOCARBON, Box 2161, Yale Station, New Haven, Connecticut 06520.

### INSTRUCTIONS TO CONTRIBUTORS

Manuscripts of radiocarbon papers should follow the recommendations in *Suggestions to Authors*, 5th ed.\* All copy (including the bibliography) must be typewritten in *double space*. Manuscripts for vol 21, no. 2 must be submitted in *duplicate* before January 1, 1979, for vol 21, no. 3 before May 1, 1979.

General or technical articles should follow the recommendations above and the editorial style of the *American Journal of Science*.

*Descriptions* of samples, in date lists, should follow as closely as possible the style shown in this volume. Each separate entry (date or series) in a date list should be considered an *abstract*, prepared in such a way that descriptive material is distinguished from geologic or archaeologic interpretation, but description and interpretation must be both brief and informative, emphasis placed on significant comments. Date lists should therefore not be preceded by abstracts, but abstracts of the more usual form should accompany all papers (eg, geochemical contributions) that are directed to specific problems.

Each description should include the following data, if possible in the order given:

1. Laboratory number, descriptive name (ordinarily that of the locality of collection), and the date expressed in years BP (before present, ie, before AD 1950). The standard error following the date should express, within limits of  $\pm 1\sigma$ , the laboratory's estimate of the accuracy of the radiocarbon measurement, as judged on *physico-chemical (not geologic or archaeologic) grounds*.

2. Substance of which the sample is composed: if a plant or animal fossil, the scientific name if possible; otherwise the popular name, but not both. Also, where pertinent, the name of the person identifying the specimen.

3. Precise geographic location, including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms; use of metric system exclusively. Stratigraphic sequences should *not* be included. However, references that contain them may be cited.

5. Reference to relevant publications. Citations within a description should be to author and year, with specific pages wherever appropriate. References to published date lists should cite the sample no., journal (R for Radiocarbon), years, vol, and specific page (eg, M-1832, R, 1968, v 10, p 97). Full bibliographic references are listed alphabetically at the end of the manuscript, in the form recommended in *Suggestions to Authors*.

6. Date of collection and name of collector.

7. Name of person submitting the sample to the laboratory, and name and address of institution or organization with which submitter is affiliated.

8. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted, as prescribed above. Interpretive material, summarizing the significance and implicitly showing that the radiocarbon measurement was worth making, belongs here, as do technical matters, eg, chemical pretreatment, special laboratory difficulties, etc. Calendar estimates, reported in AD/BC may be included, citing the specific calibration curve used to obtain the estimate.

*Illustrations* should not be included unless absolutely essential. They should be original drawings, although photographic reproductions of line drawings are sometimes acceptable, and should accompany the manuscript in any case, if the two dimensions exceed 30cm and 23cm.

*Reprints*. Thirty copies of each article, without covers, will be furnished without cost. Additional copies and printed covers can be specially ordered.

*Back issues*. Back issues (vols 1-9) are available at a reduced rate to subscribers at \$52.00 a set, including postage; vols 10-14 are \$20.00 each for individual subscribers and \$30.00 for institutions; vols 15-20 are \$30.00 each for individuals and \$45.00 for institutions; single back issues \$10.00 each; comprehensive index \$10.00 each.

\* *Suggestions to authors of the reports of the United States Geological Survey*, 5th ed, Washington, DC, 1958 (Government Printing Office, \$1.75).



## NOTICE TO READERS

**Half life of  $^{14}\text{C}$ .** In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, **all dates published in this volume (as in previous volumes) are based on the Libby value,  $5570 \pm 30$  yr**, for the half life. This decision was reaffirmed at the 9th International Conference on Radiocarbon Dating, Los Angeles/La Jolla, 1976. Because of various uncertainties, when  $^{14}\text{C}$  measurements are expressed as dates in years BP the accuracy of the dates is limited, and refinements that take some but not all uncertainties into account may be misleading. The mean of three recent determinations of the half life,  $5730 \pm 40$  yr, (**Nature**, v 195, no. 4845, p 984, 1962), is regarded as the best value presently available. Published dates in years BP, can be converted to this basis by multiplying them by 1.03.

**AD/BC Dates.** In accordance with the decision of the Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, the designation of AD/BC, obtained by subtracting AD 1950 from conventional BP determinations is discontinued in Radiocarbon.

Authors or submitters may include calendar estimates as a comment, and report these estimates as AD/BC, citing the specific calibration curve used to obtain the estimate.

**Meaning of  $\delta^{14}\text{C}$ .** In Volume 3, 1961, we endorsed the notation  $\Delta$  (Lamont VIII, 1961) for geochemical measurements of  $^{14}\text{C}$  activity, corrected for isotopic fractionation in samples and in the NBS oxalic-acid standard. The value of  $\delta^{14}\text{C}$  that entered the calculation of  $\Delta$  was defined by reference to Lamont VI, 1959, and **was corrected for age**. This fact has been lost sight of, by editors as well as by authors, and recent papers have used  $\delta^{14}\text{C}$  as the **observed** deviation from the standard. At the New Zealand Radiocarbon Dating Conference it was recommended to use  $\delta^{14}\text{C}$  only for age-corrected samples. Without an age correction, the value should then be reported as percent of modern relative to 0.95 NBS oxalic acid. (Proceedings 8th Conference on Radiocarbon Dating, Wellington, New Zealand, 1972). The Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, recommended that the reference standard, 0.95 times NBS oxalic acid activity, be normalized to  $\delta^{13}\text{C} = -19\text{‰}$ .

In several fields, however, age corrections are not possible.  $\delta^{14}\text{C}$  and  $\Delta$ , uncorrected for age, have been used extensively in oceanography, and are an integral part of models and theories. For the present therefore we continue the editorial policy of using  $\Delta$  notations for samples not corrected for age.

**Citations.** A number of radiocarbon dates appear in publications without laboratory citation or reference to published date lists. We ask that laboratories remind submitters and users of radiocarbon dates to include proper citation (laboratory number and date-list citation) in all publications in which radiocarbon dates appear.

**Radiocarbon Measurements: Comprehensive Index, 1950-1965.** This index, covering all published  $^{14}\text{C}$  measurements through Volume 7 of

RADIOCARBON, and incorporating revisions made by all laboratories, has been published. It is available to all subscribers to RADIOCARBON at \$10.00 US per copy.

**Publication schedule.** Beginning with Volume 15, RADIOCARBON has been published in three numbers: Winter, Spring, and Summer. The deadline for v 21, no. 2 is January 1, 1979. Contributors who meet our deadlines will be given priority but publication is not guaranteed in the following issue.

**List of laboratories.** The comprehensive list of laboratories at the end of each volume now appears in the third number of each volume.

**Index.** All dates appear in index form at the end of the third number of each volume.

Volume 20, Number 3 - 1978

---

# RADIOCARBON

Published by  
**THE AMERICAN JOURNAL OF SCIENCE**

Editor  
MINZE STUIVER

Associate Editors

TO SERVE UNTIL JANUARY 1, 1982  
J GORDON OGDEN, III                      IRVING ROUSE  
HALIFAX, CANADA                      NEW HAVEN, CONNECTICUT

TO SERVE UNTIL JANUARY 1, 1984  
STEPHEN C PORTER  
SEATTLE, WASHINGTON

TO SERVE UNTIL JANUARY 1, 1985  
W M MOOK                      H OESCHGER  
GRONINGEN, THE NETHERLANDS                      BERN, SWITZERLAND

Managing Editor  
RENEE S KRA

---

KLINE GEOLOGY LABORATORY  
YALE UNIVERSITY  
NEW HAVEN, CONNECTICUT 06520

## EDITORIAL STATEMENT TO CONTRIBUTORS

Since its inception, the basic purpose of Radiocarbon has been the publication of compilations of  $^{14}\text{C}$  dates produced by various laboratories. These lists are extremely useful for the dissemination of basic  $^{14}\text{C}$  information.

The editors have recently agreed to an expanded role for the Journal. In addition to date lists, the editors will now consider technical or interpretative articles on all aspects of  $^{14}\text{C}$ . In general, the type of material presented at International Radiocarbon conferences is appropriate for inclusion in Radiocarbon. Articles containing scientific knowledge based on  $^{14}\text{C}$  data broadens the scope of the Journal.

All correspondence and manuscripts should be sent to the Managing Editor, Radiocarbon, Box 2161, Yale Station, New Haven, Connecticut 06520.

The Editors

## CONTENTS

|      |                                                                                                                                                                                              |     |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|      | Optimum operating conditions of $^{14}\text{C}$ -methane isotope enrichment by<br>concentric type thermal diffusion columns for use in radiocarbon<br>dating ..... <i>Helmut Erlenkeuser</i> | 313 |
|      | LaJolla measurements of radiocarbon in the oceans ..... <i>G W Linick</i>                                                                                                                    | 333 |
|      | DATE LISTS                                                                                                                                                                                   |     |
| ANU  | <i>H A Polach, M J Head, and J D Gower</i><br>ANU Radiocarbon Date List VI .....                                                                                                             | 360 |
| Bln  | <i>G Kohl and H Quitta</i><br>Berlin Radiocarbon Dates V .....                                                                                                                               | 386 |
| BS   | <i>G Rajagopalan, Vishnu Mittre, and B Sekar</i><br>Birbal Sahni Institute Radiocarbon Measurement I .....                                                                                   | 398 |
| Gd   | <i>Włodzimierz Moscicki, Anna Pazdur, Mieczysław F Pazdur,</i><br><i>and Andrzej Zastawny</i><br>Gliwice Radiocarbon Dates IV .....                                                          | 405 |
| Lu   | <i>Soren Hakansson</i><br>University of Lund Radiocarbon Dates XI .....                                                                                                                      | 416 |
| MRRl | <i>Thomas D Mathews</i><br>Marine Resources Research Institute Radiocarbon Dates II .....                                                                                                    | 436 |
| TA   | <i>Aveli Liiva, Ilpo Ekman, and Toivo Rinne</i><br>Tartu Radiocarbon Dates VII .....                                                                                                         | 441 |
| TA   | <i>E Ilves</i><br>Tartu Radiocarbon Dates VIII .....                                                                                                                                         | 449 |
| TAM  | <i>R A Parker and W M Sackett</i><br>Texas A&M University Radiocarbon Dates IV .....                                                                                                         | 455 |
| Tln  | <i>J M Punning, R Rajamae, and J Ehrenpreis</i><br>Tallinn Radiocarbon Dates V .....                                                                                                         | 461 |
| U    | <i>Ingrid U Olsson and M Farid A F El-Daoushy</i><br>Uppsala Natural Radiocarbon Measurements XII .....                                                                                      | 469 |
| UGa  | <i>Betty Lee Brandau and John E Noakes</i><br>University of Georgia Radiocarbon Dates VI .....                                                                                               | 487 |
| UM   | <i>P M Calvert, D S Introne, and J J Stipp</i><br>University of Miami Radiocarbon Dates XIII .....                                                                                           | 502 |
|      | List of Laboratories .....                                                                                                                                                                   | 513 |
|      | Index to Volume 20 .....                                                                                                                                                                     | 524 |
|      | Erratum .....                                                                                                                                                                                | 539 |