A database of radiocarbon dates for archaeology

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Describes the formation of a finding aid for published radiocarbon dates for archaeological sites, first (in the 1970s) by manual methods, latterly by computer database.

Introduction

How do you work out the date of an archaeological site when it offers up no artefacts to guide you? Archaeologists had long wanted something better than dead-reckoning of dates, but they had to wait until the 1950s to achieve a more precise technique. Without datable artefacts one can only assign relative dates to a site or part of site—layer B lies below layer A so must be earlier; or site X has similar artefacts to site Y so must be broadly contemporary; and so on. In Britain, for instance, we knew that the Stone Ages (Old, Middle and New) were succeeded by a period in which bronze was the dominant material, then came iron, then the dawn of 'proper' history with the Roman conquest. Within that framework certain refinements could be made, mostly by studying developing pottery or metalwork styles. Fixing on actual calendar years for the duration of those periods was, however, entirely problematic, and some of our beliefs arrived at by dead-reckoning were to be rudely shattered when Libby's new technique of radiocarbon dating came along.

Willard Libby was a professor of chemistry in Chicago in the late 1940s when he developed the idea that, since living things continually absorb carbon from their surroundings and cease to do so when they die, one can examine the proportion of radiocarbon (the radioactive isotope ^{14}C which decays at a known rate) which remains in a piece of archaeological organic material, and thus calculate how long ago it died. That is a gross oversimplification of the very complicated process of radiocarbon dating, which after fifty years is still being refined and better understood, but it will serve for this article. (For the curious, a few references to relevant publications are appended. [1, 2, 3])

The new technique was slow, expensive, and subject to errors of all kinds, but by the late 1960s enough sites in Britain and Ireland had been carbon-dated to force reappraisal of many archaeological ideas. In particular the Neolithic, formerly thought to start in about 2000 BC, seemed to begin as much as a couple of millennia earlier. Hence it soon became necessary to see where further dating effort was needed, and to that end the Council for British Archaeology (CBA) was asked to produce a list of sites that had been dated by that time (1970).

The printed index

The job of extracting the scattered data from the archaeological literature landed on my desk as editor of *British Archaeological Abstracts*. It was decided to produce the date list as an 'index' to guide users to the relevant literature; only minimal data would be presented, plus references to allow readers to look up the publication(s) where additional contextual and other information would be found.

At that time the main source of published radiocarbon dates was the journal *Radiocarbon*, published in the USA from 1959 onwards, which took dating reports from laboratories all over the world. It also issued, for an extra subscription, a series of edge-notched cards printed with the same data. These cards, 8 inches by 5, allowed information retrieval by means of holes punched all around their edges. At appropriate (coded) points the holes on each card could be enlarged with a special punch into V-shapes; to extract a particular set of data (for instance, Neolithic habitations) you took a long spike, poked it through the relevant hole in a stack of cards, and lifted the stack up. Those cards which had the V-punching for 'Neolithic habitations' were selected because they fell away from the spike. It was a primitive, but effective and quite popular retrieval system—while it lasted.[4] (Incidentally, to this day *Radiocarbon* has never produced a comprehensive finding aid to its 35 bulky volumes, though it is struggling towards production of an international computer database.[5])

With the permission of *Radiocarbon*, and through the courtesy, moral support and help of Richard Burleigh (then head of the British Museum Laboratory) I spent a week consulting these punched cards and hand-copying the data on to cyclostyled formatted slips of my own design. (Photocopying was still too primitive even if we could have afforded it.) The data were already fairly highly structured on the *Radiocarbon* cards and I added some more to suit the British/Irish situation. The fun came with the poor initial coding of the cards; I found a lot of purely geo-

BURIALS–EARTHEN LONG BARROWS

Lambourn, Berkshire
SU 323834 — J J Wymer

Burnt wood on natural chalk under primary rubble of ditch	GX–1178	3415 B.C. ±180

Radiocarbon (n y p)
Berkshire Archaeol J, vol. 62, 1965–6, 1–16
Antiquity, vol. 44, 1970, 144

Windmill Hill, Avebury, Wiltshire (Horslip barrow)
SU 087714 — P Ashbee

Antler from primary chalk silt in ditch	BM–180	3240 B.C. ±150

Radiocarbon, vol. 11, 1969, 285
Antiquity, vol. 34, 1960, 297–9; vol. 40, 1966, 299

Fussell's Lodge, Wiltshire
SU 192324 — P Ashbee

Charcoal with burnt stone and flints over primary burials	BM–134	3230 B.C. ±150

Radiocarbon, vol. 10, 1968, 2
Archaeologia, vol. 100, 1966, 1–80

Willerby Wold, Bridlington, Yorkshire ER
TA 029761 — T G Manby

Charcoal from centre of façade bedding trench	BM–189	3010 B.C. ±150
Charcoal from base of "crematorium" deposit	BM–188	2950 B.C. ±150

Radiocarbon, vol. 11, 1969, 287
Proc Prehist Soc, vol. 29, 1963, 173–205
Antiquity, vol. 41, 1967, 306–7

South Street, Avebury, Wiltshire
SU 090692 — J G Evans

Charcoal on buried soil surface under mound	BM–356	2810 B.C. ±130
Bos sp. bone on ditch bottom	BM–357	2750 B.C. ±135
Antler on ditch bottom	BM–358a	2670 B.C. ±140
Antler embedded in mound	BM–358b	2580 B.C. ±110

Note: collagen fraction used for last three samples

The figure shows the highly structured data format of the printed index. Reproduced, by permission of the Council for British Archaeology, from *Archaeological site index to radiocarbon dates for Great Britain and Ireland*, CBA, 1971.

logical cards had been punched as 'archaeology', and vice versa, so that made a lot of extra work, along with other mistakes I found. (I have often wondered who did the original punchings . . .) After the data had been extracted from the punched cards it remained to plough through scores of archaeological journals, and a few others like *Science*, to find any further radiocarbon dates and copy them on the same formatted slips.

Nothing about this extraction job can ever be taken for granted; archaeologists can make all the mistakes possible, get their map references muddled up or omitted entirely, confuse the laboratory numbers, forget to say which layer the sample came from, and so on; letters have to be written, and/or several different accounts compared to see which of the conflicting versions is most likely. Some dates have never gone into my index simply because their deficiencies in vital data could not be supplied.

The classification and indexing system

Since a looseleaf system had been decreed by the CBA's Scientific Research Committee, to allow for continual updating, I had to devise a suitable classification scheme. Retrieval was arranged to be possible in several ways: by type of site (e.g. Bronze Age settlement, Neolithic henge monument); by laboratory number (each date determination has a unique identification number, e.g. HAR–4806 or OxA–4050); and by name of site (e.g. Stonehenge).

The main division of the classification was by archaeological period (e.g. Neolithic, Iron Age), with site-type as the next division (e.g. settlement, henge, cist burial). Appendix A illustrates a small section of this scheme. Within site types the dates were presented by individual site-name, these being arranged with oldest sites first. A simple index was made for the laboratory numbers, numerically within alphabetical order of laboratory code; over thirty radiocarbon laboratories around the world were involved. The site-name index was not entirely straightforward, because sites can be named in various ways and occasionally it takes time for a name to settle down between two alternatives, so cross-references were needed. Sites can be named after a modern settlement (e.g. Rothesay Townhead), a topographical feature name (e.g. Hambledon Hill), or an individual farm (e.g. Peacock's Farm, also sometimes known as Shippea Hill). Unfortunately resources in this manual system never ran to producing one further aid to users, an index by county.

The completed slips were then turned into typescript for the printer in the usual way. The first CBA *Archaeological site index to radiocarbon dates for Great Britain and Ireland* appeared in 1971, to be followed at irregular intervals by four supplements (each with amended indexes), the last one appearing in 1982. (Incidentally, I would never do a looseleaf system for an archaeological subject again; it worked well enough, but the new sheets were a dreadful chore to file into the main sequence, there was often only one new date within a particular classification—which looked silly on the new page—and there were always many small manual additions and amendments to be made to extant sheets. So it would be surprising indeed if all subscribers accomplished the task.)

An embarrassment of dates?

As time went on the trickle of fresh dates became a flood, to the point where 30 or more would come from a single archaeological site. Also the pressure of my daily work inexorably built up to the point where, for the 1982 supplement, outside help had to be sought to edit and type the slips for the printer. Thereafter it proved impossible even to find an editor, and the whole growing pile of fresh slips languished in a box. After 1986 even collecting the data from the literature had to be abandoned; no more slips, and no more printed supplements. The project looked doomed.

Enter, galumphing over the horizon, the computer. Bob Otlet and Jill Walker, at that time running the radiocarbon dating service at Harwell's Atomic Energy Research Establishment, devised a computer program to accept the dates for more sophisticated retrieval. The strictly standardised format used in the printed index made designing the database relatively easy, with each data element—site name, excavator name, location details, carbon date, etc.—going into its own field. Copying of the data into the machine went very slowly because of lack of funds; eventually a grant from the Headley Trust allowed the whole of the printed index (about 2000 dates), together with that old box of hand-written slips, to be entered into the machine. As I write we are waiting for a fresh source of funds to assure the future of the whole project, both in collecting the data and maintaining its input to the machine; but the database is at last a reality, even if not yet up to date. (On retiring from my job in 1991 I began catching up the 'lost' years of data collection, and a great mound of this new material is now ready for keying as word-processor files with tagged fields which the database can recognize.)

Choice of STATUS

The particular database package chosen by my computerate colleagues was STATUS from Harwell Computer Power, the current implementation being the version for PC. This was chosen for its remarkable ease of use (even I can work it) and its ability to perform rapid full-text searches. There are several computer steps involved in converting the word-processor files into STATUS records: not surprisingly, some tiresome bugs appeared in those successive programs, but we hope they have now been hunted to extinction at last . . .

Retrieval, formerly only possible by three routes, is now possible in myriad ways; by laboratory number, by name of excavator, by type of site, by site name, by county, by material dated, and so on. One can ask, for instance, for all examples of grain dates, for hearths dated by alderwood twigs (not large timbers), or all carbon-dated Beaker settlements in the southern counties, or all Iron Age dates obtained by excavator XYZ, or all dates before AD 43 obtained for Cambridgeshire or for National Grid Square SP. One can also ask to see all dates falling within a particular range, say 3000 to 1500 BP (Before Present, the conventional way of citing radiocarbon dates). A search can be limited by selecting a particular 'chapter' (e.g. Iron Age), but searching the entire database is virtually instantaneous anyway. Two fields contain free text comments by excavator and/or laboratory, but since STATUS searches on full text it will automatically retrieve relevant information in these fields.

There remains one important indexing refinement to make to the system, and that is to use the 'ring' structure of STATUS to allow thesaurial control of the site-type words. Natural language was always used in the printed index, so we now require a setup that will be independent of different nomenclatures. Accordingly links will be set up between 'cemetery', 'burial(s)' and 'graves'; between 'farmstead', 'settlement', 'occupation site', 'lakeside dwelling', etc.; between 'wood' and 'timber', and so on. This ensures that whatever term the user selects for the search, all equally relevant items will be presented for inspection.

The future

Although the system has been demonstrated at several archaeological or radiocarbon conferences (including one in Tucson), and received a warm welcome, it would be premature to open it up to public access until more of the waiting materials have been entered on the machine. I still visit archaeological libraries once a week to garner fresh dates from the literature, because it would be intolerable to fall behind again with the collection. Keying the data on the machine is, however, having to wait for proper funding; there is only so much one can do for love . . .

The ultimate hope is to set up an overnight service; users should be able to ring or write for the particular information they require, which can be selected and printed out for despatch the same day. Charges for such a service will have to be worked out. It is unlikely, for software licensing and other reasons, that the database can go online for direct interrogation by subscribers; and archaeology, despite the rapid advances it has made over the years since Libby's invention, is not usually such a hurried matter that answers are needed within ten minutes.

I have said nothing of the various technical and philosophical refinements of the radiocarbon dating process, which make a never-ending story in themselves. For instance, a single grape-pip was carbon-dated to the Neolithic period and thus relieved of the strong suspicion of being a modern intrusion; and the dates of some mediaeval panel paintings have been corrected, to the chagrin of the art historians. The search for financial help is a saga too. Nonetheless I hope this article gives some idea, however over-simplified, of the work involved in trying to keep a growing flood of complex data under some kind of control.

References

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Appendix: Sample of the classification scheme:

Section 4. BRONZE AGE

- 4A. Occupation sites [e.g. settlements]
- 4B. Barrows and cairns [burial mounds]
- 4C. Enclosed cremation cemeteries [e.g. ring cairns]
- 4D. Trackways [e.g. brushwood or timber paths constructed over bogs]
- 4E. Artefacts [e.g. stray finds not associated with settlements]
- 4F. Miscellaneous Bronze Age [e.g. stray bones]

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