RADIOCARBON DATES OF SOME PREHISTORIC AND PLEISTOCENE SAMPLES

D. P. AGRAWAL AND SHEELA KUSUMGAR
Tata Institute of Fundamental Research, Bombay-5

TODATE, most of our C^{14}-datings have referred to sites that are younger than 5000 B.P. A beginning is now made towards evolving a chronology of stone-age cultures and of Pleistocene events. Present paper includes samples from prehistoric sites as also from geologic deposits. Wherever the Pleistocene deposits were implementiferous, mention has been made in the sample description. The "chemical" and "counting" procedures adopted in making the radiocarbon measurements have been reported earlier (Kusumgar *et al.*, 1963; Agrawal *et al*, 1965) in detail.

[All samples were first manually cleaned to remove extraneous matter including rootlets. Dilute HCl (1%) was used to dissolve any soluble soil carbonates present in the samples. Charcoal with bigger and harder lumps alone was given NaOH pretreatment, lest it disintegrated, for removal of humic acid, if present. Samples were converted into pure methane and counted in gas proportional counters. Ninety-five per cent. activity of N.B.S. oxalic acid is taken as the 1950 reference standard.

For each sample two dates are given: first is based on the C^{14} half-life of 5568 years; the second, within parenthesis, is based on the value of 5730 years. All dates are expressed in years B.P., for conversion to A.D./B.C. scale 1950 A.D. should be used as reference year (Godwin, 1962).]

General Comments

Terdal, a neolithic site, has been dated to ca. 1800 B.C. and shows its contemporaneity to Tekklakota (Nagaraja Rao, 1965) and other allied sites. For the first time the microlithic cultures of Adamgarh and Lekhahia rock-shelters have been dated. Mula dam samples seem to show that Indian middle stone-age is younger than about 35,000 years.

For dating prehistoric cultures the problem of collecting datable samples is quite difficult. Charcoal is rare in stone-age deposits. Bones are available sometimes, but unless charred, their inorganic fractions have a high propensity to get contaminated by ground water carbonates. Collagen, the organic fraction of bones, is a more reliable material (Berger, 1964; Krueger, 1965) but it is difficult to extract it in sufficient quantities. The sampling techniques of palæobotanists may prove more useful for these early deposits.

Present paper includes a few early Holocene and upper Pleistocene samples from Kerala Coast, Godavari Delta, Mula river deposits and Kathmandu valley. Several institutions* are currently engaged in studying this period from various angles. The Radiocarbon Laboratory is actively collaborating with them to evolve an absolute chronology for the late Pleistocene period. We hope that radiocarbon dating would provide a valuable linking factor in the correlation of eustatic sea-level changes and time sequences of terraces (Zeuner, 1964) of thalassostatic, periglacial, climatic and glacifluvial origins.

C^{14} Dates with Sample Descriptions

Adamgarh, Madhya Pradesh, India

Adamgarh (Lat. 22° 43′ N., Long. 77° 44′ E.), District Hoshangabad, is a microlithic site with rock-shelters. It was excavated by R. V. Joshi and M. D. Khare. Sample submitted by A. Ghosh, Director-General of Archæology, New Delhi-11.

TF-116, Rock Shelter, 2765 ± 105
(2845 ± 105)

Uncharred bones from Trench ADG-2, Layer 3, Depth 1·90 m., Field No. II. Comment: only inorganic fraction dated, hence probability of contamination high.

TF-120, Rock Shelter, 7240 ± 125
(7450 ± 130)

Shells from Trench ADG-10, Layer 2, Depth 0·15 to 0·21 m., Field No. X. Comment: sample from pre-chalcolithic microlithic phase.

General comment: Dating of collagen (organic fraction) from some more bone samples from Adamgarh can alone confirm the chronology of this mesolithic culture.

Chavara-Kayankulam, Kerala Coast, India

Chavara-Kayankulam Coast (Lat. 8° 49′ N., Long. 76° 30′ E.), Kerala. Sample submitted by G. Prabhakar Rao, Atomic Minerals Division, Department of Atomic Energy, Shardhanandpeth, Nagpur-3.

* Sahni Institute of Palæobotany, French Institute Indian Institute of Oceanography, Meerut and Allahabad Universities.

TF-203, Borehole No. 20, 5470 ± 115
(5610 ± 115)

Molluscan shells from off-shore borehole No. 20, Depth 1·8 to 3·6 m., Field No. CKO/1.

TF-204, Borehole No. 21, 6120 ± 110
(6295 ± 115)

Molluscan shells from off-shore borehole No. 21, Depth 3·9 to 5·2 m., Field No. CKO/2.

Dum-Dum, India

TF-443, Dum-Dum area, 6000 ± 120
(6175 ± 125)

Wood, *Heretiera* sp., from Dum-Dum near Calcutta, District 24 Parganas. Sample No. 4(*a*), Field No. IV. Palæobotanical sample submitted by A. K. Ghosh, Botany Department, Calcutta. NaOH pretreatment was also given.

Godavari Delta, India

TF-612, Godavari Delta core, 10815 ± 155
(11130 ± 160)

Shells from a core from Godavari Delta (Lat. 16° 59′ N., Long. 82° 45′ E.), Depth 117 m. Sample submitted by Dr. Aswathanarayan of Andhra University, Waltair. Comment: the sample will date the upper age limits of the marine facies of the recent Godavari delta.

Har Raipur, India

TF-611, Har Raipur, terrace, 4070 ± 95
(4190 ± 95)

Elephant tusk from Har Raipur, Field No. HRP. F-1 from a river terrace. Sample submitted by G. C. Mohapatra, Chandigarh. Comment: inorganic fraction of bone alone could be dated; contamination probability is high. Organic fraction recovered was not sufficient.

Lekhahia, Uttar Pradesh, India

Lekhahia (Lat. 24° 80′ 5″ N., Long. 82° 32′ E.), District Mirzapur. The site is being excavated by G. R. Sharma who submitted the samples.

TF-343, TF-341, TF-342, TF-344—all charcoal samples gave modern ages. Samples seem to be heavily mixed up with modern charcoal. The excavator informs that these rock shelters have been used by shepherds to light fires till modern times. All of the samples derive from layer 1 levels only. As the site was important four samples were measured, but to no avail.

TF-417, Rock Shelter, 3560 ± 105
(3660 ± 110)

Bones from Rock Shelter I, Skeleton No. VI, Locus 5-7, Layer 4, Depth 15 cm.

Mula Dam, Maharashtra, India

Mula Dam (Lat. 20° 21′ N., Long. 74° 37′ E.), District Ahmednagar. Samples submitted by H. D. Sankalia, Deccan College, Poona, India. Samples were exposed during dam construction operations.

TF-345, Pleistocene deposits,

$$31075\,{}^{+\,5550}_{-\,3245}\left(31980\;{}^{+\,5715}_{-\,3340}\right)$$

Wood from "Pleistocene deposits" at R.L. 1640 from old bed of Mula river, Sample No. 2. NaOH pretreatment was also given. Comment: From the uppermost alluvium few middle stone-age and late stone-age tools have been recovered. Error given with data is 2 standard deviations.

TF-217, Pleistocene deposits, > 39,000

Wood from "Pleistocene deposits" at R.L. 1645 from old bed of Mula river, Sample No. 1. NaOH pretreatment was also given. Comment: no tools are reported from these deposits.

Sankhu, Nepal

TF-189, Pleistocene deposits,

$$29115\,{}^{+\,3220}_{-\,2285}\left(29960\;{}^{+\,3315}_{-\,2350}\right)$$

Peat sample from naturally exposed road-cutting on way to Sankhu (Lat. 27° 43′ N., Long. 80° 25′ E.), near Kathmandu, Stratum Upper peat-bed. Visible rootlets were handpicked. Sample submitted by A. Ghosh.

Terdal, Mysore, India

Terdal (Lat. 15° 59′ 30″ N., Long 75° 5′ E.), District Bijapur, first site excavated in West in the Krishna Valley by Dr. H. D. Sankalia, who has submitted the sample.

TF-683, Neolitric, 3615 ± 120
(3720 ± 120)

Charcoal from Trench-1, Layer 3, Depth 45-65 cm., Field No. 40.

TF-684, Neolithic, 3775 ± 95
(3885 ± 100)

Charcoal from Trench-1, Layer 2, Depth 17–25 cm., Field No. 28.

Warkala, Kerala, India

Warkala (Lat. 8° 44′ N., Long. 76° 42′ 20″ E.), coast has been subject of many geologic investigations. Charred wood dated here was part of Warkala formation of Kerala Coast. Samples submitted by G. Prabhakar Rao.

TF-201, Warkala formations, > 45,000

Charred wood from Warkala formations, embedded ca. 0·3 m., in compact clay, Field No. WK/1.

TF-202, Warkala formations, > 40,000

Charred wood from Warkala formations, embedded ca. 0·3 m., in compact clay, Field No. WK/2. NaOH pretreatment was also given.

Comment: Dating of these formations has a bearing on the possibility or otherwise of oil-bearing strata in the region and on causes of the present-day coastal erosion. Samples will date emergence of the Kerala Coast also.

ACKNOWLEDGEMENTS

The authors are beholden to Prof. D. Lal for his guidance throughout the work. They also acknowledge the help rendered by Shri S. V. Kerkar.

1. Agrawal D. P., Kusumgar, Sheela, *Curr. Sci.*, 1965, **34** (13), 394.
2. Berger, R., Horney, A. G. and Libby, W. F., *Science*, 1964, **144**, 999.
3. Godwin, H., *Nature*, 1962, **195**, 984.
4. Krueger, H., *Proc. 6th International Conference on Radiocarbon and Tritium Dating*, USAEC, Div. of Tech. Information, CONF 650652, 1965, p. 332.
5. Kusumgar, S., Lal, D. and Sharma, V. K., *Proc. Ind. Acad. Sci.*, 1963, **58** (3), 125.
6. Nagaraja Rao, M. S., *The Stone-Age Hill Dwellers of Tekklakota*, Deccan College, Poona, 1965.
7. Zeuner, F. E., *The Pleistocene Period*, Hutchinson, London, 1964.

MODIFICATION OF ALUMINIUM-SILICON ALLOYS BY MISCH METAL ADDITIONS

R. SHARAN* AND T. R. ANANTHARAMAN

Department of Metallurgy, Banaras Hindu University, Varanasi-5

THE modification of aluminium-silicon alloys by additions of small percentages of a few selected elements, particularly sodium, has been investigated by several workers[1-4] recently. The present work was planned to explore the possible role of misch metal, primarily as modifier and secondarily as beneficial alloying addition, in improving the quality of hyper-eutectic aluminium-silicon alloys. Earlier work[5] in our laboratory has already established the beneficial role of misch metal in refining the structure of Al-Cu and Al-Mg alloys.

Commercial aluminium of 99·5% purity and silicon of 99·0% purity were used in the present investigations. The misch metal contained 50–52% cerium, 20–22% lanthanum, 15–17% neodymium and 10–12% of other rare earth elements. This mixture of metals was preferred to one or more of the pure metals because of its low cost and easy availability, particularly in our country. A systematic study has been completed of the effects of this addition on the microstructure and mechanical properties at room and elevated temperature, both in the sand-cast and metal mould-cast conditions.

An aluminium—13% silicon alloy was first prepared. In each experiment, a sample of the alloy was melted in an induction furnace and held at 800° C. The required amount of misch metal wrapped in aluminium foil was plunged into the molten bath, agitated mildly and the casting made at 700° C. in a cast iron or sand mould, as desired. Routine mechanical testing methods were employed.

The results (Figs. 1–7) display the following salient features:

1. Misch metal additions seem to modify the structure appreciably in both sand-cast and metal mould-cast conditions (Figs. 1-6). There is little effect upto 0·5% addition (Fig. 2), but complete modification is obtained at about 1·0% addition (Figs. 3 and 6). With further additions, recoarsening of the eutectic takes place and some new phase makes its appearance in the microstructure (Fig. 6).

2. Tensile strength and percentage elongation at room temperature increase upto about 1·0% addition of misch metal and then decrease in both sand and metal mould-cast alloys (Fig. 7). The tensile strength of the alloy with 1·0% misch metal is 5 tons/sq. inch higher than the tensile strength of the sodium-modified alloy cast under the same condition.

3. Hardness also increases upto about 1·0% addition of misch metal, but remains almost constant upto 2·0% (Fig. 7). Further additions lead to a steady increase in hardness.

4. As at room temperature, tensile strength was found to increase appreciably at 200° C. upto about 1·0% misch metal addition and then to decrease. At 400° C the tensile strength was found to remain almost unchanged with misch metal additions.

Kim and Heine[1] have developed a growth temperature critical shape hypothesis for modification in Al-Si alloys. Their experiments indicate that the phase shape assumed by silicon

* Present Address: Department of Metallurgical Engineering, Roorkee University, Roorkee.