

TATA INSTITUTE RADIOCARBON DATE LIST II

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The C^{14} dates presented here have been obtained by counting acetylene, synthesised from the sample, in an Oeschger-Houtermans' gas proportional counter. The chemical and counting procedures have been described in some detail (Kusumgar *et al.*, 1963a).

Dates are based on the C^{14} half-life value of 5568 yr. For conversion of B.P. dates to A.D./B.C. scale, A.D. 1950 has been taken as the reference yr. Ninety-five % activity of NBS oxalic acid has been adopted as the value for the pre-1900 age-corrected wood.

All samples were treated with dilute HCl. Whenever NaOH pretreatment was possible, it has been mentioned in the date list. In the case of bones, only the inorganic fraction has been dated.

GENERAL COMMENT ON DATES

The C^{14} dates for Kalibangan presented here and those for other Harappan and allied sites (Broecker *et al.*, 1956; Kusumgar *et al.*, 1963b; Stuckenrath, 1963) now establish a compact date bracket of ca. 2300 to 1750 B.C. The total time spread of Harappa Culture is much smaller than the millenium-long span postulated on the basis of archaeological evidence (Gadd, 1932). For a detailed discussion of the evaluation of Harappan chronology on the basis of C^{14} dates, reference is made to Agrawal (1964). The few C^{14} dates available for the Painted Grey Ware (upper levels) agree with Wheeler's chronology, ca. 800 to 500 B.C. (Wheeler, 1959). More measurements from different sites would be necessary to determine precisely the time spread of this ware. However, it seems certain that P. G. Ware people did not come in contact with the Harappans; in fact C^{14} dates suggest a gap of ca. 1000 yr between the two.

Several dates of bone samples from Alamgirpur, Mohanur, and Nagarjunakonda presented here are in complete disagreement with the archaeological estimates. These samples were not specifically collected for C^{14} dating. Furthermore, possibility of misidentification of levels due to later disturbances at the site is not ruled out. Thus the disagreement is probably not entirely due to the fact that the samples dated are bones. It may be mentioned here that TF-112, also a bone sample, gives a date in excellent agreement with that of charcoal from the same layer.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

TF-70. Adichannalur, India, burials**775 ± 95****A.D. 1175**

Wood sample from Adichannalur (8° 50' N Lat, 76° 40' E Long), Tin-

nevelly District, Madras, believed to be associated with urn burials. The site was excavated during 1899 to 1905. The sample had been stored after soaking in wax. Subm. by Satyamurti. Wood pieces were boiled in hot water to remove wax. NaOH pretreatment was also given. *Comment*: date obtained is in wide divergence with the archaeological estimates, if the sample is correctly identified.

TF-51. Alamgirpur, India **1060 ± 95**
A.D. 890

A composite of three bone samples believed to have been derived from the Painted Grey Ware deposit of the site, Alamgirpur (30° 45' N Lat, 75° 50' E Long), District Meerut, U.P. Subm. by A. Ghosh. *Comment*: date obtained is at considerable variance with the archaeological estimate. Because such a large contamination is unlikely and because from the sections the samples appear to belong to disturbed strata, the possibility of a wrong identification of the levels cannot be ruled out.

TF-173. Dwarka, India, Medieval Culture **310 ± 90**
A.D. 1640

Charcoal from Dwarka (22° 15' N Lat, 69° E Long), District Jamnagar, Gujarat, from Trench A, Locus 3.40 × 1.50 m, depth 1.45 to 1.50 m, Layer 3, Field No. 119. The site was excavated by Dr. H. D. Sankalia, Deccan College, Poona-6, who subm. the sample. Visible rootlets were hand-picked. *Comment*: it will help date the medieval period of the site.

Hastinapur series, Uttar Pradesh

Hastinapur (29° 9' N Lat, 78° 3' E Long) is located on the left bank of Ganga River in Meerut District. The site was excavated by B. B. Lal, Director, School of Archaeol., in 1950-52 and 1962. The samples presented in this paper belong to Periods II and III, characterized by the occurrence of Painted Grey Ware and Northern Black Polished Ware, respectively, in the site. The excavator has suggested an association of Aryans with the P. G. Ware industry of Period II. Samples subm. by A. Ghosh.

The eight dates presented here have an internal consistency borne out by the stratigraphic sequence of the site. The C¹⁴ measurements suggest the spread of Period III between ca. 400 and ca. 100 B.C. (on the basis of $\tau_{1/2} = 5730$ yr). There also does not appear to be much of a gap between the end of Period II and the beginning of Period III. It is highly desirable to obtain more C¹⁴ measurements for these crucial periods in Indian archaeology in order to define the chronologies of N.B.P. and P.G. Wares.

TF-80, 82. Period III **1940 ± 110**
A.D. 10

A composite of two samples of charcoal (mixed with soil) from Trench HST-1/1962 (northern extension), Locus G-H, Layer 23, Field Nos. HST/62/C/1 & 4, depth 3.9 m below surface. Visible rootlets were hand-picked. *Comment*: samples derived from identical depths and layers. They are believed to be associated with the end of Period III, which marks the culmination of N.B.P. Ware.

TF-81. Period III**2015 ± 95
65 B.C.**

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XC-XCIV, Layer 18, depth 5.1 m below surface. Field No. HST/62/C/2. Visible rootlets were hand-picked. NaOH pretreatment was also given. CO₂ was evolved by wet combustion method. *Comment:* sample derives from the uppermost layer of Period III, marking the end of N.B.P. Ware. Compare with TF-80, 82, 1940 ± 110.

TF-88. Period III**2225 ± 110
275 B.C.**

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 25, Field No. HST/62/C/15, depth 6.45 m below surface. Visible rootlets were hand-picked. *Comment:* sample is from the lowest layer of Period III which marks the beginning of N.B.P. Ware.

TF-83. Period II**2220 ± 110
270 B.C.**

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 26, and Pit Y sealed by Layer 25, Field No. HST/62/C/6, depth 6.75 m below surface. Visible rootlets were hand-picked. *Comment:* sample derives from the uppermost layer of Period II marking the end of P.G. Ware.

TF-112. Period II**2260 ± 95
310 B.C.**

Bone sample (coated with earth) from Trench HST-1/1962, Locus XC'-XCVII', Layer 26 and Pit Y sealed by Layer 25, depth 6.8 m below surface, Field No. HST/62/C/7. *Comment:* sample derives from the latest layer of Period II and will date the flooding of the site which led to its desertion by P.G. Ware-using people.

TF-90. Period II**2270 ± 110
320 B.C.**

Charcoal (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 26, Field No. HST/62/C/17, depth 6.6 m below surface. *Comment:* sample is from the same layer as TF-83.

TF-85. Period II**2385 ± 125
435 B.C.**

Charcoal (mixed with earth) from Trench HST-1/1962, Locus XC-XCIV, Layer 28 and Pit Z which is sealed by Layer 27, Field No. HST/62/C/10, depth 7.25 m to 7.45 m below surface. Visible rootlets were hand-picked. *Comment:* sample belongs to the late levels of Period II.

TF-91. Period II**2450 ± 120
500 B.C.**

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 27, depth 6.9 m below surface, Field No. HST/62/C/18. Visible rootlets were hand-picked. *Comment:* sample derives from late levels of Period II.

TF-109. Hathinia Hill-Baira, India, ash pit **30 ± 90**
A.D. 1920

Charcoal (mixed with earth) from the Megalithic site of Hathinia Hill-Baira, Varanasi District of U.P. Sample derives from Trench KKR-A1, Locus III-IV, Pit A sealed by Layer 1, depth 1.09 m below surface, Field No. HAH/63/KKR-2. Visible rootlets were handpicked. NaOH pretreatment was also given. *Comment:* as Pit A was disturbed by a late pit, the excavators were doubtful about its association with the megalithic habitation, but since this was the only sample which was adequate for C¹⁴ measurement, it was taken up for dating. Site excavated by the Inst. of Archaeol. of Allahabad Univ. under the supervision of its Director, G. R. Sharma, who subm. the samples.

Kalibangan series, Rajasthan

The twin mounds of Kalibangan (29° 25' N Lat, 74° 05' E Long), District Sri Ganganagar, are located on the banks of Ghaggar (now dried). The site, discovered by Sir Aurel Stein, was identified as belonging to Harappa Culture by A. Ghosh. Excavations have been conducted under the joint supervision of B. B. Lal and B. K. Thapar since 1960 to 1961 (Lal, 1962). The site has yielded relics of Kalibangan Culture which preceded the Harappans. The Kalibangan Culture has some affinities with the Kot Diji pre-Harappan and pre-defence Cultures of Harappa itself. Samples subm. by A. Ghosh.

TF-150. Harappa Culture **3740 ± 100**
1790 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus ZE1, Qdt. 4, Layer 6, depth 1.35 m below surface, Field No. KLB-2, ZE1/C/1962-63-16. NaOH pretreatment was given. *Comment:* sample belongs to the latest levels of Harappa Culture at the site.

TF-139. Harappa Culture **3775 ± 100**
1825 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus XA8, Qdt. 2, Layer 6, depth 0.95 m below surface, Field No. KLB 2, XA8/C/1962-63-2. NaOH pretreatment was given. *Comment:* sample derives from the middle levels of Harappa Culture at the site.

TF-151. Harappa Culture **3800 ± 100**
1850 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus E1, Qdt. 1, Layer 17, depth 3.10 m below surface, Field No. KLB-2, E1/C/1962-63-17. *Comment:* sample belongs to the middle levels of Harappa Culture at the site.

TF-147. Harappa Culture **3865 ± 100**
1915 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus E1, Qdt. 1, Layer 23, depth 5.00 m below surface, Field No. KLB-2, E1/C/1962-63-13. NaOH pretreatment was given. *Comment:* sample from the lower middle levels of Harappa Culture at the site.

TF-145. Harappa Culture **3895 ± 100**
1945 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus XA8, Qdt. 3,

Layer 14, depth 2.25 m below surface, Field No. KLB-2, XA8/C/1962-63-10. NaOH pretreatment was given. *Comment*: sample derives from the lower middle levels of Harappa Culture at the site.

Kausambi series, Uttar Pradesh

Kausambi (25° 20' N Lat, 81° 23' E Long), modern Kosam, is situated on the northern bank of Yamuna. According to the Puranas, the capital of the Pandavas was shifted from Hastinapur to Kausambi at the time of Nichaksu, fifth in descent from Parikshita, the grandson of Arjuna. The measured samples cover Periods III and IV of the site (Sharma, 1960). Site excavated every year during past decade by Allahabad Univ. under direction of G. R. Sharma who subm. these samples.

TF-98. Period IV **1470 ± 90**
A.D. 480

Charcoal (mixed with earth) from Trench KSB-G/R-E6, Locus XXXIII-XXXIV, Pit sealed by Layer 2, depth 1.25 m below surface, Field No. KSB/63/GR-101. Visible rootlets were hand-picked. *Comment*: sample is derived from the debris of Huna invasion.

TF-93. Period IV **1655 ± 105**
A.D. 295

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 3-5, Layer 4, Field No. KSB/63/AP-1, depth 1.25 m below surface from Asokan Pillar area. Visible rootlets were hand-picked.

TF-97. Period IV **1640 ± 105**
A.D. 310

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 2-5, Layer 6, Field No. KSB/63/AP-5, depth 1.65 to 1.7 m below surface from Asokan Pillar area. Visible rootlets were hand-picked.

TF-94. Period IV **1945 ± 90**
A.D. 5

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 4-5, Road VI, depth 1.33 m below surface, Field No. KSB/63/AP-2. Visible rootlets were hand-picked.

TF-95. Period IV **1840 ± 115**
A.D. 110

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 4-6, Road V, depth 1.44 m below surface, Field No. KSB/63/AP-3. Visible rootlets were hand-picked.

TF-96. Period IV **2005 ± 95**
55 B.C.

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 4-6, Road IV, depth 2.03 m below surface, Field No. KSB/63/AP-4. Visible rootlets were hand-picked.

TF-100. Period III **2160 ± 95**
210 B.C.

Charcoal (mixed with earth) from Trench KSB-G/R-YZ2, Locus 1-2, Pit A sealed by Layer 18A, BK, depth 2.15 m below surface, Field No. KSB/63/

GR-103. Visible rootlets were hand-picked. *Comment*: sample derives from the last phase of N.B.P. Ware from Ghositarama area.

TF-62. Kudan, Nepal, early medieval temple **TF-62a 1020 ± 100**
TF-62b 850 ± 95

935 ± 70
A.D. 1015

Charred wood (mixed with earth) from Kudan (27° 32' N Lat, 83° 2' E Long), Layer 3, depth 1.55 m, Field No. Kudan D6, from a temple door frame. Visible rootlets were hand-picked. NaOH pretreatment was given. Subm. by A. Ghosh.

TF-77. Mohanur, India, burials **330 ± 100**
A.D. 1620

Bone sample from Mohanur (10° 30' N Lat, 79° 05' E Long), Salem District. Sample is believed to have derived from the accidental discovery of the "vestigeal urn burials" on the banks of Kaveri River. Subm. by Satyamurti, State Mus., Madras.

TF-75. Mohenjodaro, W. Pakistan, Harappa Culture **3600 ± 110**
1650 B.C.

Clean charred grain from Mohenjodaro (27° 19' N Lat, 68° 8' E Long), Sind. Locus: Chamber 60, Block-2, from the pavement of a 'late date', depth 1.27 m below datum, Field No. L855, as recorded in Marshall's report. Since A.D. 1925 the sample has been kept sealed in a glass bottle in the Safdarjang-Collection, New Delhi. Subm. by A. Ghosh. *Comment*: this is the first C¹⁴ date for the late Harappan levels of Mohenjodaro.

Nagarjunakonda series, Andhra Pradesh

The extensive site of Nagarjunakonda (16° 31' N Lat, 79° 14' E Long) is situated in Guntur District. Excavations were conducted by Dr. Subramanyham of the Survey during 1954 to 1961 (Ghosh, 1954-61). The samples described below are believed to have all derived from the Neolithic cemetery (ca. 2000 B.C.). Samples subm. by A. Ghosh. *Comment*: the C¹⁴ dates obtained are in complete disagreement with the archaeological estimates. As there was no sealing deposit over these graves, later disturbances and possibilities of misidentification cannot be ruled out.

TF-73. Burials **1495 ± 105**
A.D. 455

Soft and spongy human bones from the Neolithic cemetery. Grave No. 4, Skeleton No. 6, depth 40 cm below surface.

TF-72. Burials **1525 ± 95**
A.D. 425

Soft and spongy human bones from the Neolithic cemetery. Grave No. 6, Skeleton No. 8, depth 52 cm below surface.

TF-30. Burials **1535 ± 95**
A.D. 415

Animal bones laden with ash from a Neolithic pit No. 44, Site 46, Sec. NV, Div. 362, Trench A3, depth 1.2 m to 1.5 m below surface.

TF-63b. Burials**1750 ± 100****A.D. 200**

Soft and spongy human bones from the Neolithic cemetery, Grave No. 5. Skeleton No. 7, depth 35 cm below surface.

TF-74. Burials**1900 ± 95****A.D. 50**

Soft and spongy human bones from Neolithic cemetery. Grave No. 8, Skeleton No. 10, depth 50 cm below surface.

TF-61. Rajar Dhibi, India, Period V**1230 ± 105****A.D. 720**

Charcoal sample (mixed with soil) from Rajar Dhibi (23° 34' N Lat, 87° 39' E Long) from District Burdwan, W. B., Trench No. RDB IV, Locus: 0-II, depth 1 m, Layer 2C. Subm. by P. Dasgupta. Visible rootlets were hand-picked. NaOH pretreatment was given. *Comment*: this is the first time that the latest period of this culture has been dated. No definite datable archaeological evidence seems to be available at present to determine the chronology of these cultures of West Bengal.

REFERENCES

Date lists:

- Lamont III Broecker, Kulp and Tucek, 1956
 Pennsylvania VI Stuckenrath, 1963
 Tata Institute I Kusumgar, Lal and Sarna, 1963
- Agrawal, D. P., 1964, New evidence for shorter Harappan chronology: in press.
 Broecker, W. S., Kulp, J. L., and Tucek, C. S., 1956, Lamont natural radiocarbon measurements III: Science, v. 124, p. 154-165.
 Gadd, C. J., 1932, Seals of ancient Indian style found at Ur: British Acad. Proc., v. 18, p. 191-210.
 Ghosh, A., 1954-61, Indian archaeology—a review: Archaeol. Survey of India.
 Kusumgar, S., Lal, D., and Sharma, V. K., Radiocarbon dating techniques, 1963a: Indian Acad. Sci. Proc., v. 58, sec. A, no. 3, p. 125-140.
 Kusumgar, S., Lal, D., and Sarna, R. P., 1963b, Tata institute date list I: Radiocarbon, v. 5, p. 273-282.
 Lal, B. B., 1962, A new Indus Valley provincial capital discovered, excavation at Kalibangan in Northern Rajasthan: Illus. London News, v. 240, p. 454-457.
 Sharma, G. R., 1960, The Excavation at Kausambi (1957-59): Inst. Archaeol., Allahabad Univ. Pub. no. 1.
 Stuckenrath, R. Jr., 1963, University of Pennsylvania radiocarbon dates VI: Radiocarbon, v. 5, p. 82-103.
 Wheeler, R. E. M., 1959, Early India and Pakistan: London, Thames & Hudson.