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# TATA INSTITUTE RADIOCARBON DATE LIST V

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The $C^{14}$ dates presented here were obtained by counting methane, using the technique described earlier (Agrawal *et al.,* 1965a). In accordance with the decision of the Sixth Pullman Conference (Internat. Conf., Pullman, 1965) and the editors' advice we continue to give dates based on $\tau 1/2 = 5568$ years. For converting dates to A.D./B.C. scale, 1950 has been used as reference year. Ninety-five per cent activity of N.B.S. oxalic acid has been used as modern standard.

This date list comprises 3 categories of samples: archaeologic, geophysical, and geologic. Highlights of $C^{14}$ dates of archaeologic samples (Ghosh, 1961-64) are given below.

### GENERAL COMMENT

Mula Dam (TF-345 and -217) and Sankhu (TF-189) samples date Pleistocene deposits for the first time in India, thus marking beginning of late Pleistocene chronology of associated human cultures. Early microlithic phase at Adamgarh rock-shelters (TF-120) appears to be ca. 5000 B.C., but more samples are needed for verification.

Neolithic sites Utnur (Tata Institute III), Tekklakota (Tata Institute IV), and now T. Narsipur, Hallur, and Sangankallu (present date list) were extensively dated. A time-spread of ca. 2300 to 1000 B.C. covers the southern Neolithic culture. More interesting are $C^{14}$ dates of late Neolithic (TF-575) and those overlapping Megalithic (TF-573 and -570) which date beginning of Megalithic culture to onset of 1st millennium B.C. Iron emerges with beginning of 1st millennium B.C. both in the South and the North. But the advent of iron in the East is much later, though definitely pre-Mauryan, as proved by Chirand (TF-336, Tata Institute IV) and Mahisdal (TF-389, present date list). These may be significant clues to understanding protohistoric migrations.

Kayatha, which was extensively dated, gives fairly complete Chalcolithic sequence. Sonegaon confirms previous chronology of Jorwe culture.

Kotia series, of Doab megaliths, and Lekhahia series, of rock-shelters, give almost modern dates. This could be due either to interrupted stratification or poor sample identification.

### ACKNOWLEDGMENTS

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## SAMPLE DESCRIPTIONS

### I. ARCHAEOLOGIC SAMPLES

**Adamgarh series, Madhya Pradesh**

Adamgarh (22° 43′ N Lat, 77° 44′ E Long), Dist. Hoshangabad, is microlithic site with rock-shelters, excavated by R. V. Joshi and M. D.

Khare in 1961. Samples subm. by A. Ghosh, Director General of Archaeol., New Delhi-ll.

**2765 ± 105**

**TF-116. Rock-shelter** **815 B.C.**

Uncharred bones from Trench ADG2, Layer 3, depth 1.90 m, Field No. II. *Comment:* only inorganic fraction dated; probability of contamination high.

**7240 ± 125**

**TF-120. Rock-shelter** **5290 B.C.**

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 other bones from Adamgarh can alone confirm chronology of this Mesolithic culture.

**650 ± 95**

**TF-296. Ahichchhatra** **A.D. 1300**

Charcoal from Ahichchhatra (28° 22′ N Lat, 79° 7′ E Long), Dist. Bareilly, High Mound, Locus VIII′-IX′, Layer 15, depth 0.31 m, Sample No. 24, Field No. 194 (H.M.). Subm. by A. Ghosh. *Comment:* archaeological date not given.

**1845 ± 95**

**TF-195. Atranjikhera, India, Period IV** **A.D. 105**

Charcoal from Atranjikhera (27° 42′ N Lat, 78° 44′ E Long), Dist. Etah, Trench ARJ-4, Locus Al NW, Layer 14, depth 2.15 m, Field No. ARJ 4 (Al NW). NaOH pretreatment was also given. Subm. by Nurul Hasan, Aligarh Univ., Aligarh.

**2350 ± 100**

**TF-387. Besnagar, India, N.B.P. ware deposits** **400 B.C.**

Charcoal from Besnagar (23° 32′ N Lat, 77° 48′ E Long), Dist. Vidisha, BSN-4, Locus G'l, Layer 8, depth 3.00 to 3.15 m, Field No. 1850. NaOH pretreatment was also given. Subm. by A. Ghosh.

**Eran series, Madhya Pradesh**

Eran (24° 5′ 16″ N Lat, 78° 10′ 24″ E Long), Dist Sagar. Site being excavated by U. B. Singh, directed by — Head, Dept. of Ancient Indian History, Culture, and Archaeol., Univ. of Sagar, Sagar, who subm. samples.

**2905 ± 105**

**TF-326. Period IIa** **955 B.C.**

Charcoal from ERN7, Locus IV′-IX′, Layer 16, depth 6.3 m, Sample No. ERN7/C/62-63/3. *Comment:* sample derives from Pd. IIa, immediately following Chalcolithic period.

**3130 ± 105**

**TF-324. Period IIa** **1180 B.C.**

Charcoal from ERN7, Locus O′-IV′, Layer 14, depth 5.3 m, Sample No. ERN7/C/62-63/1. *Comment:* sample derives from Pd. IIa following Chalcolithic period.

**3220 ± 100**

**TF-330. Period I** **1270 B.C.**

Charcoal from ERN7, Locus IV′-IX′, Layer 20, depth 7.7 m, Sample No. ERN7/C/62-63/7. *Comment:* belongs to a middle level of Chalcolithic period.

**3280 ± 100**

**TF-327. Period I** **1330 B.C.**

Charcoal from ERN 7, Locus VI′-IX′, Layer 17, depth 6.8 m, sample No. ERN7/C/62-63/4. *Comment:* belongs to Chalcolithic period.

**3300 ± 105**

**TF-329. Period I** **1350 B.C.**

Charcoal from ERN7, Locus VI′-IX′, Layer 19, depth 7.5 m, Sample No. ERN7/C/62-63/6.

**3355 ± 90**

**TF-331. Period I** **1405 B.C.**

Charcoal from ERN7, Locus IV′-IX′, Layer 21, depth 8.0 m, Sample No. ERN7/C/62-63/8. *Comment:* compare TF-330, 3220 ± 100 from Layer 20 of same trench.

*General Comment:* $C^{14}$ dates clearly show no great time gap between Pd. IIa and Pd. I. Pd. IIa of Eran is evidently earlier than Navdatoli Period IV (if samples are authentic).

**Hallur series, Mysore**

Hallur (14° 20′ N Lat, 75° 37′ E Long), Dist. Dharwar, recently excavated by M. S. Nagaraj Rao, Curator, Karnatak Univ., Dharwar-3, who subm. samples. Hallur gives sequence from Neolithic to Megalithic phases.

**3560 ± 105**

**TF-580. Early Neolithic period** **1610 B.C.**

Charcoal from Trench 1, Layer 14, depth 6.1 to 6.4 m, Sample No. 11, Field No. HLR/1965. Visible rootlets were handpicked. NaOH pretreatment was also given.

**2895 ± 100**

**TF-575. Late Neolithic period** **945 B.C.**

Charcoal from Trench 1, Layer 7, depth 3.2 m, Sample No. 6, Field No. HLR/1965. NaOH pretreatment was also given. *Comment* (M.S.N.): sample derives from latest Neolithic phase just prior to the arrival of Megalithic people.

**2820 ± 100**

**TF-573. Overlap phase** **870 B.C.**

Charcoal from Trench 1, Layer 5, depth 2.5 to 3.5 m, Sample No. 4, Field No. HLR/1965. NaOH pretreatment was also given. *Comment:* belongs to Megalithic-Neolithic phase.

**2970 ± 105**

**TF-570. Overlap phase** **1020 B.C.**

Charcoal from Trench 1, Layer 4, depth 1.80 to 2.10 m, Sample No. 1, Field No. HLR/1965. NaOH pretreatment was also given. *Comment:* belongs to Megalithic-Neolithic Overlap phase.

**4070 ± 95**

**TF-611. Har Raipur, India** **2120 B.C.**

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

**Kalibangan series, Rajasthan**

Kalibangan (29° 25′ N Lat, 74° 05′ E Long), Dist. Sri Ganganagar, was provincial capital of Harappa culture. Site also yields remains of pre-Harappa culture. Excavations are being jointly conducted by B. B. Lal and B. K. Thapar. Samples subm. by A. Ghosh. Earlier period is termed Kalibangan Period I and later period, Harappan, Kalibangan Period II, by the excavators.

**3810 ± 105**

**TF-605. Harappa culture** **1860 B.C.**

Charcoal from Trench KLB-1, Locus ZB-9, Qd. 3, Layer 10, depth 1.6 m, Field No. KLB-1, ZB.9, Qd.3/C/1965-66-7. NaOH pretreatment was also given. *Comment:* belongs to late phase of citadel fortification.

**3930 ± 120**

**TF-607. Harappa culture** **1980 B.C.**

Charred wheat and charcoal bits from Trench KLB-2, Locus A8, Qd. 2 Layer 18, depth 4.10 m, Field No. KLB-2, A-8, Qd.1/C/1965-66-9.

**3910 ± 110**

**TF-608. Harappa culture** **1960 B.C.**

Charred wheat from Trench KLB-2, Locus A-6, Qd. 2, Layer 18, depth 4.50 m, Field No. KLB-2, A-6, Qd.2/C/1965-66-10.

*General Comment:* to reduce risk of contamination, samples were coll. from early levels with thick soil cover. TF-607 and TF-608 are from early phase.

**Kayāthā series, Madhya Pradesh**

Kayāthā (23° 30′ N Lat, 76° E Long), Dist. Ujjain. Site is being excavated by V. S. Wakankar, Vikram Univ., Ujjain, who subm. samples.

**2380±95**

**TF-394. Pre-Mauryan** **430 B.C.**

Charcoal from Trench KTH-1, Layer 23, depth 5.80 m, Field No. 2. NaOH pretreatment was also given.

**3575 ± 105**

**TF-396. Chalcolithic culture** **1625 B.C.**

Charcoal from KTH-1, Layer 32, depth 7.80 m, Field No. 5. NaOH pretreatment was also given.

**3350 ± 100**

**TF-397. Chalcolithic culture** **1400 B.C.**

Charcoal from KTH-1, Layer 33, depth 8 m, Field No. 7. NaOH pretreatment was also given.

**3525 ± 100**

**TF-399. Chalcolithic culture** **1575 B.C.**

Charcoal from KTH-1, Layer 37, depth 9.1 m, Field No. 8. NaOH pretreatment was also given.

**3800 ± 105**

**TF-400. Chalcolithic culture** **1850 B.C.**

Charcoal from KTH-1, Layer 38, depth 9.60 m, Field No. 9. NaOH pretreatment was also given.

**3190 ± 105**

**TF-401. Chalcolithic culture** **1240 B.C.**

Charcoal from KTH-1, Layer 39, depth 10 m, Field No. 10. NaOH pretreatment was also given. *Comment:* date is younger than expected.

**3240 ± 100**

**TF-402. Chalcolithic culture** **1290 B.C.**

Charred wheat from KTH-1, Layer 35, depth not given, Field No. 11. NaOH pretreatment was also given. *Comment:* date is younger than expected.

**TF-207. Kilayur, India, Black-and-Red ware deposits** **2200 ± 100** **250 B.C.**

Wood from Kilayur (11° 77′ N Lat, 79° 82′ E Long), Dist. Thanjvur, Madras, from Trench KLR-1, Locus $A_2$, Layer 4, depth 1.25 m, Field No. 1/63, subm. by A. Ghosh. *Comment:* post was embedded in back waters of sea.

**Kotia series, Uttar Pradesh**

Kotia (24° 55′ N Lat, 82° 25′ E Long), Dist. Allahabad, site being excavated by G. R. Sharma, Inst. of Archaeol., Allahabad Univ., Allahabad, who subm. samples. Samples are from iron-bearing megaliths.

**220 ± 95**

**TF-318. Megalithic culture (?)** **A.D. 1730**

Charcoal from Kotia-Meg.-I, depth 0.15 to 0.3 m, Field No. KTA (A) 64/3501. Visible rootlets were removed. NaOH pretreatment was also given.

**480 ± 95**

**TF-320. Megalithic culture (?)** **A.D. 1470**

Charcoal from Kotia-Meg.-IV, depth 0.15 to 0.6 m, Field No. KTA (A)64/3504. NaOH pretreatment was also given.

**570 ± 95**

**TF-322. Megalithic culture (?) A.D. 1380**

Charcoal from Kotia-Meg.-VA, depth 0.15 to 0.25 m, Field No. KTA (A)64/3506. Visible rootlets were removed. NaOH pretreatment was also given.

**965 ± 100**

**TF-321. Megalithic culture (?) A.D. 985**

Charcoal from Kotia-Meg.-V, depth 0.25 to 0.35 m, Field No. KTA (A) 64/3505. Visible rootlets were removed. NaOH pretreatment was also given.

**2135 ± 100**

**TF-319. Megalithic culture 185 B.C.**

Charcoal from Kotia-Meg.-II, depth 0.1 to 0.55 m, Field No. KTA (A)64/3502. Visible rootlets were removed. NaOH pretreatment was also given.

*General Comment:* except for TF-319, other samples are modern. To verify this divergence, four samples were dated; all were recent. This could be possible only if modern charcoal were mixed with samples. Natural contamination of this magnitude is ruled out.

**Lekhahia series, Uttar Pradesh**

Lekhahia (24° 80′ 5″ N Lat, 82° 32′ E Long), Dist. Mirzapur. Site is being excavated by G. R. Sharma who subm. samples.

**140 ± 90**

**TF-343. Rock-shelter A.D. 1810**

Charcoal from Trench LKH(M)-RS-I, Pit B sealed by Layer 1, depth 0.15 m, Field No. LKH (M)64/3006. NaOH pretreatment was also given.

**155 ± 90**

**TF-341. Rock-shelter A.D. 1795**

Charcoal from Trench LKH(M)-RS-I, Pit A sealed by Layer 1, depth 0.12 m, Field No. LKH(M)64/3004. NaOH pretreatment was also given.

**180 ± 110**

**TF-342. Rock-shelter A.D. 1770**

Charcoal from Trench LKH(M)-RS-I, Pit B sealed by Layer 1, depth 0.10 m, Field No. LKH(M)64/3005. NaOH pretreatment was also given.

**TF-344. Rock-shelter Modern**

Charcoal from Trench LKH(M)-RS-II, Layer 1, depth 0.02 m, Field No. LKH(M)64/3007. NaOH pretreatment was also given.

*General Comment:* samples seem to be heavily mixed with modern charcoal. Rock-shelters were used by shepherds to light fires till modern times. All samples derive from Layer 1 levels only. Four samples were measured, but to no avail.

**Mahisdal series, West Bengal**

Mahisdal (23° 42′ 45″ N Lat, 87° 41′ 33″ E Long), Dist. Birbhum. Site was excavated by R. P. Das; samples subm. by A. Ghosh.

**2565 ± 105**

**TF-389. Early Iron age** **615 B.C.**

Charcoal from Trench MDL-1, Locus XI′-XII′, Pit 2 sealed by 1B, depth 0.55 m, Field No. MDL-1/C/64-1. Visible rootlets were hand-picked. NaOH pretreatment was also given.

**2725 ± 100**

**TF-390. Chalcolithic culture** **775 B.C.**

Charred rice from Trench MDL-1, Locus I-II, Layer 4, depth 1.45 m, Field No. MDL-1/C/64-2. NaOH pretreatment was also given. *Comment:* from late phase.

**2950 ± 105**

**TF-392. Chalcolithic culture** **1000 B.C.**

Charcoal from Trench MDL-1, Locus IV-VI, Layer 5, depth 1.30 m, Field No. MDL-1/C/64-4. Visible rootlets were removed. NaOH pretreatment was also given. *Comment:* from middle phase.

**3235 ± 105**

**TF-391. Chalcolithic culture** **1285 B.C.**

Charcoal from Trench MDL-1, Locus VII-VIII, Pit 3 sealed by Layer 5, depth 1.61 m, Field No. MDL-1/C/64-3. *Comment:* from middle phase.

*General Comment:* $C^{14}$ dates for this eastern protohistoric site conform to new chronological framework. Iron in the region is pre-Mauryan.

**520 ± 90**

**TF-373. Mailaram, India** **A.D. 1430**

Charcoal from Mailaram (17° 43′ N Lat, 80° 37′ E Long), Dist. Khammam, Andhra Pradesh. Coll. from trench in an old slag heap, depth 1 m, Field No. SK3, Sample No. 1. Visible rootlets were hand-picked. NaOH pretreatment was also given. Subm. by S. N. Sen, Geological Survey of India, Hyderabad. *Comment:* sample indicates earlier co )per mining activity in area.

**1420 ± 95**

**TF-347. Mainahai, India, historic levels** **A.D. 530**

Charcoal from Mainahai (25° 21′ N Lat, 81° 25′ E Long), Dist. Allahabad, Uttar Pradesh, from Trench MNH/BWN-1, Locus 0-3, Layer 6 N, depth 0.75 m, Field No. MNH/64/901. NaOH pretreatment was also given. Subm. by G. R. Sharma. *Comment:* date agrees with archaeol. estimates.

**Mula Dam series, Maharashtra**

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

**TF-345. Pleistocene deposits** **31,075** $^{+5550}_{-3254}$

Wood from "Pleistocene deposits" at R.L. 1640 from old bed of Mula River, Sample No. 2. NaOH pretreatment was also given. *Comment:* from uppermost alluvium few Middle Stone age and Late Stone age tools were recovered. Error given with date is 2 std. 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.

**Nagara series, Gujarat**

Nagara (22° 41′ 15″ N Lat, 72° 38′ 31″ E Long), Dist. Kaira. Site was excavated by R. N. Mehta, Dept. of Archaeol., M. S. Univ., Baroda, India, who subm. samples.

**TF-362. Historic sample** **1945 ± 90 A.D. 5**

Charcoal from NGR II, Tr. III, Layer 13, depth 3.3 m, Field No. 1947. NaOH pretreatment was also given.

**TF-364. Historic sample** **2030 ± 100 80 B.C.**

Charcoal from NGR II (?), Tr. III, Layer 16, depth 4.4 m, Field No. 1949.

*General Comment:* $C^{14}$ dates agree with excavator's estimates.

**TF-651. Nam Pong 7, Thailand, Early Bronze age** **4155 ± 200 2205 B.C.**

Charcoal from Nam Pong 7 (16° 50′ N Lat, 102° 30′ E Long), Square ES, Layer 19, depth 1.2 m, Bag No. 1810E. Subm. by W. G. Solheim II, Dept. of Anthropol., Univ. of Hawaii, Hawaii, U.S.A.

**TF-370. Saradkel, India, "Asura" culture** **1795 ± 100 A.D. 155**

Charcoal from Saradkel (23° 3′ 30″ N Lat, 85° 21′ E Long), Dist. Ranchi, Trench SDK-2, Locus A1-A2, Layer 3, depth 0.07 m. (?), Field No. SDK-2/65-248.

**Sangankallu series, Mysore**

Sangankallu (15° 11′ N Lat, 76° 58′ E Long), Dist. Bellary, was excavated first by the late Subba Rao. Excavations were resumed recently by H. D. Sankalia who subm. samples.

**TF-359. Neolithic period** **3400 ± 100 1450 B.C.**

Charcoal from Trench 1-2, Layer 4, depth 2.4 m, Field No. SKL/Tr.1-2/64-65/568. Visible rootlets removed. NaOH pretreatment was also given. *Comment:* sample comes from an early level.

**3435 ± 100**

**TF-355. Neolithic period** **1485 B.C.**

Charcoal from Trench SKL S. Rao's II, Layer 2, depth 1.4 m, Field No. SKL S. Rao's II/64-65/474. Visible rootlets were handpicked. NaOH pretreatment was also given.

**3440 ± 100**

**TF-354. Neolithic period** **1490 B.C.**

Charcoal from Trench 1-2, Layer 3, depth 2.5 m, Field No. SKL/Tr. 1-2/64-65/393. NaOH pretreatment was also given. *Comment:* sample belongs to an early level.

**+ 3220**

**TF-189. Sankhu, Nepal** **29,115**

**− 2285**

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

**Sonegaon series, Maharashtra**

Sonegaon (18° 39′ N Lat, 74° 5′ E Long), Dist. Poona. Site is being excavated by H. D. Sankalia, who subm. samples.

**3150 ± 90**

**TF-379. Jorwe culture** **1200 B.C.**

Charred grain from Mound II, Layer 2b, depth 1.2 m, Field No. 69. Visible rootlets removed.

**3185 ± 100**

**TF-383. Jorwe culture** **1235 B.C.**

Charcoal from a corner of baulk-cutting, depth 4.3 m, Field No. 303, NaOH pretreatment was also given.

**3195 ± 100**

**TF-382. Jorwe culture** **1245 B.C.**

Charred wheat from Mound II, Layer 5, depth 2.2 m, Field No. 136.

**3230 ± 105**

**TF-380. Jorwe culture** **1280 B.C.**

Charcoal from Mound II, Layer 4, depth 1.8 m, Field No. 120. Visible rootlets removed. NaOH pretreatment was given.

**3415 ± 105**

**TF-384. Jorwe culture** **1465 B.C.**

Charcoal from Mound II, Layer 7, depth 2.36 m, Field No. 321. Visible rootlets were handpicked. NaOH pretreatment was also given.

*General Comment:* Site is similar to Jorwe and Nevasa. $C^{14}$ dates also confirm its assignment to late Chalcolithic period.

**T. Narsipur series, Mysore**

T. Narsipur (12° 13′ N Lat, 76° 55′ E Long), Dist. Mysore, was excavated by M. Seshadri, Dept. of Archaeol., Mysore, who subm. samples.

**220 ± 90**

**TF-414. Megalithic culture** **A.D. 1730**

Charcoal from T.N. 24A, Locus C-D, Layer 3A, depth 0.68 m, Sample No. 3, 1965. Visible rootlets were handpicked. *Comment:* sample is much younger than expected.

**3345 ± 105**

**TF-413. Neolithic culture** **1395 B.C.**

Charcoal from T.N. 24A, Locus C-D, Pit IV, sealed by Layer 6 (?), depth 1.8 m, Sample No. 2, 1965.

**3645 ± 105**

**TF-412. Neolithic culture** **1695 B.C.**

Charcoal from T.N. 24A, Locus A-B, Layer 6, depth 1.6 m, Sample No. 1, 1965. NaOH pretreatment was also given.

*General Comment:* $C^{14}$ dates appear to assign a middle phase to T. Narsipur in the general Neolithic time-spread.

## II. GEOPHYSICAL SAMPLES

### *$C^{14}$ in Atmospheric Carbon Dioxide*

The $C^{14}/C^{12}$ ratio in atmospheric $CO_2$ was measured for 3 stations: (1) Gulmarg 34° 04′ N Lat, 74° 25′ E Long), alt. 2745 m; (2) Bombay (18° 56′ N Lat, 72° 51′ E Long), sea level; and (3) Kodaikanal (10° 15′ N Lat, 77° 31′ E Long), alt. 2300 m. Carbonate-free 0.1 N NaOH solution was exposed in enamel trays. Evaporation losses were made up by adding weakly acidified tap water. At Gulmarg, during winter and spring, electric heaters were placed below enamel trays to keep temperature of the exposed solution well above freezing point.

The following tables give exposure time of NaOH solution to atmospheric air and the observed per cent excess of $C^{14}$ in the atmospheric $CO_2$ samples above the reference level of 1890 wood (corrected for decay), *i.e.*, 0.95 N.B.S. oxalic acid.

Table 1. Atmospheric Radiocarbon Activity series, Gulmarg

| *Sample No.* | *Exposure Dates* | $\delta C^{14}‰$ |
|---|---|---|
| TF-457 | Nov. 19, 1963 — Nov. 30, 1963 | 77.37 ± 2.37 |
| TF-459 | Dec. 16, 1963 — Dec. 31, 1963 | 82.38 ± 2.10 |
| TF-461 | Jan. 16, 1964 — Jan. 31, 1964 | 81.95 ± 1.78 |
| TF-462 | Feb. 1, 1964 — Feb. 15, 1964 | 79.44 ± 1.91 |
| TF-464 | April 1, 1964 — April 15, 1964 | 79.37 ± 1.78 |
| TF-466 | May 1, 1964 — May 15, 1964 | 81.17 ± 1.77 |
| TF-468 | June 1, 1964 — June 15, 1964 | 84.08 ± 2.02 |
| TF-469 | June 15, 1964 — July 1, 1964 | 91.79 ± 1.95 |
| TF-470 | July 1, 1964 — July 15, 1964 | 85.23 ± 2.06 |
| TF-471 | July 15, 1964 — Aug. 1, 1964 | 88.89 ± 2.01 |

Table 1. (cont'd.)

| *Sample No.* | *Exposure Dates* | $\delta C^{14}\%$ |
|---|---|---|
| TF-472 | Aug. 1, 1964 – Aug. 15, 1964 | 79.13 ± 1.94 |
| TF-475 | Sept. 15, 1964 – Oct. 1, 1964 | 76.15 ± 1.81 |
| TF-478 | Nov. 1, 1964 – Nov. 15, 1964 | 79.56 ± 2.22 |
| TF-481 | Dec. 15, 1964 – Jan. 1, 1965 | 72.19 ± 1.90 |
| TF-482 | Jan. 1, 1965 – Jan. 15, 1965 | 81.99 ± 2.00 |
| TF-483 | Jan. 15, 1965 – Feb. 1, 1965 | 74.58 ± 1.94 |
| TF-486 | Mar. 1, 1965 – Mar. 15, 1965 | 73.71 ± 1.68 |
| TF-487 | Mar. 15, 1965 – April 1, 1965 | 77.31 ± 1.83 |
| TF-489 | April 15, 1965 – May 1, 1965 | 90.29 ± 2.01 |

Table 2. Atmospheric Radiocarbon Activity series, Bombay

| *Sample No.* | *Exposure Dates* | $\delta C^{14}\%$ |
|---|---|---|
| TF-493 | Nov. 1, 1963 – Nov. 11, 1963 | 80.49 ± 2.01 |
| TF-494 | Aug. 1, 1964 – Aug. 11, 1964 | 64.10 ± 1.83 |
| TF-496 | Aug. 26, 1964 – Sept. 4, 1964 | 65.66 ± 1.75 |
| TF-547 | Nov. 16, 1964 – Nov. 30, 1964 | 77.70 ± 1.97 |

Table 3. Atmospheric Radiocarbon Activity series, Kodaikanal

| *Sample No.* | *Exposure Dates* | $\delta C^{14}\%$ |
|---|---|---|
| TF-503 | Nov. 16, 1963 – Dec. 1, 1963 | 74.26 ± 2.58 |
| TF-505 | Dec. 16, 1963 – Dec. 31, 1963 | 72.10 ± 1.69 |
| TF-506 | Dec. 31, 1963 – Jan. 13, 1964 | 69.76 ± 1.70 |
| TF-507 | Jan. 13, 1964 – Jan. 23, 1964 | 68.56 ± 1.57 |
| TF-510 | Mar. 2, 1964 – Mar. 16, 1964 | 70.45 ± 1.83 |
| TF-511 | Mar. 16, 1964 – Mar. 31, 1964 | 71.47 ± 1.83 |
| TF-514 | May 1, 1964 – May 16, 1964 | 76.61 ± 1.92 |
| TF-516 | June 1, 1964 – June 16, 1964 | 77.17 ± 1.96 |
| TF-517 | June 16, 1964 – July 3, 1964 | 76.48 ± 1.95 |
| TF-519 | July 16, 1964 – July 31, 1964 | 76.48 ± 1.94 |
| TF-521 | Aug. 16, 1964 – Sept. 1, 1964 | 77.39 ± 1.93 |
| TF-523 | Sept. 16, 1964 – Oct. 1, 1964 | 71.89 ± 1.89 |
| TF-526 | Nov. 1, 1964 – Nov. 11, 1964 | 80.06 ± 1.95 |
| TF-529 | Dec. 15, 1964 – Dec. 31, 1964 | 73.27 ± 1.75 |
| TF-531 | Jan. 15, 1965 – Feb. 1, 1965 | 75.06 ± 1.83 |
| TF-534 | Mar. 1, 1965 – Mar. 15, 1965 | 77.21 ± 1.64 |
| TF-537 | April 16, 1965 – May 1, 1965 | 72.67 ± 1.76 |

**Red Sea piston core series**

Sediment samples subm. by Dr. Y. Herman, Washington Univ., Pullman, in connection with paleoclimatological studies. Errors quoted below are only $1\sigma$, though, generally, $2\sigma$ errors are given for samples of this age range.

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**22,050 ± 600**

**TF-450. Core No. V14-118(a) 20,100 B.C.**

Whole sediment, a foraminiferal and pteropodal calci-lutite from 150 to 180 cm. below top. Core taken at depth of 516 m (18° 37′ N Lat, 39° 03′ E Long).

**24,585 ± 1000**

**TF-455. Core No. V14-118(b) 22,635 B.C.**

Whole sample, a foraminiferal and pteropodal calci-lutite from 220 to 250 cm below top. Sediments deposited during a short, mild oscillation within Last Glacial. *Comment:* due to possible contamination by recent carbon, age should be considered a minimum.

**7615 ± 125**

**TF-451. Core No. V14-122 5665 B.C.**

Coarse fraction (>62$\mu$), mainly planktonic Foraminifera and Pteropoda from depth of 30 to 50 cm in core. Core taken at depth of 1486 m. (23° 55′ N Lat, 36° 28′ E Long). Sample comes from just above organic-rich black layer of sapropelitic mud, therefore dates time since last stagnation of basin.

**29,445 ± 1045**

**TF-453. Core No. V14-123(a) 27,495 B.C.**

Whole sediment, a foraminiferal and pteropodal calci-lutite, from 170 to 190 cm below top. Core taken at depth of 816 m. (24° 02′ N Lat, 36° 02′ E Long). Dated sediments were deposited during Last Glaciation.

**35,195 ± 1825**

**TF-449. Core No. V14-12(b) 33,245 B.C.**

Whole sediment, a foraminiferal and pteropodal calci-lutite from 200 to 230 cm below top.

**30,385 ± 1165**

**TF-454. Core No. V14-125 28,435 B.C.**

Whole sediment, a foraminiferal and pteropodal calci-lutite from 170 to 200 cm below top. Core taken at depth of 956 m. (26° 57′ N Lat, 34° 38′ E Long).

### III. GEOLOGIC SAMPLES

**Chavara-Kayankulam series, India**

Chavara-Kayankulam coast (8° 49′ N Lat, 76° 30′ E Long), Kerala. Samples subm. by G. Prabhakar Rao, Atomic Minerals Div., Dept. of Atomic Energy, Shradhanandpeth, Nagpur-3.

**5470 ± 115**

**TF-203. Borehole No. 20 3520 B.C.**

Mollusc shells from off-shore borehole No. 20, depth 1.8 to 3.6 m, Field No. CKO/1.

**6120 ± 110**

**TF-204. Borehole No. 21** **4170 B.C.**

Mollusc shells from off-shore borehole No. 21, depth 3.9 to 5.2 m, Field No. CKO/2.

**6000 ± 120**

**TF-443. Dum-Dum, India** **4050 B.C.**

Wood (*Heretiera* sp.) from Dum-Dum near Calcutta, Dist. 24 Parganas. Sample No. 4 (a), Field No. IV. Paleobotanical sample subm. by A. K. Ghosh, Botany Dept., Calcutta Univ., Calcutta. NaOH pretreatment was given.

**10,815 ± 155**

**TF-612. Godavari delta, India** **8865 B.C.**

Shells from a core from Godavari Delta (16° 59′ N Lat, 82° 45′ E Long), depth 117 m. Subm. by Dr. Aswathanarayan, Andhra Univ., Waltair. *Comment:* date is minimum for marine facies of recent Godavari delta.

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