

BIRBAL SAHNI INSTITUTE RADIOCARBON MEASUREMENTS I

G RAJAGOPALAN, VISHNU-MITTRE, and B SEKAR

Birbal Sahni Institute of Palaeobotany, Lucknow, India 226007

The Radiocarbon Dating Laboratory of the Institute was established in 1974 primarily to assist in the program of research undertaken by the Institute's Department of Quaternary Palynology (Rajagopalan and Vishnu-Mittre, 1977). The measurements carried out by the Laboratory up to December 1977 are presented in this date list.

The specific activity of ^{14}C in samples is measured by counting methane synthesized from sample carbon (Agrawal *et al*, 1971) in an Oeschger-Houtermans gas proportional counter (Houtermans and Oeschger, 1958). The counter is filled to a pressure of 900mm mercury. The background and net NBS oxalic acid counting rates were close to 2.45cpm and 10.25cpm, respectively, throughout the measurement of the samples presented here. The experimental methods of methane synthesis are very similar to the ones described by Agrawal *et al* (1971). Samples are counted for 2500 minutes, initially, and a repeat counting for 1000 minutes is made after 30 days.

Dates are based on the value of 5570 years for the half-life of ^{14}C and 95% of the activity of NBS oxalic acid. The error on the date refers to 1σ value which is calculated taking into account the counting statistics, uncertainty in the half-life and instability in the counting system (Kusumgar *et al*, 1963; Kusumgar, 1973). $\delta^{13}\text{C}$ measurements have not been made on these samples.

We have carried out measurements of the specific activity of ^{14}C on a number of samples kindly supplied by D P Agrawal for cross-checking purposes. These samples are portions of well-dated charcoal samples from archaeological sites in India. Table 1 presents the comparison on measurements made at the Birbal Sahni Institute and at the Tata Institute Lab, Bombay.

ACKNOWLEDGMENTS

The Laboratory received help and encouragement from T S Sadashivan, ex-Chairman, and K R Surange, Director, Birbal Sahni Institute of Palaeobotany in the initial phases of setting up. Their continued encouragement and interest in the growth of the laboratory is gratefully acknowledged. With deep gratitude we thank D P Agrawal for his help in construction of the laboratory and in supplying some equipment. We also thank D Lal, Director, Physical Research Laboratory, B V Srekanth, Director, Tata Institute of Fundamental Research, and Rama for equipment and advice. We are grateful to H Oeschger for supplying the low-level counter.

Technical help from V S Panwar and P S Saluja are thankfully acknowledged.

The electronics units were constructed in the Electronics shop of the Physical Research Laboratory. One of us (G R) had the privilege of

learning design details of the glass system at the Radiocarbon Lab in the Physical Research Laboratory. We are indebted to D P Agrawal, the staff of Radiocarbon Lab and the staff of the Electronics shop for help and facilities extended.

We are thankful to the Director of the Central Drug Research Institute, Lucknow for the supply of liquid air.

SAMPLE DESCRIPTIONS

QUATERNARY SAMPLES

BS-2. Mandhata, Uttar Pradesh **4380 ± 130**

Carbonaceous sediments, depth 2 to 2.1m, from Horse Shore Lake, Mandhata (25° 40' N, 82° E), Dist Pratapgarh. Sample subm by H P Gupta, Birbal Sahni Inst Palaeobot (BSIP), Lucknow.

Kashmir series

Haigam Lake (34° 3' N, 74° 29' E), Kashmir Valley. Clayey organic sediment samples coll 1963 by Vishnu-Mittre & B D Sharma and subm by Vishnu-Mittre. Pollen diagram was previously pub (Vishnu-Mittre & Sharma, 1966).

BS-36. Carbonaceous clay **1640 ± 115**

Depth 4 to 5m.

BS-37. Carbonaceous clay **2120 ± 110**

Depth 5 to 6m.

Comment: pollen sequence was interpreted to date from Neolithic, *ie*, ca 5000 BP. ¹⁴C dates are younger.

TABLE I
Cross check samples

Sample/site	Birbal Sahni Inst age (yr)	Tata Inst TF no.	age (yr)	Ref
Charcoal Kalibangan	3925 ± 125	163	3910 ± 100	R, 1965, v 7, p 293
Charcoal Kalibangan	3570 ± 125	152	3615 ± 85	R, 1966, v 8, p 447
Charcoal Kalibangan	3585 ± 120	149	3675 ± 140	R, 1966, v 8, p 448
Charcoal Kalibangan	4010 ± 165	156	3740 ± 105	R, 1966, v 8, p 448
Charcoal Kayatha	3490 ± 125	777	3625 ± 95	R, 1969, v 11, p 503
Charcoal Taklaghat	2370 ± 120	784	2435 ± 95	R, 1969, v 11, p 504
Charcoal Inamgaon	2855 ± 150	923	2890 ± 170	R, 1971, v 13, p 85
Charcoal Nindwari	3840 ± 235	862	3900 ± 105	R, 1971, v 13, p 86
Charcoal Paiyampalli	1125 ± 100	829	985 ± 105	R, 1971, v 13, p 87
Carbonized kernals Lena Athula	7190 ± 155	1094	7640 ± 110	R, 1975, v 17, p 220

Tsokar Lake (33° 20' N, 78° E), alt 4600m, Dist Ladakh. Samples coll by Geol Survey India, subm by Vishnu-Mittre dated for origin, history, vegetation, and climate of Tsokar Lake and region.

Samples from bore hole Core TP-6

BS-5. Carbonaceous clay	11,830 ± 500
Depth 3m.	
BS-9. Carbonaceous clay	15,800 ± 1110
Depth 5.15m.	
BS-11. Carbonaceous clay	20,500 ± 2000
Depth 12m.	
BS-17. Biogenic deposit	30,600 ± 1400
Depth 21.85m.	

Samples from bore hole Core TSD-1

BS-28. Biogenic deposit	34,170 ± 3370
Depth 7.7 to 8.2m.	
BS-29. Carbonaceous clay	>40,000
Depth 13.5 to 13.7m.	
BS-30. Carbonaceous clay	>41,000
Depth 18.5m.	
BS-31. Carbonaceous clay	>15,000
Depth 23.2 to 23.85m.	

Comment: biogenic deposits from bore hole Cores TP-6 and TSD-1 (BS-17 & 28) indicate warm fluctuation within Weichselian glaciation. Pollen sequence is under preparation.

Lahul series

Batal (32° 14' 30" N, 77° 33' 40" E), Lahul Valley, Dist Lahul & Spiti. Samples coll from trial trench along river bed and subm by A Bhattacharya, BSIP. Samples date pollen sequence.

BS-54. Varved silty clay	495 ± 90
Depth 7 to 17cm.	
BS-60. Varved silty clay	1370 ± 135
Depth 60 to 97cm.	

Rajasthan series

Samples from trial trenches from lakes in Rajasthan desert coll and subm by A K Saxena, BSIP to date origin and history of these lakes and of vegetation and climate of Rajasthan desert.

Didwana Salt Lake (27° 30' N, 74° 30' E), Dist Nagaur.

BS-24. Laminated dark clay **1960 ± 160**
Depth 40 to 75cm.

BS-26. Laminated dark clay **3725 ± 125**
Depth 130 to 135cm.

BS-34. Laminated dark clay **6110 ± 125**
Depth 230 to 235cm.

BS-35. Laminated dark clay **7835 ± 165**
Depth 290 to 295cm.

Comment: pollen sequence from this lake pub earlier (Singh *et al*, 1974) had a single date (WIS-415 – 2970 ± 65 BP) at depth 125cm. Present profile has consistent dates; bottom date agrees with estimates made by Singh *et al* (1974). Immigration of *Calligonum polygonoides*, a psammophytic sp, from extreme W of desert into vicinity of Didwana as observed in pollen diagram (Singh *et al*, 1974) is dated by BS-34 to ca 6000 BP. Pollen analysis of present profile is in progress.

Kanod (29° N, 71° E), Dist Jaisalmer.

BS-50. Sandy clay **8700 ± 200**
Depth 50cm.

BS-51. Sandy clay **9570 ± 160**
Depth 120cm.

Comment: deposits of Kanod playa are dated to 10,000 BP, same as some of salt lakes in N of Rajasthan desert. Sedges dominated grasses in vicinity of this playa until 8700 BP. Thereafter, grasses dominated. Pollen grains of thorn forest elements are scarce.

Pushkar lake (26° 29' N, 74° 33' 50" E), Dist Ajmer.

BS-12. Sandy clay **Modern**
Depth 110 to 115cm.

BS-13. Sandy clay **1035 ± 110**
Depth 130 to 135cm.

Comment: beginning of *Anogeissus* forest with low frequencies of *Calligonum* and abundance of sedges is dated by BS-13. This is in contrast to changes observed at nearly same depth in Pushkar lake diagram pub by Singh *et al* (1974).

Budh Pushkar Lake (26° 29' N, 74° 33' 50" E), Dist Ajmer.

BS-4. Sandy clay **Modern**
Depth 20 to 25cm.

BS-6. Sandy clay **425 ± 80**
Depth 105 to 110cm.

Comment: BS-6 dates occurrence of grassland-chenopod savannah in vicinity of lake.

Nilgiri series

Colgrain (11° 35' N, 76° 52' E), Dist Nilgiris. Samples from bore holes in peat deposits, subm by K Prasad, BSIP to date pollen diagram.

BS-19. Peaty clay **7840 ± 125**

Depth 20 to 50cm.

BS-20. Clay **27,450 ± 1000**

Depth 70 to 100cm.

BS-21. Peaty clay **21,350 ± 450**

Depth 120 to 150cm.

BS-23. Peaty clay **14,500 ± 930**

Depth 220 to 250cm.

Comment: middle 2 dates are highly inconsistent. BS-23 dates profile from late Weichselian. Pollen diagram reveals that ca 15,000 yr ago a grassland with *Impatiens* occurred around Colgrain and Shola forest was established here ca 8000 yr ago (Vishnu-Mittre & Gupta, 1971).

Upper Bhawani (11° 21' N, 76° 45' E), Dist Nilgiris. Samples from bore hole in peat deposits coll and subm by H P Gupta. Samples date pollen diagram.

BS-52. Peaty clay **5690 ± 110**

Depth 1.4m.

BS-53. Peaty clay **18,540 ± 290**

Depth 2.15m.

Comment: hiatus in stratigraphy seems involved. Pollen analysis of profile is in progress.

GEOLOGIC SAMPLES

BS-7. Nainital flats, Uttar Pradesh **1470 ± 100**

Wood assoc with landslide debris recovered by drilling at depth 61m from Nainital Flats (29° 23' 30" N, 79° 27' 30" E), Dist Nainital. Samples subm by Geol Survey of India.

BS-8. Mothranwala Swamp, Uttar Pradesh **585 ± 140**

Clay from Mothranwala swamp (30° 15' N, 78° 2' E) alt 680m Dist Dehra Dun. Sample, depth 70 to 90cm, subm by B S Venkatachala, Indian Inst Petroleum.

BS-18. Corubathan, Bengal **250 ± 115**

Charcoal fragments from excavation at Corubathan (27° 6' 6" N, 88° 48' 53" E), Dist Darjeeling. Excavated across exposed terrace. Subm by S Ghosh, Geol Survey India.

BS-33. Vettikod, Kerala **>40,000**

Wood fragment removed from stump in natural exposure, pit depth 1.5m at Vettikod (9° 10' 30" N, 76° 35' 15" E), Dist Allepey.

BS-32. Vettikod, Kerala **>40,000**

Lignite from natural exposure, pit depth 1.5m at Vettikod (9° 10' 30" N, 76° 35' 15" E), Dist Allepey.

BS-27. Kutheravattam, Kerala **23,300 ± 600**

Lignite from well dug in Kutheravattam (9° 11' N, 76° 36' 40" E), Dist Allepey. Sample from depth 8m. Samples BS-33, 32 and 27 subm by Dir Geochronol Div, Geol Survey India to date occurrence of lignite in Kerala. *Comment:* lignite deposits in Kerala are believed by geologists to be of Late Tertiary age (Wadia, 1961). It is interesting to find that BS-27 is dated to late Quaternary.

BS-47. Rajdanda, Bihar **36,560 ± 2535**

Carbonized wood from natural exposures, 1.5m below surface, along river at Rajdanda (23° 45' 37" N, 84° 07' 28" E), Dist Palamau. Sample dates rich fossiliferous shell horizon. Subm by V P Misra, Geol Survey India.

BS-48. Khetri, Rajasthan **140 ± 90**

Gray-colored fire wood stacked at head of Madan (Khetri) copper mine (28° N, 75° 47' E), Dist Jhunjhunu. Date of copper mining in area is too recent; it was known to be much earlier from other evidence.

ARCHAEOLOGIC SAMPLES

BS-15. Tilapat, Haryana **290 ± 150**

Decaying timber (*Adansonia digitata*) from exposed stump at Tilapat (28° 30' N, 77° 20' E), Dist Gurgaon. Felling date of tree is unknown but is believed to have been planted during Mahabaratha period. Subm by K M Vaid, Forest Research Inst, India. *Comment:* younger than expected.

BS-38. Appukullu, Madras **2235 ± 140**

Charcoal from APKL-1. Systematic excavation at Appukullu (12° 52' N, 78° 59' 2" E), Dist N Arcot. Subm by K V Raman, Univ Madras. Dated for sequence and chronology of Neolithic and Megalithic cultures of Tamil Nadu.

BS-39. Lumbini, Nepal **2105 ± 100**

Charcoal, Sample 3, depth 2m, from Lumbini (27° 20' N, 83° 30' E), Dist Taulihawa, believed to be birth place of Lord Buddha, Nepal. Systematic excavation by Dir Archaeol, HMG, Nepal, and Archaeol Adviser, Indian Cooperation Mission, Nepal. Subm by Vishnu-Mittre. Date is close to archaeol estimate.

BS-42. Marakadola, Assam **660 ± 95**

Charcoal from Trench 3, systematic excavation, Marakadola (26° N, 91° 48' E), Dist Kamrup. Subm by S N Rao, North Eastern Hill Univ, Shillong.

BS-44. Dazelling, Arunachal Pradesh **410 ± 125**

Carbonized rice coll from a pit, depth 40cm, at Dazelling (27° 30' N, 92° 20' E), Dist Kameng. Subm by S K Dutta, Dibrugarh Univ, Assam.

OCEANOGRAPHIC SAMPLES

BS-40. Off-Bombay Coast **9830 ± 180**

Sediment core coll by R V Oceanographer, Off-Bombay Coast (20° 10' N, 70° 26' 59" E). Top sample of Core 4. Subm by M G A P Shetty, Natl Inst Oceanog (NIO), Goa.

BS-45. Off-Bombay Coast **20,940 ± 450**

Sediment core coll by RV Oceanographer, Off-Bombay Coast (18° 35' 12" N, 69° 17' 12" E). Bottom sample, No. 7, of Core 2. Subm by M G A P Shetty, NIO, Goa.

GEOPHYSICAL SAMPLES

Minicoy series

Dead corals from natural exposure near Light House, Minicoy (8° 0' 8" N, 73° E). Sample to date storm beaches and formation of islands. Subm by H N Siddiquie, NIO, Goa.

BS-56.**Modern****BS-57.****205 ± 105**

REFERENCES

- Agrawal, D P, Gupta, S K and Kusumgar, Sheela, 1971, Tata Institute radiocarbon date list IX: Radiocarbon, v 13, p 442-449.
- Houtermans, F G and Oeschger, H, 1958, Proportional zählrohr zur Messung Schwacher Aktivitäten Weicher β Strahlung: Helvetica Phys Acta, v 31, p 117-126.
- Kusumgar, Sheela, 1973, Problems of errors in radiocarbon dating, *in*: Radiocarbon and Indian archaeology, D P Agrawal and A Ghosh (eds), Tata Institute of Fundamental Research, Bombay.
- Kusumgar, S, Lal, D and Sharma V K, 1963, Radiocarbon dating techniques: Indian Acad Sci Proc sec A, v 58, no. 3, p 125-141.
- Rajagopalan, G and Vishnu-Mittre, 1977, Radiocarbon dating programme at the Birbal Sahni Institute of Palaeobotany, Lucknow: Internatl conf low radioactivity measurements and applications, Proc. High Tatras, 6-10 Oct 1975, p 335-340.
- Singh, G, Joshi, R D, Chopra, S K and Singh, A B, 1974, Late Quaternary history of vegetation and climate of Rajasthan desert, India: Royal Soc [London] Philos Trans, v 267B (889), p 467-501.
- Vishnu-Mittre and Sharma, B D, 1966, Studies on postglacial vegetational history from the Kashmir Valley—1, Haigam Lake: Palaeobotanist, v 15 (1 & 2), p 185-212.
- Vishnu-Mittre and Gupta, H P, 1971, Origin of Shola forests in the Nilgiris, South India: Palaeobotanist, v 19, no. 1, p 110-114.
- Wadia, D N, 1961, Geology of India. Macmillan, London, p 459-461.