[RADIOCARBON, VOL. 14, No. 2, P. 456-460]

TEHRAN UNIVERSITY NUCLEAR CENTRE RADIOCARBON DATE LIST I

CHARLES BOVINGTON and ROGHIYEH MASOUMI

Tehran University Nuclear Centre, P.O. Box 2989, Tehran, Iran

The Radiocarbon Dating Laboratory of Tehran University Nuclear Centre began operation in autumn 1970. Benzene synthesis and liquid scintillation counting was chosen as the best method for processing a large number of archaeologic specimens most of whose ages are less than twice the half-life of C^{14}. Advantage of benzene synthesis; ease of chemical processing light transfer properties, lack of isotopic fractionation and radioactive contamination, removal of radon, and improbability of cross-contamination, have been discussed (Noakes *et al.*, 1964; Noakes, Stipp, and Hood, 1964; Kowalski, 1965).

All samples were examined under a microscope and rootlets or foreign matter were removed. The samples were boiled in 3M HCl for 1 hr, washed with distilled water, and then boiled with 3M NaOH to remove humic acids, rinsed with distilled water and dried, prior to conversion to benzene. The chemistry of benzene synthesis has been described (Tamers *et al.*, 1961; Stipp *et al.*, 1962; Noakes, 1963, L'eger and Tamers, 1963; Tamers *et al.*, 1964; Noakes *et al.*, 1965; Tamers, 1965). Our technique is based on these studies and on improvements made by Polach and Stipp (1967). Organic samples are burned in an oxygen atmosphere to CO_2. The CO_2 is admitted into an evacuated stainless steel container containing a 10% excess of molten lithium (Polach and Stipp, 1967) at 650 C. After heating to insure high yields, radon removal is carried out for 1 hr at 750 to 800 C. After completion of the reaction and cooling, hydrolysis of the lithium carbide yields acetylene which is purified to remove any potential quenching agents by passing through a purification column to remove nitrogenous quenching agents (Tamers *et al.*, 1964). The acetylene is polymerized to benzene by a vanadium/silica catalyst. After distillation the benzene is poured into pre-weighed low K^{40} counting vial and the carbon content determined quantitatively. The sample is diluted to 4.5 g weight with specpure benzene and primary (PPO, 4g/l) and secondary (dimethyl POPOP, 100 mg/l) scintillators are added to a total volume of 20 ml.

The samples are counted in a Packard Tri-Carb Liquid Scintillation Spectrometer Model 3312. One channel is set to count C^{14} above the level of H^3 (water used for hydrolysis of the Li_2C_2 contains traces of H^3), the other 2 channels are used for channels ratio measurements on the sample and external standard to correct for any quenching. To date we have not encountered quenching in any samples prepared.

Background, high activity C^{14} standard, modern reference and samples are measured in sequence for 20 mins. each as described by Polach and Stipp (1969). This affords nearly simultaneous background and sample counting and enables a check on long term instrumental drift or change in environmental background. The freezer temperature is set at

+6 C to minimize noise from the low noise photomultiplier tubes. Vials are sealed with "Stabilit" adhesive to preclude loss of sample by evaporation. The contemporary reference used is 95% of the specific activity of NBS oxalic acid and gives a count rate of 9.4 ± 0.1 cpm/g carbon. Dates are calculated using the Libby half-life of 5568 ± 30 years with 1950 as the standard year of reference. Results may be converted to the best current estimate of calendrical age by multiplying the age B.P. by 1.03 and adding on the correction factors proposed by Ralph and Michael (1969).

ACKNOWLEDGMENTS

Samples were contributed and evaluated by D. Stronach, Dir. British Inst. of Persian Studies, Jean Perrot, Dir. French Archaeological Delegation in Iran, and E. O. Negahban, Tehran Univ. The advice of W. Sumner, Dir. American Inst. of Iranian Studies and R. Dyson, Univ. of Pennsylvania is much appreciated. This work was carried out during the secondment of C.H.B. to Tehran Univ. Nuclear Centre by the British Government Overseas Development Administration under CENTO Technical Assistance agreement. Assistance of K. Kamali is gratefully acknowledged.

Shahr-I-Qumis

Shahr-I-Qumis is a large flat 7×4 km site (54° 7′ N Lat, 35° 55′ E Long), 34 km W of Damghan, 4 km S of Tehran-Meshhed Rd. Surface pottery ranges from 700 B.C. to post-Saljug time. Due to wind and water erosion only a few isolated mounds still harbor intact mudbrick remains. The largest of these is known as Site VI, excavated by John Hansman and David Stronach in 1967; Site VI represents remains of a fortified mansion of the mid-Pathian period which fell into disuse in the 1st century B.C. In the late Sassanian period Qumis seems to have been revived and a Sassanian grave on the 1st floor of one of the tall mud-brick towers of the original mansion yielded a large piece of felt and a silver coin dated ca. A.D. 580 (Hansman, 1968).

TUNC-1. **1310 ± 39**
A.D. 640

TUNC-2. **1314 ± 43**
A.D. 636

Comment: corrected results agree well with coin evidence mentioned above. Usual sample pretreatment precluded by chemical nature of specimen. Sample boiled in deionized water until free of soil.

Tepe Djaffarabad series

Tepe Djaffarabad is in Khuzestan, 7 km from Susa (32° 11′ N Lat, 48° 27′ E Long) on left bank of R. Chaour. Coll. 1969 and subm. 1970 by J. Perrot and G. Dollfus. Samples are from levels of pottery assoc. with Susa A culture, dated at 1st half of 4th millennium (LeBreton, 1957; Perrot, 1971).

TUNC-3. **5062 ± 68**
3112 B.C.

Burnt wood from Sq. E8, 2 m below summit.

TUNC-4. **5166 ± 72**
3216 B.C.

Burnt wood from Sq. G9-H9, Bed e, 3.20 m below summit.

TUNC-5. **5246 ± 71**
3296 B.C.

Burnt wood from Sq. G9-H9, Bed f, 4.10 m below summit.

TUNC-6. **5238 ± 72**
3288 B.C.

Burnt wood from Sq. G9-H9, Bed f, 4.50 m below summit. *Comment*: dates may be compared with P-912; 5418 B.P.

Sagz-Abad and Zage series

The adjacent Tepes of Sagz-Abad and Zage are 64 km S of Ghazvin 10 km W of Buin Zahra (49° 56′ E Lat, 35° 47′ N Long), Central Ostan, Iran. Samples coll. 1970 and subm. by E. O. Negahban, Dir. Tehran Univ. Inst. of Archaeol. expedition. Samples strongly resemble those from Tepes Hissar and Sialk (Negahban, 1971).

TUNC-7. Sagz-Abad Cemetery, Trench A **3665 ± 61**
1715 B.C.

Burnt wood from depth 1.60 m. Cultural context is still uncertain.

TUNC-11. Sagz-Abad Cemetery, Trench A **6083 ± 84**
4133 B.C.

Burnt wood obtained from depth 2.68 m. Level contains a fine textured, grit-tempered red ware with monochrome brown or black decoration similar to Sialk III (5) and Hissar IB.

TUNC-13. Sagz-Abad, Trench A, Level III **3696 ± 62**
1746 B.C.

Burnt wood from level containing bichrome ware, black and red on buff comparable to Godin III pottery.

TUNC-8. Sagz-Abad, Trench A, Level II **4086 ± 66**
2136 B.C.

Burnt wood from level containing bichrome ware, black and red on buff comparable to Godin III pottery.

TUNC-9. Sagz-Abad, Trench A, Level I **4426 ± 69**
2476 B.C.

Burnt wood from level containing bichrome ware, black and red on buff comparable to Godin III pottery.

TUNC-10. Zage F. X., Level I **4909 ± 73**
2959 B.C.

Burnt wood from level of test trench; cultural context still uncertain.

TUNC-12. Zage F. X., depth 2.89 m **7147 ± 91**
5197 B.C.

Burnt wood from level containing material which appears to predate Sialk I.

General Comment: TUNC-11 assoc. with pottery of Sialk III, 4 and 5 and Hissar IB type normally assoc. with period 3450 to 3200 B.C. in Dyson's relative chronology of Iran, (1968, pers. commun.). This date, 4322 B.C. based on 5730 yr half-life, would redate Sialk III sequence and lend evidence to support the theory that Sagez-Abad and Zage predate the Hissar and Sialk sequences. The existence of a continuous pottery sequence from pre-Sialk I onwards and the strong parallels between Sagz-Abad, Zage Sialk, and Hissar suggest the possibility that this site may have been the source of both these cultures. TUNC-13, -8, -9 are comparable with dates for III (Gak-1071, -1070; Young, 1969). Further excavations in 1971 should clarify relationship between Sagz-Abad, Zage, Sialk, and Hissar.

References

Dyson, R. H., 1968: Am. Jour. Archaeol., v. 72, no. 4, p. 308-312.

Hansman, J., 1968: Royal Asiatic Soc. Jour., p. 111-139.

Kowalski, S. J., 1965, Packard Instrument Company radiocarbon dates I: Radiocarbon, v. 7, p. 200-204.

L'eger, C. and Tamers, M., 1963, The counting of naturally occurring radiocarbon in the form of benzene in a liquid scintillation counter: Internatl. Jour. Applied Radiation and Isotopes, v. 14, p. 65-70.

LeBreton, L., 1957, The early period at Susa, Mesopotamian relations: Iraq, v. 19, pt. 2, p. 79-125.

Negahban, E., Excavations at tepes Sagz-Abad and Zage: Symposium, Tehran Univ., June, 1971.

Noakes, J. E., 1963, Benzene synthesis by low temperature catalysis for radiocarbon dating: Geochim. et Cosmochim. Acta, v. 27, p. 797-804.

Noakes, J. E., *et al.*, 1964: ORINS Pub. No. 46, Oak Ridge, Tennessee.

Noakes, J., Kim, S., and Stipp, J. J., 1965, Sixth internatl. conf. on radiocarbon and tritium dating Proc.: USAEC CONF-650652, p. 68-91.

Noakes, J. E., Stipp, J. J., and Hood, D. W., 1964, Texas A & M University radiocarbon dates I: Radiocarbon, v. 6, p. 189-193.

Perrot, J., 1971, Excavations at Susa and Jaffarabad: Iran, v. 9, p. 178-181.

Polach, H., 1969, Optimisation of liquid scintillation radiocarbon age determinations and reporting of ages: Atomic Energy in Australia, v. 12, pt. 3, July, 1969, p. 21-28.

Polach, H. and Stipp, J. J., 1967, Improved synthesis techniques for methane and benzene radiocarbon dating: Internatl. Jour. Applied Radiation and Isotopes, v. 18, p. 354-364.

Ralph, E. K. and Michael, H. N., 1969, Univ. of Pennsylvania radiocarbon dates XII, v. 11, p. 469-481.

Stipp, J. J. *et al.*, 1962, University of Texas radiocarbon dates I: Radiocarbon, v. 4, p. 43-50.

Stronach, D., 1968, Tepe Nush-I-Jan and Shahr-I-Qumis: Iran, v. 6, p. 162.

Stuckenrath, R., Coe, W. R., and Ralph, E. K., 1966, University of Pennsylvania radiocarbon dates IX: Radiocarbon, v. 8, p. 348-385.

Tamers, M. A., 1965, Routine ^{14}C dating using liquid scintillation techniques: 6th internatl. conf. radiocarbon and tritium dating Proc.: USAEC CONF-650652, p. 53-67.

Tamers, M. A., Pearson, F. J., and Davis, E. M., 1964, University of Texas radiocarbon dates II: Radiocarbon, v. 6, p. 138-159.

Tamers, M. A., Stipp, J. J., and Collier, J., 1961, High sensitivity detection of naturally occurring radiocarbon: chemistry of the counting sample: Geochim. et Cosmochim. Acta, v. 24, p. 266-276.

Univ. of Pennsylvania, 1970, Summary radiocarbon chronology for NW Iran: priv. pub.

Young, T. and Cuyler, Jr., 1969, Excavations at Godin Tepe, 1st progress report: Royal Ontario Mus. Art and Archaeol., occ. paper 17.