

proembryo is formed in the developing seed. The embryo attains the early heart-shaped stage nearly 10 days after pollination. Mature seeds are formed 15 days after pollination. The mature seed contains a dicotyledonous embryo and a massive endosperm.

To apply the technique of test-tube fertilization, flower-buds were emasculated and bagged one day before anthesis. On the day of anthesis the emasculated buds were excised, their calyx and corolla removed, and their pistils surface-sterilized in fresh chlorine water for about ten minutes and washed twice in sterile distilled water. The ovary was vertically cut such that each half contained one placenta. From each half the tips were discarded, and the remaining portion bearing the ovules, placenta, and ovary wall (Fig. 1, A) was cultured on an agar nutrient medium containing Knop's mineral elements, four B-vitamins, glycine, and sucrose.⁶ Thus two cultures were raised from each ovary; one of them was maintained as unpollinated control, and the other was sprinkled with pollen collected at random from about-to-dehisce anthers. In all, 96 cultures were prepared and maintained under 200 Lux diffuse daylight and $22 \pm 2^\circ \text{C}$.

All 48 control cultures shrivelled in 5-8 days. Of the 48 pollinated cultures, 12 shrivelled, 3 became infected, 10 were used for embryologic studies, and the remaining 23 were grown until 21 days. In the pollinated cultures the pollen readily germinated, and the pollen tubes grew amidst the ovules (Fig. 1, B). Three days after pollination 2-5 ovules began enlarging as though they had

been fertilized. Embryologic preparations of such enlarging ovules four days after pollination did show 4-8 endosperm nuclei and a zygote or occasionally a filamentous proembryo (Fig. 1, C). This confirmed double fertilization *in vitro*. During six days after pollination the fertilized ovules enlarged considerably (Fig. 1, D) and the unfertilized ovules shrivelled; the young seeds contained cellular endosperm and globular embryo (Fig. 1, E). In 15 days after pollination, mature seeds containing dicotyledonous embryo (Fig. 1, F) and endosperm were formed. Thus, from 23 cultures harvested 18-21 days after pollination, 88 seeds were obtained. Of these 16 seeds germinated *in situ* (Fig. 1, G). Upon harvest, 10 of the remaining 72 seeds were cultured on fresh nutrient medium; 7 of these produced normal seedlings. Studies on root tips of two seedlings showed that both seedlings contained the diploid number of 12 chromosomes.

Thus our investigations have demonstrated that the technique of test-tube fertilization is effective with *Dicranostigma franchetianum* also.

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RADIOCARBON DATES FROM TER AND SOME OTHER HISTORICAL SITES

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ABSTRACT

The C^{14} dates presented are from historical sites. Of special interest are the dates from an Asura site, as also from the late phase of the N.B.P. ware. The samples were counted in the form of methane in gas-proportional counters.

IN the present report are included the C^{14} dates from the sites* of Chandraketugarh, Chirand, Mailaram, Rajbadidanga, Saradkel, Ter, Tripuri and Ujjain.

Each sample has been given two dates in years B.P.; the first one is based on the half-life value of 5568 ± 30 yrs; within the parenthesis is given the second date, based on the half-life value of 5730 ± 40 yrs. To

convert the dates to A.D./B.C. scale, 1950 should be used as the reference year (Godwin, 1962).

Before converting the samples into methane, they were pretreated for the removal of extraneous humic acid and carbonates. Rootlets were hand-picked, wherever visible. The samples, in the form of methane, were counted in gas-proportional counters. For modern reference standard 95% activity of the N.B.S. oxalic acid was used. Detailed procedures

* Short summaries of these excavations are published regularly in the *Indian Archaeology—a Review*.

have already been described elsewhere (Kusumgar et al., 1963; Agrawal et al., 1965).

GENERAL COMMENT ON DATES†

TF-446—places the late phase of N.B.P., in the first century B.C. The Asura site of Saradkel has been dated to the first century A.D. (TF-370). The early levels of Ter, a Satavahana site, have been ascribed to ca. 150 B.C.

C¹⁴ DATES WITH SAMPLE DESCRIPTION

Chandraketugarh, India

TF-367, Historical Deposits, 660 ± 90
(680 ± 95)

Shells from Chandraketugarh, District 24-Paraganas, West Bengal, Locus H 2, Depth 2.6 m., Sample No. 2. Sample submitted by C. R. Roy Choudhury, Asutosh Museum, Calcutta-14. Comment: Organic fraction was not sufficient, hence only inorganic fraction was dated.

Chirand, India

TF-446, N.B.P. Ware Deposits, 1930 ± 105
(1985 ± 105)

Charred rice from Chirand (Lat. $25^{\circ} 45' N.$, Long. $84^{\circ} 45' E.$), District Saran, Bihar, Trench CRD-1 c, Locus B'-C', Layer 6, Depth 3.25 m. NaOH pretreatment was also given. Sample submitted by Director of Archaeology and Museum, Patna. Comment: Sample derives from the top of N.B.P. ware deposits.

Mailaram, India

TF-373, Historical Deposits, 520 ± 90
(535 ± 90)

Charcoal from Mailaram (Lat. $17^{\circ} 43' N.$, Long. $80^{\circ} 37' E.$), District Khammam, Andhra Pradesh. Collection from a trench in an old slag heap, Depth 1 m., Field No. SK 3, Sample No. 1. Visible rootlets were hand-picked. NaOH pretreatment was also given. Sample submitted by S. N. Sen, Geological Survey of India, Hyderabad. Comment: Sample dates an earlier copper mining activity in the area.

Rajbadidanga, West Bengal, India

Rajbadidanga (Lat. $24^{\circ} 01' N.$, Long. $88^{\circ} 11' E.$), District Murshidabad, was excavated by S. R. Das, Department of Archaeology, University of Calcutta, who submitted the samples.

TF-629, Historical Deposits, 1495 ± 90
(1540 ± 95)

Charcoal from Trench B 3, Layer 12 A, Depth 3.5 m., Field No. 3. Comment: Associated finds have terracotta seals.

TF-634, Historical Deposits, 1520 ± 90
(1565 ± 95)

Charcoal from Trench B 5, Layer 8, Depth 3.1 m., Field No. 9.

† The dates based on 5730 years half-life value have been used for discussions.

TF-636, Historical Deposits, 1665 ± 95
(1710 ± 95)

Charcoal from Trench B 5, Layer 8, Depth 3.3 m.

Saradkel, India

TF-370, 'Asura' Culture, 1795 ± 100
(1850 ± 100)

Charcoal from Saradkel (Lat. $23^{\circ} 03' 30'' N.$, Long. $85^{\circ} 21' E.$), District Ranchi, Bihar, Trench SDK-2, Locus A 1-A 2, Layer 3, Depth 0.07 m. (?), Field No. SDK-2/65-248. Submitted by Director-General of Archaeology in India, New Delhi.

Ter, Maharashtra, India

Ter, District Osmanabad, was excavated by M. G. Dixit, Director of State Archaeology, Maharashtra, Bombay, who submitted the samples. NaOH pretreatment was given to all the samples.

TF-746, Historical Deposits, 1645 ± 100
(1690 ± 105)

Charcoal from Layer 3, Registration No. 5/619.

TF-747, Historical Deposits, 2045 ± 100
(2105 ± 100)

Charcoal from Layer 22, Registration No. 5/573.

Tripuri, India

TF-681, Early Historic Period, 2155 ± 100
(2220 ± 105)

Charcoal from Tripuri (Lat. $23^{\circ} 08' N.$, Long. $79^{\circ} 50' E.$), District Jabalpur, Madhya Pradesh, Locus II, Layer 5, Depth 2.8 m., Field No. 246. Sample submitted by H. D. Sankalia, Deccan College, Poona-6. Rootlets were hand-picked. NaOH pretreatment was also given.

Ujjain, Madhya Pradesh, India

Ujjain (Lat. $23^{\circ} 11' N.$, Long. $75^{\circ} 46' E.$), District Ujjain. Samples submitted by Director-General of Archaeology, New Delhi-11. Site excavated by N. R. Banerjee.

TF-407, Black-&-Red Ware(?) Deposits,
 1990 ± 100
(2050 ± 100)

Charcoal, Locus O-I, Layer 23, Depth 4.4 m., Field No. UJN 17 Ext/108. Comment: Date is younger than expected.

TF-409, N.B.P. Ware Deposits, 2335 ± 95
(2400 ± 95)

Charcoal, Locus IV-V, Layer 28, Depth 5.50 m., Field No. UJN 28/155.

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