

UNIVERSITY OF ROME CARBON-14 DATES VII

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We list measurements carried out between June and November 1968. Archaeologic samples are from Italian and Swat (W Pakistan) territories; all geologic samples are from Italian territory.

Chemical preparation of samples, measurement technique, and the modern standard are unchanged (Bella and Cortesi, 1960; Alessio, Bella, and Cortesi, 1964; Alessio *et al.*, 1968).

For each sample of CO₂ the counting rate was corrected according to mass-spectrometrically measured C¹³/C¹² ratio. Isotopic analyses were carried out with a 6 in., 60°-sector, double-collecting mass spectrometer, designed and built by G. Boato at Ist. di Fisica, Univ. of Genoa (Boato *et al.*, 1960) and now in use at Ist. di Geochim., Univ. of Rome. C¹³/C¹² ratio is reported as δ -value, the deviation in parts per mil of the C¹³/C¹² ratio of sample from the PDB standard:

$$\delta \text{ C}^{13}\text{‰} = \left(\frac{\text{R sample}}{\text{R standard}} - 1 \right) \cdot 1000$$

where $\text{R} = \text{C}^{13}/\text{C}^{12}$.

δ -values have also been corrected for O¹⁷ contribution to mass 45 and other instrumental factors, as described by Craig (1957). The uncertainty in the δ -values is $\pm 0.1\text{‰}$.

Our modern standard (wood grown near Rome between 1949 and 1953) has $\delta \text{C}^{13} = -24.9\text{‰}$, coincident, within the analytical uncertainty, with the one of average wood ($\delta \text{C}^{13} = -25\text{‰}$) (Craig, 1961). δC^{13} of R-180, R-181, R-182 and R-489 _{α} samples has not been measured.

Age has been calculated using the Libby half-life of 5568 ± 30 yr, with 1950 as the standard year of reference.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

*A. Italy***Vatte di Zambana series**

Charcoal from Riparo di Vatte, at foot of triassic dolomite wall, 950 m high, right side of Adige R. valley, Comune di Zambana, ca. 12 km N Trento, Trentino-Alto Adige (46° 09' 44" N Lat, 11° 04' 37" E Long),

at +220 m. Coll. 1968 by G. Bartolomei and A. Broglio, Ist. di Geol., Univ. of Ferrara; subm. 1968 by P. Leonardi, Dir. Ist. di Geol., Univ. of Ferrara. Quarry works revealed small rock shelter wholly filled with and hidden by debris cone. Throughout whole sec. of deposit, 4 m thick, and partially outside the shelter, flint implements of Late Epigravettian type, hearths, mammal and micromammal cold fauna were found. Three cultural horizons were singled from surface: Layer 1) dolomite rubble, average thickness 80 cm, sterile; 2) and 3) dolomite rubble, average thickness 30 cm, with charcoal; 4) dolomite rubble, average thickness ca. 10 cm, sterile; 5) upper cultural horizon, 20 cm thick, Late Epigravettian phase, hypermicrolithic industry characterized by beaked points, largely protogeometrics (beaked truncate bladelets) and geometrics (scalene triangles), Hearth I; 6) dolomite rubble, average thickness 20 cm, sterile; 7) middle cultural horizon, 20 cm thick, with same industry as 5), Hearth II; 8) and 9) dolomite rubble, average thickness 1 m, sterile; 10) lower cultural horizon, 20 cm thick, same industry as 5) and 7), Hearth III, burial of a woman in supine position, with no grave articles, covered by large stones; 11) dolomite rubble, average thickness 1 m, sterile to rocky bottom. Fauna in whole deposit: *Cervus elaphus*, *Castor fiber*, *Ursus* sp., *Capra ibex*, *Apodemus*, *Arvicola*, *Crocidura*; micromammal assoc. shows arid and xerothermic environment (Leonardi and Tomasi, 1968; Broglio, 1969).

R-487 α . Vatte di Zambana 2-3 **7250 \pm 110**
5300 B.C.
 $\delta C^{13} = -25.2\%$

Charcoal from Layers 2 and 3. *Comment*: only scarce charcoal was found, possibly remains of later settlement outside of shelter were upset and destroyed by quarry works.

R-488. Vatte di Zambana 5-HI **7540 \pm 75**
5590 B.C.
 $\delta C^{13} = -24.8\%$

R-488 α . Vatte di Zambana 5-HI **7585 \pm 75**
5635 B.C.
 $\delta C^{13} = -25.1\%$

Charcoal from Layer 5, Hearth I, upper cultural horizon, Late Epipaleolithic industry.

R-489. Vatte di Zambana 7-HII **7860 \pm 75**
5910 B.C.
 $\delta C^{13} = -25.2\%$

R-489 α . Vatte di Zambana 7-HII **7810 \pm 95**
5860 B.C.

Charcoal from Layer 7, Hearth II, middle cultural horizon, Late Epipaleolithic industry.

R-490. Vatte di Zambana 10-HIII **7860 \pm 110**
5910 B.C.
 $\delta C^{13} = -25.3\%$

R-490 α . Vatte di Zambana 10-HIII **7960 \pm 100**
6010 B.C.
 $\delta C^{13} = -25.2\%$

Charcoal from Layer 10, Hearth III, lower cultural horizon, Late Epipaleolithic industry.

R-491. Vatte di Zambana 10-B **8000 \pm 110**
6050 B.C.
 $\delta C^{13} = -25.8\%$

R-491 α . Vatte di Zambana 10-B **7740 \pm 150**
5790 B.C.
 $\delta C^{13} = -25.4\%$

Charcoal from Layer 10 found with flint industry and fauna in mould overlying skelton.

General Comment: all charcoal was given standard pretreatment with 10% HCl; samples α -labelled were given additional leaching by 6% NH_4OH , 2 measurements were made and found consistent; abundant humic fraction obtained should not be regarded as contaminating, but as belonging to humic charcoal. R-488 to R-491 dates agree with Late Epigravettian phase industry found in Layers 5, 7, and 10, and with features of micromammal fauna.

Dates obtained can be compared with Mesolithic layers of Grotta della Madonna, Praia a Mare: R-188, 9070 \pm 80; R-187, 8875 \pm 85 (Radiocarbon, 1967, v. 9, p. 404) and of Riparo Blanc at Mt. Circeo: R-341, 8565 \pm 80 (Radiocarbon, 1968, v. 10, p. 341) in S Italy. More recent industry of Riparo di Vatte are better connected with Epigravettian tradition than are Mesolithic industries of the 2 sites in S Italy.

R-376. S. Lorenzo Isontino **2790 \pm 55**
840 B.C.
 $\delta C^{13} = -25.3\%$

Charcoal from hearth at 1.30 m depth in clay quarry of Soc. Fornaci Giuliana, Comune di S. Lorenzo Isontino, former S. Lorenzo di Mossa, 6 km SW Gorizia, Venezia Giulia (45° 55' 39" N Lat, 13° 31' 43" E Long), at + 57 m. Coll. 1968 by U. Furlani; subm. 1968 by P. Leonardi. In hearth were 2 vases ascribed to Late Bronze age cultures of central Europe, and D phase of Reinecke, 13th century B.C. *Comment:* according to pottery typology, C^{14} date looks too young. Also if findings belong to marginal zone of cultural influence age cannot be accepted.

R-486. Grotta Calindri **3090 \pm 75**
1140 B.C.
 $\delta C^{13} = -25.2\%$

R-486 α . Grotta Calindri **3200 \pm 60**
1250 B.C.
 $\delta C^{13} = -25.0\%$

Charcoal from hearth in autochthonous Level E of deposit of Grotta Serafino Calindri a karst cave in Messinian selenitic gypsa of Bolognese

Pedeapennine, ca. 500 m ESE of Mt. Croara, 7.5 km SE Bologna, Emilia (44° 26' 16" N Lat, 11° 23' 28" E Long) at +162 m. Coll. 1968 by G. Bardella, Gruppo Speleologico Bolognese of Club Alpino Italiano; subm. 1968 by G. Pasini, Ist. di Geol., Univ. of Bologna. In 1964 cave was discovered by G. Zuffa, Gruppo Speleologico Bolognese, C.A.I. At present, entrance is at bottom of a dolina, so-called "Buca di Budriolo," on the water parting between streams Zena and Savena, ca. 100 m from upper main cave and connected by winding shaft. Three paleoentrances closer to cave, and now completely closed by old clay flows, have been id. (Altara, 1965; Badini, 1965; Badini *et al.*, 1964). In cave smoke traces were seen on walls and flint implements and potsherds found on surface. Excavation ca. 1.40 m deep in an area of 8 m² through soil deposit of main cave revealed from rocky bottom upward: A) coarse gravels, ca. 50 cm thick; B) fluvial sand, 10 cm; C) compact clay, 10 cm; D) lower allochthonous cultural horizon, ca. 20 cm, consisting of clay flow containing charcoal, flint implements, and potsherds, probably transported by alluvial waters inside cave through paleoentrances now occluded; E) autochthonous cultural horizon singled out by several hearths containing charcoal in thin layer, 10 cm, of baked clay; only 2 potsherds found at this level; F) upper allochthonous cultural horizon, ca. 30 cm, very similar to lower one, testifying new clay flow with archaeol. remains transported inside by alluvial waters; and G) clayey surface soil of cave. Allochthonous artifacts in D) and F) were similar and can be referred to the Late Bronze age, sub-Apennine culture, found in nearby Grotta del Farneto; they are probably derived from remains enclosed in clayey sediments of overlying dolina. *Comment:* R-486, only 10% HCl pretreatment was given, R-486 α , additional leaching by NH₄OH 6% was given. Results agree and show material was not contaminated. They date frequentation of cave and lighting of fires, perhaps to dehydrate and use gypsum. As dating is consistent with that of nearby Grotta del Farneto, ca. 1 km SE: Pi-53, 3240 \pm 110 (Radiocarbon, 1961, v. 3, p. 103) where artifacts of sub-Apennine culture were also found, people belonging to same culture probably frequented the cave.

R-349. Grotta Scaloria I

5480 \pm 70

3530 B.C.

$\delta C^{13} = -25.9\%$

Finely powdered calcareous-carbonaceous earthy material from hearth in inner part of Grotta Scaloria, suburb of Manfredonia, S Gargano promontory, 18 km NE Foggia, Apulia (41° 38' 20" N Lat, 15° 54' 23" E Long), at +44 m. Coll. 1967 and subm. 1968 by S. Tinè, Sopr. Antichità della Puglia. In 1931 works for Apulia aqueduct led to discovery in limestone spur of forepart of interstratum-sloping cave. Excavations near entrance were carried out by Q. Quagliati, 1931 and U. Rellini, 1932-34; they found impressed pottery and "figulina" red-on-buff pottery, the latter with red-band painted decoration (bichrome pottery), or with black-edged red-band-and-black geometrically painted decoration

(trichrome pottery, of Scaloria style), belonging to Middle Neolithic (Rellini, 1934). In 1967, deeper part of cavity, ca. 50 m long, 100 m from entrance, and very difficult to approach, was discovered and excavated under direction of S. Tinè. Cave was identified as votive place probably dedicated to cult of dripping waters. On limestone soil, spreading on wide area, up to ca. 10 m from few small lakes at end of cave, ca. 100 "figulina" bichrome and trichrome vases were found, the latter of "Scaloria style" slightly different from one known; no impressed pottery was found at this level. Vases were *in situ* in ritual groups, completely covered by calcareous concretions formed by dripping waters; some were placed on base of stalagmites intentionally broken probably to catch drops from upper stalacite. In small flat area was small votive basin dug in limestone filled with dripping water, and 2 m away was hearth, also ritual, whose calcareous-carbonaceous material has been coll. (Tinè, 1969). *Comment*: carbonaceous material was entirely formed by 2 different humic fractions, one soluble in 10% HCl, the other soluble in 6% NH₄OH: the 2 fractions were dated together. On archaeol. evidence, bichrome and trichrome votive pottery are ascribed to Middle Neolithic, 2nd phase; R-349 date agrees with archaeol. expected age.

Villaggi Scaramella series

Fortified Neolithic villages, contiguous and partially superimposed, have been id. by aerial photograph in Tavoliere at S. Vito locality, near Borgo Tavernole, ca. 8 km SE Foggia, Apulia (41° 29' 55" N Lat, 15° 41' 28" E Long), at +15 m. Soundings were made in all 9 villages at least partly contemporaneous; all are ascribed to same Neolithic cultural phase. All had impressed pottery and red-and-black-on-buff geometrically decorated pottery, the latter of "Masseria della Quercia" style. Charcoal, coll. 1967 and subm. 1968 by S. Tinè, who carried out excavation, came from bottom strata of 2 circular, concentric ditches enclosing Village A: only these 2 strata can be ascribed to inhabitants of village; upper strata were filled after village had been abandoned.

7000 ± 100
5050 B.C.
 $\delta C^{13} = -23.3\%$

R-350. Scaramella A-I

Charcoal from Cut 6, Sounding I, in bottom layer of outer circular ditch of Villaggio Scaramella A. *Comment*: humic charcoal nearly all soluble in 6% NH₄OH.

6540 ± 65
4590 B.C.
 $\delta C^{13} = -24.3\%$

R-351. Scaramella A-II

Scarce charcoal fragments and mainly calcareous-carbonaceous earth from Cut 7, Sounding II, in bottom layer of inner circular ditch of Villaggio Scaramella A. *Comment*: after 10% HCl pretreatment, brownish earth containing not more than 30% of humic carbonaceous matter nearly all soluble in 6% NH₄OH was obtained. Because of foreign, per-

haps contaminating matter and in comparison with R-350 date, R-351 may result rather younger than it is.

General Comment: pottery of "Masseria La Quercia" style, appears mainly in very numerous ditched villages of Tavoliere id. by aerial photograph (Bradford, 1949; 1950a; 1950b); considered most ancient painted pottery yet known in Italy, its archaeol. dating is still discussed (Peroni, 1967): as it precedes typical Middle Neolithic "figulina" painted pottery, and is assoc. with older impressed pottery of Early Neolithic, as belonging to this period could be considered (S. Tinè, pers. commun.). High C^{14} ages, 1st half of 5th millennium B.C., confirm attribution; they are 1st dates for this cultural horizon.

B. Aeolian Islands

Lipari series

Excavations of well-known prehistoric settlements of Lipari I., Aeolian archipelago, off N coast of Sicily, have been carried out since 1950 by L. Bernabò Brea, Sopr. alle Antichità della Sicilia Orientale, Siracusa, and M. Cavalier, Mus. Archeol. Eoliano. Main settlement is the one of Castello, or Acropoli of Lipari, on rhyolitic cliff ($38^{\circ} 27' 58''$ N Lat, $14^{\circ} 57' 24''$ E Long), at +16 m. Throughout deposit, ca 9 m thick, all cultural horizons in Aeolian Is. from Middle Neolithic to Greek, Roman, Middle ages and Modern times, are represented. From rocky bottom and thin sterile clayey layer upward: 1) Middle Neolithic, mainly trichrome pottery with black-edged red-band or flame-painted decoration; 2) Middle Neolithic, 3rd phase, very fine "figulina" spiral-meander painted pottery, Serra d'Alto style; 3) Late Neolithic, monochrome undecorated red pottery, Diana style, copper slag also present (at this time, though some activity continued on Acropoli, main settlement of island had moved down on the plain in Contrada Diana); 4) Early Eneolithic, burnished pottery with decoration of large parallel grooves, Piano Conte culture (at this time, lower settlement was still prosperous); 5) Eneolithic, only scanty potsherds attributed to Piano Quartara culture (absence of concentrated cultural deposit indicates little frequentation of Acropoli during this period; Piano Quartara culture is well represented in Aeolian Is. at eponymous locality in Panarea I. and at clearly characterized layer of Contrada Diana deposit, Lipari); 6) Early Bronze age: very rich and thick layer of Capo Graziano culture (shows return to Acropoli settlement; oval huts partly dug into ground, sometimes superimposed; there is local pottery with first potter's marks, together with pottery imported from Aegean); 7) Middle Bronze age, Milazzese culture (oval huts mostly elevated, showing traces of violent destruction; local pottery with raised ribs, engraving decoration, and potter's marks, together with imported pottery from Aegean and Apennine-culture pottery from Italian Peninsula); 8) Late Bronze age, Ausonio I civilization (huts of various types, these likewise showing traces of violent destruction; darkish pottery characterized by different shaped projections on handles; scarce potsherds of Mycenaean IIIc and Protovillanovan-type imported pottery; and 1st

cremation tombs); 9) Early Iron age, Ausonio II civilization (wood-framed huts imbedded in stone and destroyed by fire; local pottery is, a) still Ausonio I style, b) bright-red showing evolution in shapes and characters, c) painted pottery of possible Mycenaean influence, older form with brown or reddish geometric motifs on yellow ground, younger with "plumed" motifs; imported vases include very fine late IIIc Mycenaean sherds and plentiful Late Nuragic pottery; bronze objects mark archaic and evolutionary phase); 10) cultural hiatus of perhaps more than 2½ centuries, between destruction of Ausonio II huts and settlement of Greek colony by Cnido and Rodi people; 11) Greek archaic age, later than 580 B.C.; 12) other layers of Greek and Roman epoch, Middle ages, and Modern times.

"Contrada Diana" corresponds to plane between foot of Lipari Acropoli and backstanding hills partly occupied by modern small town of Lipari. Excavations of prehistoric settlement, carried out in W zone from town up to 1st part of slope (38° 27' 45" N Lat, 14° 57' 04" E Long) brought to light from bottom upward: A) Late Neolithic stratum, over 1 m, containing monochrome undecorated pottery, named after site "Diana"; B) Eneolithic strata of Piano Conte and Piano Quartara cultures; and C) Early Bronze age stratum of Capo Graziano culture, 1st phase. In this last phase, perhaps in 17th century B.C., prehistoric settlement probably moved back to Acropoli for security reasons, as it had moved down to Contrada Diana in Late Neolithic (Bernabò Brea, 1966; Bernabò Brea and Cavalier, 1956; 1957; 1959; 1960). Charcoal from Lipari Acropoli and from Contrada Diana coll. from 1952 to 1965 and subm. 1960 and 1968 by L. Bernabò Brea and M. Cavalier.

R-366α. Acropoli di Lipari AO-y

5200 ± 60

3250 B.C.

$\delta C^{13} = -24.0\%$

Charcoal from Zone AO, Sounding y, 1958 excavations, in deepest archaeol. horizon: Middle Neolithic, trichrome pottery. *Comment:* sample 10% HCl pretreatment and 6% NH₄OH additional leaching was given. Age obtained seems rather young when compared with dates obtained for overlying layer of Late Neolithic; see R-180 and R-182 below.

R-180. Acropoli di Lipari AP

5000 ± 200

3050 B.C.

Charcoal from Zone AP, 1952 excavation, Later Neolithic layer, monochrome, undecorated red pottery of Diana style in level containing also copper slag. *Comment:* date agrees with C¹⁴ dates obtained for same cultural level in Diana settlement and with dates available for Diana and some parallel cultures in other Italian and Mediterranean sites; see R-182 comment below.

R-365α. Acropoli di Lipari BF-17

2900 ± 50

950 B.C.

$\delta C^{13} = -24.5\%$

Charcoal from Zone BF, Cut 17, 1958 excavation, in destruction

level outside Hut γ -VIII, Middle Bronze age, Milazzese culture. *Comment:* sample 10% HCl pretreatment and additional leaching with 6% NH_4OH was given. Since small vase of Mycenaean III A₂ style dated, according to Mycenaean chronology, at 14th century B.C. has been found on hut floor, C^{14} is too young, but pretreatment ought to exclude contamination by younger material.

R-181. Acropoli di Lipari BR

2555 \pm 50

605 B.C.

Charcoal from Zone BR, 1958 excavation, in thick fire level testifying final destruction of Ausonio II settlement. *Comment:* presumed archaeol. age does not agree with date obtained: possible contamination by mixture with younger material; see R-367 and R-367 α , from same level, comment below.

R-367. Acropoli di Lipari BR-6

2820 \pm 50

870 B.C.

$\delta\text{C}^{13} = -24.0\text{‰}$

R-367 α . Acropoli di Lipari BR-6

2770 \pm 50

820 B.C.

$\delta\text{C}^{13} = -24.0\text{‰}$

Charcoal from Zone BR, Cut 6, 1965 excavation, outside door of Great Hut α II: thick fire level testifying to final destruction of Ausonio II settlement. *Comment:* R-367 only 10% HCl pretreatment was given, R-367 α additional 6% NH_4OH leaching was given; consistent dates show material not contaminated. Mainly on basis of typology of bronze objects found in fire level, destruction of Ausonio II was dated between 2nd half and end of 9th century B.C.; C^{14} age agrees well with archaeol. evidence.

Culture comparable with Ausonio civilization of Lipari has been dated in Sicily at Morgantina site, province of Enna: St-1339, 2695 \pm 70 (Radiocarbon, 1965, v. 7, p. 286).

R-182. Contrada Diana XXI

4885 \pm 55

2935 B.C.

Charred wood from Zone XXI, Contrada Diana settlement, 1954 excavation, in Late Neolithic thick layer containing monochrome undecorated pottery of Diana style. *Comment:* R-182 and R-180 dates, the latter belonging to Diana culture in Acropoli settlement (this list), are consistent and also agree with other ages of the same or parallel Late Neolithic cultures in Italy and Malta hitherto available: Grotta delle Arene Candide, Liguria, Lagozza culture: R-104, 5075 \pm 45 (Radiocarbon, 1966, v. 8, p. 402); Lagozza di Besnate, Varese: Pi-34, 4794 \pm 90 (Radiocarbon, 1961, v. 3, p. 102), R-78, 4735 \pm 50 and R-338, 4980 \pm 50 (Radiocarbon, 1968, v. 10, p. 356); Grotta della Madonna, Praia a Mare, Calabria, Diana culture: 5110 \pm 70 (Radiocarbon, 1967, v. 9, p. 355); Grotta dei Piccioni, Abruzzi, Lagozza culture: Pi-49, 4770 \pm 110 (Radiocarbon, 1961, v. 3, p. 100); Skorba, Malta, Zebbug phase (Diana style): BM-147, 5000 \pm 150 and BM-145, 5140 \pm 150 (Radiocarbon, 1968, v. 10, p. 5; Trump, 1966).

3000 \pm 60
1050 B.C.
 $\delta C^{13} = -23.9\text{‰}$

R-369. Filicudi, Capo Graziano Cap. VIII

In 1956 and 1964, prehistoric settlements in Filicudi I., Aeolian Is., were excavated by L. Bernabò Brea and M. Cavalier. Settlement on Capo Graziano hillock (38° 33' 22" N Lat, 14° 35' 18" E Long), at +100 m yielded: A) lower layer, village of oval huts belonging to Capo Graziano eponymous culture, Early Bronze age; B) upper layer, more recent huts, Milazzese culture, Middle Bronze age. Both layers have been very exactly dated by means of typology of imported Aegean pottery present in them (Bernabò Brea and Cavalier, 1966). Charred wood, remains of wooden threshold on door of Hut VIII, one of the more superficial, completely belonging to Milazzese age; coll. 1964 and subm. 1968 by L. Bernabò Brea and M. Cavalier. *Comment:* archaeol. evidence, finding of Mycenaean III A2 pottery, dates Hut VIII at 14th or 13th century B.C.: R-369 age appears too young, probably contaminated by younger material.

C. Sardinia

2870 \pm 70
920 B.C.
 $\delta C^{13} = -23.9\text{‰}$

R-344 α . Malchittu

Charcoal from hearth inside "Tempietto di Malchittu," ca. 4 km E Arzachena, Gallura, prov. of Sassari (41° 04' 40" N Lat, 9° 24' 38" E Long) at +100 m. Coll. and subm. 1967 by M. L. Ferrarese Ceruti, Ist. di Antichità, Archeol. e Arte, Univ. of Cagliari. The well-preserved small stone temple, or sacellum, consists of a vestibule (3 \times 3.50 m) preceding a single elongated ellipsoid chamber (8 \times 4 m) with bench or altar at rear (Ferrarese Ceruti, 1962a). In deposit filling chamber and under layer of fall, 2 cultural horizons were id.: lower one, at floor level, containing ritual stone hearth and pottery with charcoal. *Comment:* because of corresponding structures and similar pottery Tempietto di Malchittu has been related to nearby Nuraghe of Albucciu near Arzachena, whose floor layer was dated ca. 1200 yr B.C.: Gif-242, 3170 \pm 250 (Radiocarbon, 1966, v. 8, p. 86). Sacellum structure has also been compared with that of W circular torrean monument of complex site of Filitosa, S Corsica, dated ca. 1200 yr B.C.: Gsy-58, 3150 \pm 150 (Radiocarbon, 1966, v. 8, p. 130; Lilliu, 1966; 1967a; 1967b). Some connections have been found between pottery of sacellum and that of so-called "Tombe dei Giganti" funerary monuments in Gallura, N Sardinia, ascribed to Middle Nuragic age, perhaps 1500 yr B.C. (Castaldi, 1969). Tempietto di Malchittu has now been ascribed to age between 1000 to 1500 yr B.C.: C^{14} age obtained is satisfactorily consistent.

In Sardinia only a few of many important prehistoric and proto-historic monuments have been dated: Nuraghe Barumini (Radiocarbon, 1960, v. 2, p. 10, K-151); Nuraghe Albucciu and Nuraghe Brunku Mādili

(Radiocarbon, 1966, v. 8, p. 86, Gif-242 and 243); Chia, Punic-Roman settlement (Radiocarbon, 1964, v. 6, p. 223, K-558 and 559).

Ossi series

In 1967, excavations carried out by M. L. Ferrarese Ceruti at Sa Mandra 'e Sa Giua near Ossi ca. 11 km S Sassari (40° 40' 35" N Lat, 8° 37' 03" E Long) brought to light 2 stone huts, A and B, of Nuragic age. From surface sec. throughout deposit inside Hut B revealed: I) loose soil; II) layer of ancient fall; III) upper cultural layer with large hearth and plentiful pottery, including typical comb-stamped pottery; IV) clay floor, sterile; V) lower cultural horizon similar to the upper one. Sec. throughout deposit outside Hut B revealed: I) loose soil; II) layer of ancient fall with fire traces; III) layer of frequentation down to rocky soil. Charcoal coll. 1967 and subm. 1968 by M. L. Ferrarese Ceruti.

R-347. Ossi B-IIIi **2600 ± 70**
650 B.C.

$$\delta C^{13} = -25.0\text{‰}$$

Charcoal from upper cultural layer of deposit inside Hut B.

R-346. Ossi B-IIIe **2460 ± 70**
510 B.C.

$$\delta C^{13} = -24.2\text{‰}$$

Charcoal from layer of frequentation outside Hut B.

General Comment: owing to stratigraphic and archaeol. data, comb-stamped pottery from Nuraghe "La Prisciona" and Nuraghe "Albucciu" is considered to precede 9th to 8th centuries B.C. (Contu, 1964-1965; Ferrarese Ceruti, 1962b). C¹⁴ dates obtained are thus younger than expected.

D. Pakistan

Ghāligai series

In April-June 1967 and in May-Sept. 1968 the Italian Archaeol. Mission in Swat State (W Pakistan) of Centro Studi e Scavi Archeologici in Asia of IsMEO (Ist. per il Medio ed Estremo Oriente) entrusted by G. Tucci, President of IsMEO, to D. Faccenna, Head of Mus. of Oriental Art in Rome, carried out excavations, under direction of G. Stacul, IsMEO, in rock shelter near village of Ghāligai, E side of Swat R. valley, at foot of one of limestone cliffs to left of, and not far from (20 m), rd. from Mingora to Barikot at 15 km from Mingora, Swat, W Pakistan (34° 70' N Lat, 72° 25' E Long). Before excavation, shelter was ca. 8 m width at mouth, 7.50 m deep in central part, and 1.80 m high from surface of deposit to vault. Deposit inside shelter was completely excavated: 2 trenches were dug, 1st one in left half (Area A), 2nd in right half (Area B). Successively, 5 contiguous trenches, C to G, whole area ca. 185 m², were dug just in front of shelter. Unified data from secs. throughout all trenches, A-G areas, of deposit, made mainly clayey flood sediments, max. thickness 12 m from surface to rocky bottom, revealed long period of

shelter dwelling or frequentation testified by different cultural strata: sterile strata were interposed and, at various levels, great and small limestone sharp-edged blocks and minute rubbles fallen from rock wall were present. Altogether 25 strata have been distinguished; on typological evidence these have been combined in different cultural horizons from bottom to top as follows. Lower deposits: Strata 24, 23, and 21, preserved only in area outside shelter, flaked pebbles and pebble flakes and coarse hand-made pottery; Strata 19 and 18, mainly very fine-textured and painted vases of various shapes and made on fast wheel (expression of more evolved culture, mostly found in Stratum 19); Strata 17 and 16, flaked pebbles and pebble flakes and coarse hand-made pottery poor in shapes (rise of new less-refined culture can be inferred); Stratum 15, scarce hand-made and fast-wheel-made fine pottery of different styles (only in part can be compared to pottery from tombs of archaic period in pre-buddhist necropolises of Swat, some a little earlier). Upper deposits: Stratum 13 (on stratigraphic evidence site probably was abandoned for long time between Strata 15 and 13 owing to landslide from rock walls) vases comparable chiefly with pottery of Buddhist epoch in Swat; Strata 12, 10, 9, 4, and 3, copper and iron objects, pottery comparable to types found at Chârsada, W Pakistan, belonging to later 3rd century B.C. and to Islamic period (Stacul, 1967; 1968). Charcoal from Strata 17, 18, 21, and 23 coll. and subm. 1967 by G. Stacul, on behalf of G. Tucci.

R-377 α . Ghāligai 17

3455 \pm 50

1505 B.C.

$\delta C^{13} = -25.9\%$

Charcoal from Stratum 17. *Comment:* sample pretreatment by 10% HCl and additional leaching with NH_4OH was given. Cultural horizon at this level, Strata 17 and 16, characterized by rudimentary, hand-made vases restricted in shapes, had already been recognized at Butkara I, near Swat Valley. Similar pottery is to be found in neighbouring countries: archaic phase at Burzahom, Kashmir, where Neolithic period has been dated from 3500 to 4300 yr B.P. (Radiocarbon, 1965, v. 7, p. 291-292); Mundigak, Afghanistan, Period V; Period I to III at this site dated from 3800 to 4300 yr B.P. (Radiocarbon, 1966, v. 8, p. 138; Casal, 1961); Tshust civilization in Ferghana, Uzbek SSR, Bronze age, referred to 2nd half of 2nd millennium B.C., on contrary, dated from 2600 to 3200 yr B.P. (Butomo, 1965).

R-378 α . Ghāligai 18

3760 \pm 55

1810 B.C.

$\delta C^{13} = -25.7\%$

Charcoal from Stratum 18. *Comment:* sample 10% HCl pretreatment and additional leaching with NH_4OH was given. Typology of shapes of fine vases at this cultural horizon, Strata 18 and 19, found for 1st time in Swat and in former NW Province, W Pakistan, has been compared with pottery of Indus civilization (or Harappa culture) common at Harappa, W Pakistan, both in early and more mature phase, and with

pottery of Chalcolithic sites of N Baluchistan: no C^{14} dates are available for these sites (Vats, 1940; Wheeler, 1947; 1966); some pottery can also be related to that of Harappan culture at Kalibangan, India.

Most reliable radiocarbon dates, till now available, for Harappa culture in W Pakistan and India are: Mohenjo-daro, W Pakistan, latest levels of mature Harappan period, 3700 to 4000 yr B.P. (Radiocarbon, 1967, v. 9, p. 333-334) and TF-75, 3600 ± 110 (Radiocarbon, 1964, v. 6, p. 231; Dales, 1965a; 1965b); Lothal, Gujarat State, India, largest Harappan settlement in India, 3600 to 4000 yr B.P. (Radiocarbon, 1963 and 1964, v. 5 and 6, p. 276-277 and 229, respectively); Kalibangan, Distr. Ganganagar, India, to be considered provincial capital of Harappan culture in India; well known twin Harappan mounds at this site have been dated several times for different periods, and ages range from 3600 to 4100 yr B.P. (Radiocarbon, 1963, v. 5, p. 92; 1964-1968, v. 6-8, 10, p. 229-230, 292-293, 447-448, and 134, respectively; Lal, 1963; Agrawal, 1964; Agrawal and Kusumgar, 1968b; Dales, 1966a; 1966b).

R-379. Ghāligai 21

4245 ± 55

2295 B.C.

$\delta C^{13} = -24.9\%$

R-379 α . Ghāligai

4180 ± 70

2230 B.C.

$\delta C^{13} = -25.3\%$

Charcoal from Stratum 21. *Comment:* see R-380.

R-380. Ghāligai

4200 ± 140

2250 B.C.

$\delta C^{13} = -25.6\%$

Charcoal from Stratum 23. *Comment:* R-379 and R-380 samples only 10% HCl pretreatment was given, R-379 α additional leaching with 6% NH_4OH was given: samples appeared not contaminated. Coarse hand-made pottery of this cultural horizon, Strata 21, 23, and 24, have been found for 1st time in Swat and in former NW Province of Pakistan. Some comparison can be made with vases common in settlements of Geoksjur, SE Turkmen SSR, from levels considered contemporary with Period II B near Namanzga Tepe. At present, C^{14} dates for Geoksjur are available only for Periods II, III, and IV and range from 3650 to 3800 B.P. but do not agree with archaeol. expected ages (Butomo, 1965). *General Comment:* 3 C^{14} well-defined chronologic horizons in Ghāligai settlement agree with expected archaeol. ages for respective cultural levels.

II. GEOLOGIC SAMPLES

Italy

Inghiottitoio series

Fragment of charred wood from materials filling a paleo-sinkhole in Messinian selenitic gypsa of Bolognese Pedepennine, 150 m NE "Il Castello" locality, Comune di Croara, ca. 6 km S Bologna, Emilia (44°

26' 31" N Lat, 11° 22' 47" E Long) at +240 m. Coll. and subm. 1967 by G. Pasini. Sec. cut by helicoidal saw in selenitic gypsum quarry across vertical funnel-shaped cavity, 12 m deep, of karst paleo-sinkhole now entirely sealed. It was presumably set at bottom of dolina but now by inversion of relief opens nearby at top of hillock. Sec. throughout deposit, 9 m thick, and resting partly on selenitic gypsum rock floor a), shows, from bottom upward: Lower formation, ca. 4 m thick, including: b) calcareous stalagmitic horizon, ca. 10 cm thick; c) to f) gypsiferous sandy-clayey silt, ca. 2 m thick; at 1.50 m, Level d), and at 2 m, Level f), from bottom, 2 thin dark-brown layers, containing fragments of charred wood and other vegetal remains; g) to i) clayey-silty very fine sand, ca. 2 m thick. Upper formation, ca. 5 m thick, includes: 1) thin gray, silty sand layer containing fragments of charred wood; m) to o) graded breccia, ca. 2 m thick, made by silty-clayey elements in gypsiferous-sandy cement, latter increases upward; p) gypsiferous sand ca. 3 m thick; q) surface humic soil. In Lower formation, mainly between d) and f) horizons with charcoal, bones of Upper Pleistocene cold fauna, including: *Mustela erminea*, *Marmota marmota primigenia*, *Lepus* cf. *timidus*, *Megaceros giganteus*, *Bison Superbison* sp., ?*Bos primigenius*, *Capreolus pygargus*; scarce remains of this fauna have also been found 1 m under d) and 1 m upper f) horizons. As sinkhole could not serve for housing, charred wood must be considered result of fire and brought by runoff into sinkhole (Pasini, 1968). Pollen analysis of lower level shows only pollen of *Pinus* (75%) and *Betula* (25%) and wood of *Pinus* sp.; at middle levels pollen showed *Pinus*, *Alnus*, *Ulmus* and *Quercus* and at upper levels pollen of *Corylus* and *Quercus* were id. (Bertolani Marchetti, 1960).

R-361. Inghiottitoio 108

11,150 ± 650

9200 B.C.

$\delta C^{13} = -23.1\text{‰}$

Fragments of charred wood, Sample 108 in Level 1), gray silty sand at bottom of Upper formation just under breccia at ca. 4 m above rock floor. *Comment*: 10% HCl pretreatment only was given: charcoal heavily penetrated by gypsum and devoid of carbonates.

R-362. Inghiottitoio 113

15,000 ± 150

13,050 B.C.

$\delta C^{13} = -23.2\text{‰}$

Fragment of charred wood, Sample 113 in Level f), dark-brown clayey-sandy silt in Lower formation, ca. 2 m above rock floor. *Comment*: only 10% HCl pretreatment; charcoal was penetrated by gypsum and devoid of carbonates.

R-363. Inghiottitoio 170

18,200 ± 200

16,250 B.C.

$\delta C^{13} = -23.1\text{‰}$

Fragments of charred wood, Sample 170, in Level d), dark-brown clayey sandy silt in Lower formation at ca. 1.50 m above rock floor. *Com-*

ment: only 10% HCl pretreatment; charcoal was penetrated by gypsum and devoid of carbonates.

General Comment: C¹⁴ ages date Lower formation and show sinkhole to have been filled from Main Würm phase to Alleröd, Pollen Zone II in central Europe, according to C¹⁴ chronology. R-363 and R-362 dates also agree with Upper Pleistocene cold fauna and pollen assoc. found at these levels.

Adriatic Sea

Our preceding date list (Radiocarbon, 1968, v. 10, p. 361-362) included oceanographic studies in Upper Adriatic Sea, on the submarine portion of Po R. delta and offshore area, by Ist. di Geol., Univ. of Bologna, under direction of R. Selli, Dir. Ist. di Geol., Univ. of Bologna (Ciabatti and Colantoni, 1966; Ciabatti, Colantoni and Rabbi, 1965; 1966). Dates of Core G.5 from Sta. 47 were reported and discussed. These samples from Core D.4 coll. 1965 by M. Ciabatti and P. Colantoni, Ist. di Geol., Univ. of Bologna, and subm. 1967 by R. Selli.

R-364. Adriatic Sea D.4

8300 ± 90

6350 B.C.

$\delta C^{13} = -28.6\%$

R-364A. Adriatic Sea D.4

8560 ± 230

6610 B.C.

$\delta C^{13} = -27.2\%$

Small bits of darkened, partially humified wood, plant fibres and some carbonized matter in sandy sediment with scarce silty and clayey fractions from Core D.4, 97 cm long, from Sta. 28, 9.8 km E off shore (45° 01' 12" N Lat, 12° 33' 59" E Long) water depth 28.80 m, 94 to 97 cm below top of core. *Comment*: only 10% HCl pretreatment was given: abundant CO₃-- and Fe++ have been detected. After pretreatment 2 fractions were separated by sieving: R-364 > 0.20 mm, R-364A < 0.20 mm; there are no significant differences between 2 ages.

General Comment: R-364 and R-364A from Core D.4 dates agree with R-334, 8475 ± 60 (Rome VI) from Core G.5-5, 90 cm below top of core, from Sta. 47, 12 km SE of Sta. 28. Available data do not yet allow correct interpretation. Systematic datings are now in process.

Only one other core in Adriatic Sea has been dated at Stockholm Lab. (Radiocarbon, 1960, v. 2, p. 195) and already discussed (Radiocarbon, 1968, v. 10, p. 362). Series of 15 samples from more or less shelly superficial bottom material, coll. between 41° 26' to 45° 17' N Lat and 12° 30' to 16° 59' E Long, have been dated at La Jolla Lab (Radiocarbon, 1967, v. 9, p. 281-282).

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Copenhagen VI	Tauber, 1964
Gif-sur-Yvette I	Coursaget and Le Run, 1966
Gif-sur-Yvette II	Delibrias, Guillier, and Labeyrie, 1966

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| La Jolla V | Hubbs and Bien, 1967 |
| Pennsylvania VI | Stuckenrath, Jr., 1963 |
| Pennsylvania X | Stuckenrath, Jr., 1967 |
| Pisa II | Ferrara, Fornaca-Rinaldi, and Tongiorgi, 1961 |
| Rome II | Alessio, Bella, and Cortesi, 1964 |
| Rome IV | Alessio, Bella, Bachechi, and Cortesi, 1966 |
| Rome V | Alessio, Bella, Bachechi, and Cortesi, 1967 |
| Rome VI | Alessio, Bella, Cortesi, and Graziadei, 1968 |
| Stockholm III | Östlund and Engstrand, 1960 |
| Stockholm VI | Engstrand, 1965 |
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