

UNIVERSITY OF ROME CARBON-14 DATES X

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This list includes age measurements made from November 1970 to December 1971. All archaeological and geologic samples come from Italian territory. Laboratory equipment, largely unchanged but expanded and technically improved, was previously described (Alessio *et al.*, 1970a). Charcoal and wood samples underwent standard pretreatment by boiling with 5 to 10% HCl; α -labeled samples were given additional leaching with 6% NH_4OH or 0.2N NaOH.

The activity of our "modern standard" wood grown near Rome between 1949 and 1953, was checked repeatedly with 95% of the counting rate of NBS oxalic acid and measurements were found coincident within 1σ . For each sample of CO_2 , the counting rate was corrected according to mass-spectrometrically measured $\text{C}^{13}/\text{C}^{12}$ ratio as described previously (Alessio *et al.*, 1969). Dates are reported in conventional radiocarbon years, 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 AND HISTORIC SAMPLES

A. Italy

- | | | |
|----------------------------------|----------------------------|---|
| R-375. | Lago Lucone, piroga | 3360 ± 50 1410 B.C. $\delta\text{C}^{13} = -29.3\text{‰}$ |
| R-375α. | Lago Lucone, piroga | 3160 ± 50 1210 B.C. $\delta\text{C}^{13} = -29.4\text{‰}$ |

Excavations made by Gruppo Grotte Gavardo in 1965 revealed pirogue from bottom peaty sediments of old intermorainal, now dried-up lacustrine basin of Lucone, near Polpenazze, prov. Brescia, Lombardy ($45^\circ 33' 05''$ N Lat $10^\circ 30' 00''$ E Long) (Cornaggia Castiglioni, 1967). Darkened wood (*Quercus* sp.) from pirogue coll. 1965 and subm. 1968 by Cornaggia Castiglioni, Sopr. Monumenti della Lombardia, Milan. *Comment:* pirogue was found at prehistoric settlement built on stacked timber platform or "bonifica" attributed to Polada culture. Dates agree

well with some dates for this culture, widespread in Po Valley and chronologically controversial (Alessio et al. 1971).

R-786 α . Bande di Cavriana, piroga

3520 \pm 50

1570 B.C.

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

Darkened wood from pirogue excavated 1970 from prehistoric "bonifica" settlement in Holocene peat bog, Bande di Cavriana, ca. 37 km N Mantua, Lombardy (45° 22' 15" N Lat, 10° 35' 00" E Long). Coll. and subm. 1970 by O. Cornaggia Castiglioni. *Comment*: date agrees with Polada culture in this site: R-25, 3495 \pm 60 (R., 1965, v. 7, p. 215).

R-359 α . Lago di Fimon, piroga

4580 \pm 50

2630 B.C.

$\delta C^{13} = -26.0\%$

Darkened wood, fragment of pirogue from peat bog, Val di Marca, near Lake Fimon, Berici Mts., ca. 9 km S Vicenza, Veneto (45° 29' 00" N Lat, 11° 31' 53" E Long). Coll. 1945 and subm. 1967 by O. Cornaggia Castiglioni. *Comment*: little is known of pirogue typology, which may be attributed to local facies of Early Bronze age. This date, in Po Valley, may be compared to age of a wooden artifact from "bonifica" settlement of Lagozzetta di Besnate, NW Lombardy, dated, according to Cornaggia Castiglioni, to beginning of Bronze age civilization of area: R-336, 4385 \pm 50 (R., 1968, v. 10, p. 357) (Cornaggia Castiglioni, 1967; 1968).

General Comment on pirogues: up to 1967, ca. 60 prehistoric boats were known, mainly in N Italy, particularly in Po Plain. These are generally one-piece pirogues, found whole or in fragments, mostly lost. Typology of only ca. 20 is known, and most are attributed to local cultures of Early Bronze age. Cornaggia Castiglioni (1967) made the 1st systematic study of Italian prehistoric pirogues. Three dates in this list are so far the only ones available for prehistory. Another pirogue from Valle Isola near Comacchio, Emilia, housed in Mus. Archeol. Ferrara, is from Roman age: R-2, 1810 \pm 140 (Bella and Cortesi, 1957) and dugout from shore of Lake Trasimeno, Umbria, is from Late Middle age; Pi-84, 744 \pm 110 (R., 1961, v. 3, p. 103).

R-819. Castelliere C. Marchesetti

3430 \pm 50

1480 B.C.

$\delta C^{13} = -25.1\%$

In 1970 G. Stacul, Ist. Storia Antica, Univ. Trieste, on behalf of Sopr. Antichità Trieste, made excavations at Castelliere C. Marchesetti, near Slivia, Commune of Duino-Aurisina, prov. Trieste, Venezia Giulia (45° 46' 00" N Lat, 13° 40' 35" E Long). Trench was dug into S slope of hill near enclosure wall of "castelliere". Through sec., ca. 2 m thick, 6 layers and 3 archaeol. horizons id. from assoc. pottery and animal bone remains, probably food refuse (Stacul, 1970; 1972). Charcoal from lower cultural horizon coll. 1970 and subm. 1971 by G. Stacul. *Comment*: place name "castellier" or "castelliere" designates prehistoric settlements, probably fortified villages, throughout Giulian Karst region and Dalmatia.

generally formed by remains of dry stone walls surrounding hill tops, with traces of stone buildings in walled area. Based on type of pottery in "castellieri", so-called Castellieri culture may be divided into at least 2 phases, between Late Bronze age and Iron age, likely up to Roman epoch (Marchesetti, 1903; Battaglia, 1958; Radmilli, 1963). C¹⁴ date is only one available for Castellieri culture and dates to Middle-Late Bronze age archaic cultural horizon of Castelliere C. Marchesetti.

Basilica di Monastero di Aquileia series

Wall foundation piling timbers from Basilica di Monastero, 1.5 km NE Aquileia, prov. Udine, Friuli (45° 46' 39" N Lat, 13° 22' 16" E Long). Coll. 1969 and subm. 1970 by L. Bertacchi, Dir., Mus. Archeol. Aquileia.

R-698. Basilica di Monastero 1 **1490 ± 50**
A.D. 460

$\delta C^{13} = -27.1\text{‰}$

Wood from foundation timber of Basilica's perimeter wall, with floor mosaic from late 4th to early 5th century A.D.

R-699. Basilica di Monastero 2 **1470 ± 50**
A.D. 480

$\delta C^{13} = -27.2\text{‰}$

Wood from foundation timber of transverse wall of 3 small rooms, also mosaic-floored, outside and adjacent to N side of Basilica. Mosaics are of same workmanship and level as those in Basilica.

General Comment: dated to determine construction stages of Basilica. Wood is coeval and ages agree with epoch of mosaics (Brusin, 1957; Bertacchi, 1965).

S. Michele di Valestra series

Since 1956, Comitato Sci. CAI Modena, Gruppo Archeol., has been excavating prehistoric settlement S. Michele di Valestra, ca. 6 km E Carpineti, prov. Reggio nell'Emilia (44° 27' 08" N Lat, 10° 33' 22" E Long). Deposit, occupying a whole plateau, ca. 120 m × 9 to 20 m, slightly below ridge of Mt. Valestra, revealed 3 archeol. layers with pottery, bone, horn, bronze and copper objects, animal bone remains, and charcoal. Finds in II and III layers attributed to Late Bronze age and Proto-Villanovan culture (Bertolani, 1967; Comitato Sci. CAI, 1970; Bellodi *et al.*, 1971). Charcoal from Layers II and III coll. 1969 and subm. 1970 by M. Bertolani, Ist. Min., Univ. Modena.

R-734 α . S. Michele di Valestra II **2660 ± 50**
710 B.C.

$\delta C^{13} = -24.7\text{‰}$

Charcoal from Layer II.

R-735 α . S. Michele di Valestra III**2830 \pm 50****880 B.C.** $\delta C^{13} = -25.0\%$

Charcoal from Layer III.

General Comment: dates confirm Proto-Villanovan culture.**R-676. Grotta dell'Orso di Sarteano****6080 \pm 50****4130 B.C.** $\delta C^{13} = -24.6\%$

Charcoal from lower Neolithic levels of Grotta dell'Orso, Villa Contucci near Sarteano, 9 km SW Chiusi, prov. Siena, Tuscany (42° 59' 25" N Lat, 11° 52' 08" E Long). Coll. 1963 and subm. 1970 by R. Grifoni, Ist. Antropol. e Paleontol. Umana, Univ. Pisa. Cave was discovered 1954 (Maetzke, 1954) and excavations made 1960-63 by A. M. Radmilli, G. Cremonesi, and R. Grifoni for Ist. Antropol., Univ. Pisa, with Sopr. alle Antichità dell'Etruria (Radmilli, 1960, 1962, 1963). In main deposit of cave's entrance chamber, various cultural horizons were id.: a) upper horizons—materials from Bronze age, Apennine, Sub-Apennine, and Proto-Villanovan cultures, only a few attributable to Anaeolithic (Cremonesi, 1968); b) lower horizons—Neolithic pottery of Linearbandkeramik cultural complex, or Sasso-Fiorano culture in Italy, some features similar to Bükk culture. Cave was also used as a burial place (Grifoni, 1967). *Comment:* date agrees with age of cultural horizon of Ripabianca di Monterado, attributed to early phase of Middle Neolithic, where both impressed pottery and elements of Fiorano culture are present: R-598, 6210 \pm 75; R-598 α , 6140 \pm 70 and R-599 α , 6260 \pm 85 (R., 1970, v. 12, p. 602-603).

*B. Elba Island***Golfo di Procchio shipwreck series**

The following series completes dating of Roman merchant ship from basal sand in Procchio Gulf, N coast Elba I. (42° 47' 31" N Lat, 10° 14' 56" E Long), water depth ca. 1.90 m (see R., 1971, v. 13, p. 398). Partially preserved wooden ship, discovered 1966 by G. Brambilla, was dug out of sand and described by G. Monaco and A. Fioravanti for Sopr. Antichità dell'Etruria, Florence. Various objects from cargo were found in ship and within radius ca. 30 m around it (Ferri Ricchi, 1969; Fioravanti and Ferri Ricchi, 1970; Fabiani, 1971; Zecchini, 1971). Wood, id. by M. Follieri, Ist. Bot., Univ. Rome (pers. commun.) and huntite samples coll. 1969 by A. Fioravanti and G. Brambilla and subm. 1971 by G. Maetzke, Sopr. Antichità dell'Etruria, Florence.

R-832. Golfo di Procchio Wreck 3**1810 \pm 50****A.D. 140** $\delta C^{13} = -25.2\%$

Fairly well-preserved wood (*Picea* sp.) from ship's outer planking. See R-835 α comment.

R-833. Golfo di Procchio Wreck 4 **1720 ± 50**
A.D. 230
 $\delta C^{13} = -26.5\text{‰}$

Fairly well-preserved wood (*Abies* sp.) from ship's inner planking. See R-835 α comment.

R-834 α . Golfo di Procchio Wreck 5 **1650 ± 50**
A.D. 300
 $\delta C^{13} = -26.8\text{‰}$

Darkened wood (*Ulmus* sp.) from a ship shelf-piece. See R-835 α comment.

R-835 α . Golfo di Procchio Wreck 6 **1660 ± 50**
A.D. 290
 $\delta C^{13} = -27.4\text{‰}$

Darkened wood (*Ulmus* sp.) from a ship frame. *Comment:* R-833/R-835 α dates agree with R-678 age: 1610 ± 50 (R., 1971, v. 13, p. 398) and confirm wreck as Imperial age Roman merchant ship.

R-836 α . Golfo di Procchio Wreck 7 **1600 ± 50**
A.D. 350
 $\delta C^{13} = -28.3\text{‰}$

Darkened wood found inside ship, but apparently unconnected with structure. *Comment:* date of another piece of wood found inside ship: R-679, 1670 ± 50 (R., 1971, v. 13, p. 398).

R-831A α . Golfo di Procchio Wreck 8 **1710 ± 50**
A.D. 240
 $\delta C^{13} = -27.0\text{‰}$

Darkened wood (*Larix* sp.) from board forming base of wooden box ca. 40 × 30 × 20 cm full of huntite on sea floor a few m from shipwreck. See R-831C α comment.

R-831B α . Golfo di Procchio Wreck 9 **1760 ± 50**
A.D. 190
 $\delta C^{13} = -25.2\text{‰}$

Darkened wood (*Larix* sp.) from thinner board forming one side of above mentioned box. See R-831C α comment.

R-831C α . Golfo di Procchio Wreck 10 **1670 ± 50**
A.D. 280
 $\delta C^{13} = -25.3\text{‰}$

Darkened wood, another fragment from board referred to above under R-831B. *Comment:* R-831A/C α dates confirm that, as inferred, box belonged to Roman ship's cargo.

R-853. Golfo di Procchio huntite **>42,000**
 $\delta C^{13} = +4.6\text{‰}$

Huntite sample from content, ca. 10 kg, of box found near shipwreck belonging to cargo (see R-831A/C α). *Comment:* upon recovery, this uncommon mineral, magnesium and calcium carbonate, Mg₃Ca-

(CO₃)₄, appeared as a white plastic mass which, in drying, turned into impalpable powder. Id. as huntite by chemical, x-ray, and differential-thermal analyses and electron microscopy. Material was not pretreated prior to CO₂ extraction by acid. C¹⁴ measurement was made because of initial supposition that huntite formed during long period on sea floor by exchange reactions with seawater ions (Ca⁺⁺, CO₃⁻⁻) of more common magnesium minerals, particularly magnesite, known to have been used and traded in antiquity, or even of hydromagnesite or possibly *magnesia usta*. Inactivity of mineral, however, disproves origin from hydromagnesite or *magnesia usta*, while thermodynamic study of reaction: 4MgCO₃ + Ca⁺⁺ → Mg₃Ca(CO₃)₄ + Mg⁺⁺ would deny possibility of formation from magnesite. We should therefore conclude huntite, as such, was originally in box, and was part of cargo leaving source of this rare mineral in doubt.

C. Sicily

1950 ± 50

R-718. Avola, anchor

A.D. 0

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

Wood from wooden core of ancient lead anchor stock, length 1.67 m, weight 107 kg, found in sea at ca. 16 m depth, near mouth of Fiumara torrent, ca. 4 km S Avola, prov. Siracusa (36° 51' 30" N Lat, 15° 08' 38" E Long) and since housed in Mus. Nazionale di Siracusa, marking: SIR A 155, inventory no. 58560. Coll. 1965 by Montenero and subm. 1970 by L. Bernabò Brea, Sopr. Antichità Sicilia Orientale, and G. Kapitän. *Comment*: numerous ancient lead anchor stocks have been found in Mediterranean on shipwrecks of known age, but no wooden-core anchor stock has yet been found on datable wrecks (Benoit, 1952, 1955). Thus, C¹⁴ age establishes for 1st time that this type of anchor was also used during Roman epoch.

II. GEOLOGIC SAMPLES

Italy

3440 ± 50

R-783_α. Rubiera

1490 B.C.

$\delta C^{13} = -26.0\%$

Slightly darkened fossil wood (*Quercus* sp.) id. by D. Bertolani Marchetti, from large trunk, ca. 7 m long, in horizontal position under alluvial gravel of Secchia R. near Rubiera, prov. Reggio nell'Emilia (44° 39' 19" N Lat, 10° 47' 45" E Long). Coll. 1970 and subm. 1971 by D. Bertolani Marchetti, Ist. Bot., Univ. Bologna. Fossil forest was buried under alluvial sandy gravel ca. 9 m thick. Several large tree stumps both *in situ* and in horizontal position, the latter 7-8 m long, were found. *Comment*: forest probably belongs to *Quercetum-Carpinetum* vegetation, which characterized Po R. valley since Sub-Atlantic, confirmed by date.

R-715 α . Monte Somma-Vesuvio**1800 \pm 50****A.D. 150** $\delta C^{13} = -24.8\%$

Carbonized wood, fragments of little branches, from reworked pyroclastic formation, overlying pumice, on road from Ercolano to Mt. Vesuvio near junction of Osservatorio Vesuviano Rd. (40° 46' 50" N Lat, 14° 39' 03" E Long). Coll. and subm. 1970 by M. Fornaseri, C. Cortesi, and G. Calderoni, Ist. Geochim., Univ. Rome. *Comment*: date attributes pyroclasts to A.D. 79 Plinian eruption of Somma-Vesuvius volcano. Age of carbonized bread from a storehouse of ancient Pompei: L-371E, 1830 \pm 50 (R., 1959, v. 1, p. 26).

Campi Flegrei, Napoli

The following series include a 2nd group of systematic dates of carbonized wood and humified layers of paleosols interbedded in pyroclasts of Campi Flegrei volcanic region. The preceding date list (R., 1971, v. 13, p. 403-409) reported the more significant outlines of long activity and structure of this volcanic system and essential bibliography. Humified layers were pretreated with 8N HCl; when not otherwise indicated, humic acids were extracted with 6% NH₄OH and precipitated again by dilute HCl. Wood id. by M. Follieri.

*1st Phlegrean period***R-824. Torre di Franco****>42,000** $\delta C^{13} = -25.2\%$

Sec. ca. 100 m W Torre di Franco, from cartway to large "piperno" quarry (40° 51' 07" N Lat, 14° 11' 31" E Long) exposes light stratified tuffs "Tufi di Torre di Franco" with several interbedded humified layers, underlying "piperno" and "breccia museo" complex (Rittmann *et al.*, 1950, p. 146, 151). Humic acids from humified layer underlying Torre di Franco tuffs coll. and subm. 1971 by A. Scherillo and E. Franco, Ist. Min., Univ. Naples, and M. Fornaseri, C. Cortesi, and G. Calderoni. *Comment*: age is as expected from stratigraphic position of Torre di Franco tuffs.

Tufo grigio campano or "Ignimbrite Campana" series

Carbonized wood embedded in "Campanian gray tuff" or "Campanian Ignimbrite" (Di Girolamo, 1970). Samples from various localities coll. and subm. 1971 by P. Di Girolamo and C. Porcelli, Ist. Min., Univ. Naples.

R-821. Monte della Taglia, Cicciano I-1**36,000 \pm 2000****34,050 B.C.** $\delta C^{13} = -23.4\%$ **R-821 α . Monte della Taglia, Cicciano I-1****35,300 \pm 1000****33,350 B.C.** $\delta C^{13} = -23.6\%$

Carbonized wood, fragment of branch, embedded in middle-upper

part of Campanian gray tuff, yellow facies, Monte della Taglia quarry, ca. 2 km NW Cicciano, prov. Naples, Campania (40° 58' 10" N Lat, 14° 33' 58" E Long).

R-822. Atripalda **33,000 ± 1500**
31,050 B.C.
 $\delta C^{13} = -22.6\text{‰}$

Carbonized wood (*Pinus* sp.) embedded in Campanian gray tuff, yellow facies, from sec. near Villa Limongelli at entrance of road from Atripalda to Salerno, ca. 4 km E Avellino, Campania (40° 54' 50" N Lat, 14° 49' 18" E Long).

R-784. Lazzaretto **29,700 ± 800**
27,750 B.C.
 $\delta C^{13} = -23.3\text{‰}$

R-784 α . Lazzaretto **28,300 ± 800**
26,350 B.C.
 $\delta C^{13} = -23.5\text{‰}$

Carbonized wood, fragment of little trunk, embedded in "cinerazzo" upper gray loose part of Campanian gray tuff, yellow facies, from quarry sec. at Lazzaretto, suburb of Avellino, Campania (40° 54' 45" N Lat, 14° 48' 33" E Long). Through sec. Campanian gray tuff, 10 m thick, overlying Pleistocene conglomerate, covered by pyroclasts mainly from A.D. 79 Plinian eruption of Somma-Vesuvius volcano.

R-820. S. Martino Valle Caudina **30,000 ± 900**
28,050 B.C.
 $\delta C^{13} = -21.9\text{‰}$

Carbonized wood, fragment of trunk, embedded in upper part, yellow facies, of Campanian gray tuff from quarry sec. 3 km E S. Martino Valle Caudina, at border of Avellino and Benevento provs., Campania (41° 01' 50" N Lat, 14° 41' 53" E Long). In sec. gray facies appears in lower part of Campanian gray tuff which overlies Pleistocene polygenic conglomerate, covered by A.D. 79 Plinian eruption of Somma-Vesuvius products.

General Comment: these dates confirm Würm age of "Campanian gray tuff" (Campanian Ignimbrite) as from stratigraphic evidence (Brancaccio, 1968). Age of carbonized wood in lower part of Campanian gray tuff: R-567, >40,000 yr (R., 1971, v. 13, p. 404). For K/Ar dates referred to Campanian gray tuff, see R., 1971, v. 13, p. 405.

R-714. Spiaggia di Acquamorta, Monte di Procida **31,700 ± 1400**
29,750 B.C.
 $\delta C^{13} = -23.6\text{‰}$

Carbonized wood, fragments of little branches, from humified layers interbedded in thick series of pyroclasts on Acquapendente shore facing Procida channel, 0.5 km SW Monte di Procida, Campi Flegrei, Napoli (40° 47' 42" N Lat, 14° 02' 37" E Long). Coll. and subm. 1970 by E. Franco. Humified layers with carbonized wood are interbedded in chaotic

gray pozzolana-pumice and lapilli layer overlying scoriae of trachyte lava dome of S. Martino later intruded in pyroclastic series. *Comment:* pyroclasts believed to belong to 1st period of Phlegrean activity and C^{14} age agrees.

R-823. Valle del Verdolino

16,390 ± 180

14,440 B.C.

$\delta C^{13} = -25.2\text{‰}$

Humic acids from lower humified layer interbedded in upper part of stratified whitish tuffs underlying Neapolitan yellow tuff, old "piperino" quarry sec. E side Verdolino Valley, Campi Flegrei (40° 51' 08" N Lat, 14° 12' 37" E Long) U.T.M. system 33T VF 333(5) 231(8). Coll. and subm. 1971 by A. Scherillo, E. Franco, M. Fornaseri, C. Cortesi and G. Calderoni. (Rittman, 1950, p. 139 ff.). *Comment:* lower pyroclasts of 2nd period and Neapolitan yellow tuff, most widespread product of main phase of 2nd period, were dated 12,800 to 11,600 and 10,000 B.P. (R., 1971, v. 13, p. 407). C^{14} age of whitish tuff formation agrees with upper part of 1st Phlegrean period. See also Campanian gray tuff series, this list.

R-825. Vallone delle Fontanelle

15,090 ± 140

13,140 B.P.

$\delta C^{13} = -25.3\text{‰}$

Humic acids from thick strongly humified pozzolana layer, Fontanelle Valley sec. on road to Castagneto locality, NW suburb of Naples (40° 51' 38" N Lat, 14° 13' 59" E Long). Coll. and subm. 1971 by A. Scherillo, E. Franco, M. Fornaseri, C. Cortesi and G. Calderoni. *Comment:* Fontanelle Valley stratigraphic series can be compared to similar one of Verdolino Valley (R-823, this list). Agreement of dates could confirm assumption.

General Comment to 1st Phlegrean period: new dates integrate C^{14} chronology of volcanic events preceding eruption of yellow Neapolitan tuff and indicate that this activity ranges from >12,000 to ca. 15,000 B.P. with an upper limit of 12,800 B.P. representing youngest of organic materials underlying the yellow Neapolitan tuff.

2nd and 3rd Phlegrean periods

Pomigliano D'Arco series

Secs. in large pozzolana and volcanic sand quarry on plain not far from N side of Somma-Vesuvio volcano, SE suburb of Pomigliano D'Arco, Napoli (40° 54' 10" N Lat, 14° 23' 53" E Long) expose volcanic formation, ca. 15 m high, with interbedded Somma-Vesuvio and Phlegrean products. Humified layers coll. and subm. 1971 by A. Scherillo, P. Di Girolamo, M. Fornaseri, C. Cortesi, and G. Calderoni. Samples were pretreated with 8N HCl; humic acids extracted both with 6% NH_4OH (-A labeled samples) and 0.2N NaOH (-B labeled samples) and precipitated again by dilute HCl: no difference between 2 dates.

R-826. Pomigliano D'Arco II-1
12,280 ± 100
10,330 B.C.
 $\delta C^{13} = -26.1\%$

Humic acids from lower Layer 1 underlying 2nd Phlegrean products. *Comment:* date agrees with other C^{14} ages related to humified layers interbedded or underlying lower pyroclasts of 2nd period in Ponti Rossi and Masseria Ferrara quarries, and in Via Provenzale and Capodichino secs. (R., 1971, v. 13, p. 406-407).

R-827A. Pomigliano D'Arco II-2
11,240 ± 80
9290 B.C.
 $\delta C^{13} = -26.2\%$

R-827B. Pomigliano D'Arco II-2
11,360 ± 100
9410 B.C.
 $\delta C^{13} = -26.1\%$

Humic acids from Layer 2 underlying Agnano products and overlying lower pyroclasts of 2nd period. *Comment:* date agrees with age of humified layers in similar stratigraphic position at Masseria Ferrara quarry: R-704, $10,740 \pm 90$ (R., 1971, v. 13, p. 407).

R-828A. Pomigliano D'Arco III-3
8620 ± 70
6670 B.C.
 $\delta C^{13} = -25.3\%$

R-828B. Pomigliano D'Arco III-3
8510 ± 50
6560 B.C.
 $\delta C^{13} = -25.5\%$

Humic acids from Layer 3 interbedded in middle 3rd Phlegrean period pyroclasts and overlying Agnano products. *Comment:* date is the only one available for pyroclasts overlying Agnano products.

R-829A. Pomigliano D'Arco III-5
4800 ± 60
2850 B.C.
 $\delta C^{13} = -26.0\%$

R-829B. Pomigliano D'Arco III-5
4800 ± 50
2850 B.C.
 $\delta C^{13} = -26.0\%$

Humic acids from Layer 5 interbedded in upper part of middle 3rd period Phlegrean products and underlying Astroni products. *Comment:* date agrees with other C^{14} ages of layers underlying Astroni at Masseria Ferrara quarry, Rione Mofete and Bivio di Quarto secs.; see R-703, 592, and 596 (R., 1971, v. 13, p. 407-409).

R830A. Pomigliano D'Arco III-6
3510 ± 50
1560 B.C.
 $\delta C^{13} = -24.5\%$

R-830B. Pomigliano D'Arco III-6**3610 ± 50****1660 B.C.** $\delta C^{13} = -25.1\%$

Humic acids from Layer 6 overlying Astroni products. *Comment:* date agrees with ages of layer overlying Astroni at Rione Mofete and Bivio di Quarto secs.; see R-591 and 597 (R., 1971, v. 13, p. 408-409), and with ages of carbonized wood in Astroni products; see R-785 and 707 to 713.

General Comment: R-828A/B ages date for the 1st time upper limit of Agnano eruptions. Dates of other humified layers confirm once more previous Phlegrean C¹⁴ chronology of main events of 2nd and 3rd periods, summarized in preceding date list (R., 1971, v. 13, p. 407 and 409; Alessio, Bella, Belluomini, *et al.*, 1971).

R-785. Via Terracina, Napoli**4070 ± 50****2120 B.C.** $\delta C^{13} = -25.0\%$

Carbonized wood, little trunk (*Quercus* sp., deciduous group), from small outcrop of pozzolana and pumice at Via Terracina, Nuovo Rione S. Paolo, W suburb of Naples (40° 50' 22" N Lat, 14° 11' 12" E Long) U.T.M. system 33T VF 315 215. Coll. and subm. by E. Franco. *Comment:* date confirms Astroni volcano products. Age of other carbonized wood from same outcrop: R-682, 4000 ± 50 (R., 1971, v. 13, p. 408).

Astroni series

Several carbonized fragments of small trunks or branches, are scattered through Astroni products; some of them have been found in pumice and pozzolana quarry in N side of well-preserved Astroni crater, Campi Flegrei (40° 51' 15" N Lat, 14° 08' 50" E Long) U.T.M. system 33T VF 282 232. Coll. and subm. by A. Scherillo, E. Franco, M. Fornaseri, C. Cortesi, and G. Calderoni.

R-707. Astroni III-1**3650 ± 50****1700 B.C.** $\delta C^{13} = -24.3\%$

Carbonized wood from Astroni crater, E side of quarry.

R-708. Astroni III-2**3680 ± 50****1730 B.C.** $\delta C^{13} = -24.2\%$

Carbonized wood from Astroni crater, E side of quarry. *Comment:* R-708 age: 3520 ± 50 (R., 1971, v. 13, p. 408).

R-709. Astroni III-3**3830 ± 50****1880 B.C.** $\delta C^{13} = -26.0\%$

R-709 α . Astroni III-3 **3670 \pm 50**
1720 B.C.
 $\delta C^{13} = -25.7\%$

Carbonized wood (*Quercus ilex*) from Astroni crater, E side of quarry.

R-710. Astroni III-4 **3710 \pm 50**
1760 B.C.
 $\delta C^{13} = -24.6\%$

Carbonized wood (*Quercus ilex*) from Astroni crater, W side of quarry.

R-711. Astroni III-5 **3700 \pm 50**
1750 B.C.
 $\delta C^{13} = -24.6\%$

R-711 α . Astroni III-5 **3710 \pm 50**
1760 B.C.
 $\delta C^{13} = -24.8\%$

Carbonized wood (*Populus* sp.) from Astroni crater, W side of quarry.

R-712. Astroni III-6 **3790 \pm 50**
1840 B.C.
 $\delta C^{13} = -24.9\%$

R-712 α . Astroni III-6 **3780 \pm 50**
1830 B.C.
 $\delta C^{13} = -25.3\%$

Carbonized wood from Astroni crater, W side of quarry.

R-713. Astroni III-7 **3640 \pm 50**
1690 B.C.
 $\delta C^{13} = -25.1\%$

R-713 α . Astroni III-7 **3760 \pm 50**
1810 B.C.
 $\delta C^{13} = -24.9\%$

Carbonized wood from Astroni crater, W side of quarry.

General Comment: R-707 and 710 were pretreated with only 5% HCl because humic charcoal was completely soluble in 0.2N NaOH; other samples R-708/9/11/12/13 also additional leaching with 0.2N NaOH were given: difference between 2 ages, not very significant, shows abundant humic fraction extracted was not contaminating but belonged to charcoal humic fraction. Complex of dates of carbonized wood in Astroni products at Via Terracina (see R-785, this list) and from Astroni crater places eruptions between 3600 and 4100 B.P.

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