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LYON NATURAL RADIOCARBON MEASUREMENTS IV

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INTRODUCTION

This list includes most of the samples measured from June 1970 to June 1972 and some other results not yet published in previous date lists.

Chemical treatment of samples and counting technique remain as described previously (R., 1969, v. 11, p. 112-113; R., 1973, v. 15, p. 134-155). See also Longin (1971) for bone preparations performed by solubilization of collagen in acid hot water.

Ages are calculated using the half-life value 5570 with 1950 as reference year. The statistical errors, corresponding to one standard deviation, include contemporary standard, background, and sample counts.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

4220 ± 130
Ly-583. Roudil, Tarn **2270 B.C.**

Clayey peat from 47 to 55cm depth in Roudil peat bog, near Arfous, Tarn (43° 26′ N Lat, 2° 31′ E Long.) Coll. and subm. 1971 by J. L. de Beaulieu, Lab. Bot. Hist., Univ. Provence, Marseille. Level marks beginning of *Fagus* increase in pollen diagram. *Comment* (J. L. de B.): low alt. of site might suggest a Sub-Atlantic age for *Fagus* increase, as in Malaroumet peat bog, Dordogne: Lv-387: 1570 ± 80 B.P. (R., 1970, v. 12, p. 554). But here it seems closer to *Fagus* increase in Les Estables peat bog, Pyrénées Orientales, a little later than Gif-1199: 5120 ± 130 B.P. (R., 1972, v. 14, p. 308) and in Les Laubies peat bog Lv-515: 3590 ± 140 B.P. (R., 1971, v. 13, p. 358); see also Lacaune D 70, 105 (Ly-545, below).

Lacaunes series, Tarn

Peat from several levels in a peat bog, alt. 1022m in Monts de Lacaune massif, near Lacaune, Tarn (43° 42′ N Lat, 2° 41′ E Long). Coll. and subm. 1970 by J. L. de Beaulieu.

1750 ± 110
Ly-543. Lacaune D 70, 50cm **A.D. 200**

50cm below surface, pollen diagram marks *Fagus* and *Abies* decline under human influence.

2790 ± 110

Ly-544. Lacaune D 70, 85cm **840 B.C.**

85cm below surface, pollen diagram marks *Fagus* and *Abies* maximum and *Ulmus* decline.

5480 ± 140

Ly-545. Lacaune D 70, 105cm **3530 B.C.**

105cm below surface, bottom of boring; pollen diagram marks *Quercus* and *Corylus* maximum, attributed to end of Atlantic A.

General Comment (J. L. de B.): age as expected. *Fagus* increase at —95cm may be extrapolated to end of Atlantic B, ca. 4000 B.P., which also agrees with dates of peat bogs of neighboring mts. (e.g., Ly-583, this list) (de Beaulieu and Evin, 1972).

Eyzin-Pinet series, Isère

Wood from La Gère R. alluvium near Eyzin-Pinet, Isère (45° 29′ N Lat, 5° 00′ E Long.) Coll. and subm. 1971 by G. Chapotat, Centre de recherches et Etudes archéol. de Vienne, Isère.

2040 ± 150

Ly-536. Eyzin-Pinet, Ey n° 1 **90 B.C.**

Fragment of a large tree trunk.

2050 ± 150

Ly-537. Eyzin-Pinet, Ey n° 2 **100 B.C.**

Fragment of a wooden picket, assoc. with Celtic pottery.

General Comment (G. C.): Ly-537 agrees with expected age. Ly-536 proves tree is contemporaneous with industry and does not belong to ancient alluvium (Chapotat and Samuel, 1972).

2600 ± 380

Ly-509. Les Angles, Corrèze **650 B.C.**

Wood coll. by boring in a sandy layer, 35m deep and 8m below Corrèze R. bed at Les Angles, Corrèze (45° 18′ N Lat, 1° 38′ E Long.) Coll. et subm. 1971 by J. P. Meunier, Elec. de France, Paris. Boring was in right bank of river, at a dam site planned by Entente Interdept. Corrèze-Dordogne for Dir. Dept. l'Equipement de la Dordogne. *Comment* (J.P.M.): sandy layer underlies 35m fissured gneiss. Date suggests gneiss slid over a sand bank in ancient channel of Corrèze R.

4640 ± 140

Ly-504. Moirans, Isère **2690 B.C.**

Wood coll. by boring 7m deep, in alluvium in former channel of Isère R. (45° 17′ N Lat, 5° 36′ E Long). Coll. and subm. 1971 by MAPA-FIT Soc. Grenoble. *Comment*: shows thickness of recent filling in Isère R. low valley.

Ly-556. Frache, Monétier-Allemont, Hautes-Alpes **Modern**

Fragment of tree trunk uprooted in alluvium of Frache torrent (44° 23′ N Lat, 5° 57′ E Long). Coll. and subm. by M. Archambault, Dept.

Lettres et Sci. Humaines, Univ. Orléans. Alluvium is related to 40m terrace of Durance R. *Comment*: tree does not belong to old sediments.

530 ± 200

Ly-557. Les Eymarrons, Ribiers, Hautes-Alpes **A.D. 1420**

Fragment of tree trunk uprooted in erosion slope, middle terrace of Le Buech R. at Les Eymarrons near Ribiers, Hautes-Alpes (44° 13′ N Lat, 5° 43′ E Long). Coll. and subm. 1970 by M. Archambault. *Comment* (M.A.): proves tree is modern and does not belong to colluvium material of terrace, despite its fossilized aspect.

8620 ± 380

Ly-558. Messires Odou, Sigottier, Hautes-Alpes **6670 B.C.**

Fragment of tree trunk rooted and fossilized in colluvial slime, under surface of slope of low terrace of Le Buech R. near Sigottier, Hautes-Alpes (44° 28′ N Lat, 5° 44′ E Long). Coll. and subm. 1970 by M. Archambault. *Comment* (M.A.): as expected, date is postglacial for the terrace. See also Ly-555 (below).

9250 ± 190

Ly-555. Les Barbiers, Lazer, Hautes-Alpes **7300 B.C.**

Fragment of tree trunk rooted in clay on Les Barbiers torrent bank, near Lazer, Hautes-Alpes (44° 21′ N Lat, 5° 50′ E Long). Coll. and subm. 1970 by M. Archambault. *Comment* (M.A.): as expected, date is postglacial for sediments and assoc. Le Buëch R. low terrace. Cf. Ly-227: 11,250 ± 250 B.P. (R., 1971, v. 13, p. 53) from Cuculiane site, in the same valley, 6km away, and Ly-558 (this list).

Ly-546. Les Guinguettes, Vaux-Milieu, Isère **Modern**

Bovine bones from 1m depth in sandy fluvial gravel of Würmian moraine at Les Guinguettes near Vaux-Milieu, Isère (45° 37′ N Lat, 5° 11′ E Long). Coll. and subm. 1971 by B. Walter, Géol. Dept., Univ. Lyon. *Comment* (B.W.): old age was expected, considering deposit conditions, but date indicates bones were buried in sediments.

370 ± 100

Ly-547. Trou Bernier, Géovreisset, Ain **A.D. 1580**

Ox and horse bones from Le Trou Bernier near Géovreisset, Ain (46° 15′ N Lat, 5° 37′ E Long). Coll. 1971 by P. Bernier and subm. 1971 by C. Guérin, Géol. Dept., Univ. Lyon. *Comment* (C.G.): bones are recent, although they underlie thick forest soil.

+ 1900

Ly-362. Rivière souterraine de La Balme d'Epy, Jura **20,300**
− 1600
18,350 B.C.

Underground river of La Balme d'Epy, Jura. Bones of large mammal from bed of an underground river 800m inside a grotto near La Balme d'Epy, Jura (46° 23′ N Lat, 5° 25′ E Long). Coll. in 1970 by C. Guérin. *Comment* (C.G.): perfect agreement with attributed late-Würm fauna

(*Crocuta spelaea, Mammuthus primigenius, Coelodonta antiquitatis, Equus caballus,* and *Bison priscus*) and shows that collagen partly remains in bones, despite long immersion.

Grotte des Hyènes series, Le Blanc, Indre

Bones of large mammal from Les Hyènes Grotto near Le Blanc, Indre (47° 22′ N Lat, 1° 42′ E Long). Coll. and subm. 1971 by C. Guérin.

Ly-548. Grotte des Hyènes, salle des Hyènes ⩾29,000

Ly-549. Grotte des Hyènes, entonnoir ⩾29,000

General Comment (C.G.): dates exclude attribution to Würm III or Würm IV; these bones cannot be contemporaneous with neighboring Magdalenian site, Saint-Marcel and Abri Fritch, Indre.

Ly-441. Châtillon Saint-Jean, Drôme ⩾31,000

Bones of large mammal from 10m depth in Fournier Quarry at Châtillon Saint-Jean, Drôme (45° 5′ N Lat, 5° 08′ E Long). Coll. 1961 and subm. 1971 by C. Mourer-Chauviré, Géol. Dept., Univ. Lyon. The quarry is in alluvium of 70m terrace Isère R. *Comment* (C.M.): assoc. pollen indicates cold-steppe phase. Because of high position of terrace had been attributed to Mindel, but species suggest a Würm age also (Chauviré and Weiss, 1962). But date proves that it cannot be Würm IV or III cold phases.

Ly-511. Grotte de l'Aldène, Cesseras, Hérault **6860 ± 190**
4910 B.C.

Calcium carbonate from upper part of stalagmitic floor obstructing one entrance of l'Aldène Grotto, near Cesseras, Hérault (43° 18′ N Lat, 2° 48′ E Long). Coll. and subm. 1971 by H. de Lumley, Lab. paleontol. humaine et Préhist., Univ. Marseille. *Comment* (H. de L.): grotto contains Magdalenian paintings. Despite lack of information of this material, date shows, as expected, that entrance, presently obstructed, was open at time of paintings.

KS 05 and KS 06 marine core series, Mediterranean Sea

$>100\mu$ fractions of *Globigerina* mud from 2 borings in bottom of Mediterranean Sea between Algeria and Balearic Is. Core KS 06 (38° 31′ N Lat, 4° 00′ E Long), 2293m depth, and Core KS 05 (38° 06′ N Lat, 2° 59′ E Long), 2710m depth. Samples coll. 1970 by Centre Océanol. Bretagne and subm. 1972 by L. Leclaire, Lab. Géol., Mus. Natl. d'Hist. Natl., Paris. For all samples, amount of available material was ca. 5g.

Ly-589. KS 05 n° 1 **9470 ± 530**
7520 B.C.
$\delta C^{13} = +0.41‰$

From 70 to 105cm in KS 05 core.

Ly-590. KS 05 n° 2 **⩾20,500**
$\delta C^{13} = +1.76‰$

From 200 to 250cm in KS 05 core.

Ly-591. KS 05 n° 3 **⩾21,100**
$\delta C^{13} = -29.70‰$

From 305 to 340cm in KS 05 core.

Ly-592. KS 06 n° 1 **13,320 ± 1070**
11,370 B.C.
$\delta C^{13} = +1.45‰$

From 70 to 110cm in KS 06 core.

Ly-593. KS 06 n° 2 **⩾25,000**
$\delta C^{13} = -1.68‰$

From 200 to 245cm in KS 06 core.

Ly-594. KS 06 n° 3 **⩾30,000**
$\delta C^{13} = -1.63‰$

From 310 to 340cm in KS 06 core.

General Comment (L.L.): confirms expected range of dates deduced from paleoclimatic curve established by Foraminifera and 0^{18} studies. At the same depth, sediments formed just before postglacial time are older in KS 06 than in KS 05. This may indicate either a different sedimentation rate or a stratigraphic gap in the KS 06 sequence. δC^{13} values are in normal range of marine sediments except the very negative value Ly-591, which remains unexplained (Leclaire, 1972).

II. ARCHAEOLOGIC SAMPLES

A. Bourgogne, Franche-Comte, Lorraine

Ly-579. Thoraise, Doubs **2400 ± 130**
450 B.C.

Wood from hearth of a kiln at Thoraise, Doubs (45° 10′ N Lat, 5° 54′ E Long). Coll. and subm. 1970 by P. Pétrequin, Dir. antiquités préhist., Besançon. *Comment* (P.P.): agrees with La Tène I-IIa industry and older than Gif-1842: 2180 ± 70 B.P., from same place.

Ly-580. Florange F2, Moselle **2600 ± 130**
650 B.C.

Charcoal from hearth of a kiln at Sainte-Agathe, near Florange, Moselle (49° 20′ N Lat, 6° 07′ E Long). Coll. and subm. 1970 by P. Pétrequin. *Comment* (P.P.): assoc. industry is middle Hallstatt ceramic of low Rhine facies (Pétrequin *et al.*, 1972). Date agrees perfectly and also fits with Gif-1843: 2500 ± 70 B.P., from same site.

Ly-578. La Motte aux Magnins n° 2, Clairvaux, Jura **4480 ± 110**
2530 B.C.

Wood from Level 1 in coastal sta. La Motte aux Magnins in Le Grand Lac, near Clairvaux, Jura (46° 34′ N Lat, 5° 45′ E Long). Coll. and subm. 1970 by P. Pétrequin. *Comment* (P.P.): date disagrees with Late

Bronze assoc. industry (bronze awl and glass-paste pearl) but agrees with Middle Neolithic industry of underlying levels. Charcoal probably came from an older sta. and was redeposited during last rise of lake. The same explanation should hold for Ly-384, from the same site, previously described for coastal sta. Les Roseaux islet, Chalain Lake, Jura: Ly-385 (R., 1973, v. 15, p. 143).

5490 ± 110

Ly-513. Abri Gay, Poncin, Ain **3540 B.C.**

Charcoal from Level 6b, W part of Abri Gay rock shelter, near Poncin, Ain (46° 05′ N Lat, 5° 24′ E Long). Coll. and subm. 1971 by R. Desbrosse, Blanzy, Saône et Loire. Assoc. to industry attributed to Tardenoisian. *Comment* (R.D.): Neolithic date is much younger than expected. May indicate Mesolithic industry lasted a long time in region. No ceramics were found in level (Desbrosse, 1971).

Thoys series, Arbignieu, Ain

Samples from several levels of Thoys rock shelter, near Arbignieu, Ain (45° 45′ N Lat, 5° 39′ E Long). Coll. 1969 and 1970 by N. S. Morelon and subm. by R. Vilain, Dept. Géol., Univ. Lyon.

2100 ± 160

Ly-285. Thoys n° 1 and 2 **150 B.C.**

Charcoal from level with Chalcolithic industry. *Comment* (R.V.): as expected, proves upper levels were disturbed.

6190 ± 160

Ly-269. Thoys n° 5 **4240 B.C.**

Charcoal assoc. with Sauvetrian industry, Boreal period.

6850 ± 420

Ly-619. Thoys n° 8 **4900 B.C.**

Charcoal from same level as Ly-269. *Comment* (R.V.): date confirms Ly-269. Both dates are younger than expected by industry but Mesolithic may have been very prolonged in region.

9350 ± 300

Ly-270. Thoys n° 6 and 7 **7400 B.C.**

Charcoal from carbonaceous level, assoc. with a transition industry, between Azilian and Sauveterrian types, attributed to Pre-Boreal period. *Comment* (R.V.): date agrees with both attributions.

10,220 ± 650

Ly-620. Thoys n° 9 **8250 B.C.**

Small amount of charcoal from same layer as Ly-270. *Comment* (R.V.): date confirms Ly-270. Both dates are in statistical range.

9390 ± 150

Ly-599. Thoys n° 11 **7440 B.C.**

Calcium carbonate from same carbonaceous level as Ly-270 and Ly-620. *Comment* (R.V.): despite lack of knowledge of original C^{14} value of that type of material, value is same as for Ly-270.

Ly-567. Grotte de la Balme, Cuiseaux, Saône et Loire Modern

Bones from entrance of La Balme grotto at La Balme, Cuiseaux, Saône et Loire (46° 30′ N Lat, 5° 23′ E Long). Coll. 1962 by Vuillemey and subm. 1971 by J. Combier, Dir. antiquités préhist., Romanèche Thorins, Saône et Loire. Assoc. with some elements of Magdalenian industry. *Comment* (J.C.): disturbance confirmed of upper sediments of grotto.

Grotte Grappin series, Arlay, Jura

Bones from several levels of Grappin grotto at Saint-Vincent, near Arlay, Jura (46° 46′ N Lat, 5° 31′ E Long). Coll. 1961 by M. Vuillemey and subm. 1971 by J. Combier.

15,320 ± 370

Ly-497. Arlay n° 1, Level g, Sq. J to N 13,370 B.C.

Bones from several animal species of Late Quaternary. Level underlies a stalagmitic floor in center of grotto at 0.5m depth; that part of grotto was destroyed by a quarry. Assoc. Magdalenian industry.

15,770 ± 390

Ly-559. Arlay n° 2, Level g, Sq. P to T 13,820 B.C.

Bones of several animal species from front grotto, 0.4m deep. Assoc. Magdalenian industry.

25,520 ± 820

Ly-498. Arlay n° 3, Level e 23,570 B.C.

Bones (*Ursus spaeleus*) embedded in clayey level, 1.2m deep.

25,920 ± 900

Ly-499. Arlay n° 4, Level c 23,970 B.C.

Ursus spaeleus and *Hyena spelea* embedded in clayey level 2.0m deep, overlying a stalagmitic floor.

General Comment (J.C.): Ly-497 and -559 assoc. with particular Magdalenian industry comparable to Central European facies (Combier, 1954) and may be contemporaneous with Middle Magdalenian of region, age Würm IV. Both dates seem a little too old for La Croze II Middle Magdalenian site, expected older: Ly-434: 14,850 ± 350 B.P. (R., 1973, v. 15, p. 150). Ly-498 and Ly-499 give a Würm III age to lowest levels, as expected by similar sediments in other grottos in Jura (see Ly-362, this list).

Solutré series, Solutré, Saône et Loire

Bones from several levels of Solutré foot of cliff site, Solutré, Saône et Loire (46° 18′ N Lat, 4° 43′ E Long). Except Ly-647, samples coll. and subm. 1969 by J. Combier. Layers consist of conglomerated horse bones and so-called "Magma de Cheval," mostly Perigordian (Würm III b).

Ly-560. Solutré n° 4 bis, Sondage b, Level 6 ⩾30,400

Small uncharred horse bones. Same level as Ly-312: 28,650 ± 1100 (R., 1971, v. 13, p. 64). Three-sigma criteria used for age limit calculation.

23,200 ± 700

Ly-561. Solutré nº 5 bis, Sondage b, Level 6 21,250 B.C.

Uncharred horse bones. Same level as Ly-313: 22,650 ± 500 (R., 1971, v. 13, p. 64).

Ly-562. Solutré nº 7, Sondage Terre sève, Level 6 21,600 ± 700 19,650 B.C.

Uncharred horse bones.

1550 ± 90

Ly-647. Barbare de Solutré A.D. 400

Human bones coll. 1923 by C. Deperet and L. Mayet and subm. 1972 by J. Combier. From burial in level attributed to Upper Aurignacian, (Riquet, 1955) overlain by layer of unconglomerated horse bones that slid into W part of site. *Comment* (J.C.): a new examination of the old excavation (Combier, 1955) attributes burial to High Middle age cemetery, established in the archaeologic layers. Date agrees with that and anthropologic character of skeletons.

General Comment (J.C.): Ly-560 and -561 confirm difference between Ly-312 and -313 and hypothesis of mixing, in level, of older small bones (may be Aurignacian). Ly-561 and -562 agree well with Solutré 11: Ly-317: 24,050 ± 400 and Saint-Martin-sous-Montaigu, Saône et Loire: Ly-309/311: 23,550 ± 400 (R., 1971, v. 13, p. 63), both assoc. with Upper Perigordian industry.

Ly-566. Grotte de La Balme, Gigny-sur-Suran, Jura 29,500 ± 1400 27,550 B.C.

Small bones from Level VIII in La Balme grotto, at Gigny-sur-Suran, Jura (46° 27′ N Lat, 5° 27′ E Long). Coll. 1962 by M. Vuillemey and subm. 1971 by J. Combier. Assoc. with Levallois facies industry ("Laminaire" Late Mousterian, attributed to end of Würm II/III interstadial). *Comment* (J.C.): consistent with sedimentology and very evolved character of industry; but needs confirmation from other measurements. Date should indicate contemporaneity between Middle Paleolithic industries (Late Mousterian) from E France and Upper Paleolithic industries (Lower Perigordian and Aurignacian) from Dordogne.

B. Dauphiné, Auvergne

Gué de l'Ozon series, Sérézin-du-Rhône, Rhône

Samples from the ford of a Roman road on Ozon R., near Sérézin-du-Rhône (45° 38′ N Lat, 4° 55′ E Long). Coll. and subm. 1971 by G. Chapotat (1972).

330 ± 140

Ly-535. Gué de l'Ozon, Se nº 1 A.D. 1620

Wood from 1m depth, set in lowest layers of road metal.

17,200 ± 700

Ly-584. Gué de l'Ozon, Se nº 2 **15,250 B.C.**

Ferruginous scoriae from upper layer of surface of road.

18,500 ± 700

Ly-585. Gué de l'Ozon, Se nº 3 **16,550 B.C.**

Ferruginous scoriae from another road overlying the Roman one, probably from the Middle age.

General Comment (G.C.): 3 dates differ from expected values: Ly-535 proves wood was pushed in from actual soil. Ly-584 and -585 show roads were metaled with scoriae partly of coal. There are coal outcrops at Communay, 7km from Sérézin.

Grésine 2 series, Savoie

Samples from Coastal sta. Grésine 2, submerged 4.5m in middle of E bank of Le Bourget lake, near Brison Saint-Innocent, Savoie (45° 44′ N Lat, 5° 53′ E Long). Coll. and subm. 1971 by R. Laurent, Centre de Recherches Archéol. Lacustres, Tresserves, Savoie.

1280 ± 120

Ly-506. Grésine 2 nº 1 **A.D. 670**

Small wooden stake in lacustrian chalk assoc. with pottery debris.

1500 ± 360

Ly-507. Grésine 2 nº 2 **A.D. 450**

Small wooden stake in lacustrian chalk, close to Ly-506.

2840 ± 300

Ly-508. Grésine 2 nº 3 **890 B.C.**

Wood from pile foundation, center of coastal sta.

General Comment (R.L.): Ly-506 and -507 prove that small stakes are relatively recent fishery posts that carried ancient pottery downward into lacustrian chalk. Ly-508 confirms Late Bronze age of sta., which is contemporaneous with Châtillon sta., N part of lake; see Ly-274: 2670 ± 110 (R., 1971, v. 13, p. 57).

3850 ± 120

Ly-595. Les Sarrasins, Level 5, Isère **1900 B.C.**

Charcoal from Level 5b in Les Sarrasins grotto, near Seyssinet-Pariset, Isère (45° 10′ N Lat, 4° 43′ E Long). Coll. and subm. 1969 by A. Bocquet, Grenoble. Assoc. with decorated vessel North Alp type. *Comment* (A.B.): when sample was subm., expected age was at the limit between Middle and Early Bronze ages because of vessel decoration. Comparison with Clairvaux sta., Jura, suggests a full Early Bronze age corresponding to ceramic and metal of Arbon-Bleich sta., Switzerland, confirmed by date. Underlying level (7) was previously dated, Gif-1204: 3900 ± 120 (R., 1972, v. 14, p. 287) and is now attributed to Late Chalcolithic, with "Caliciforme" and "cordé" ceramic. Both dates agree perfectly.

4150 ± 100

Ly-296. Corent, Puy-de-Dôme **2200 B.C.**

Charcoal from Corent oppidum, Puy-de-Dôme (45° 40′ N Lat, 3° 11′ E Long). Coll. and subm. 1970 by J. P. Daugas, Dir. Antiquités préhistoriques, Clermont-Ferrand, Puy-de-Dôme. *Comment* (J.P.D.): date confirms industry is local evolution of Chassean to Chalcolithic influenced by civilizations of SE France (Daugas, 1972).

1490 ± 250

Ly-336. Le Taï, Saint-Nazaire-en-Royans, Drôme **A.D. 460**

Charcoal from upper layer La Grotte du Taï site, near Saint-Nazaire-en-Royans, Drôme (45° 09′ N Lat, 5° 15′ E Long). Coll. and subm. 1970 by J. and J. Brochier, Lab. Paléontol., Univ. Marseille. Assoc. with Epipaleolithic industries. *Comment* (J. and J. B.): proves upper layers were disturbed.

7100 ± 180

Ly-539. La Baume Loire III, Haute-Loire **5150 B.C.**

Small pieces of charcoal from rock shelter La Baume Loire III, near Solignac, Haute-Loire (44° 56′ N Lat, 3° 54′ E Long). Coll. and subm. 1971 by A. Crémilleux, Le Monastier-sur-Gazeille, Haute-Loire. *Comment* (A.C.): agrees well with assoc. industry, Tardenoisian without ceramics (Crémilleux, 1971). Should be compared to level 70 to 80cm, Longetraye site (this list).

La Grotte Béraud series, Saint-Privat d'Allier, Haute-Loire

Charcoal from several levels in La Grotte Béraud site, near Saint-Privat d'Allier, Haute-Loire (44° 58′ N Lat, 3° 40′ E Long). Coll. and subm. by A. Quinqueton, Le Puy, Haute-Loire. The 4 lowest levels contain 2 hearth zones, all with same industry that may correspond to Late Magdalenian with Azilian characters.

600 ± 150

Ly-49. Grotte Béraud AD 1 **A.D. 1350**

Coll. and subm. 1967, from 70cm depth in upper layers. *Comment* (A.Q.): just above a Middle age sepulchre; agrees well.

7110 ± 140

Ly-358. Grotte Béraud IN_2 156 **5160 B.C.**

Coll. and subm. 1970, from 95cm depth in upper hearth zone.

6640 ± 800

Ly-197. Grotte Béraud GN 3 **4690 B.C.**

Very small amount of charcoal, coll. and subm. 1969, from 110cm depth, Level 3, just above lowest hearth zone, in part of site very rich in industry.

8020 ± 260

Ly-646. Grotte Béraud GN 4 **6070 B.C.**

Coll. and subm. 1972, from 120cm depth in lowest hearth zone.

General Comment (A.Q.): Ly-358, -197, and -646 are coherent with stra-

tigraphy; deposit conditions seem to exclude all contamination. However, dates are much younger than indications of industry, which may be due to alt. or remote position of site, where Epimagdalenian characters may have lasted longer than elsewhere.

Longetraye series, Haute-Loire

Charcoal from rock shelter Longetraye, near Freycenet-la-Cuche, Haute-Loire (44° 52′ N Lat, 3° 55′ E Long). Coll. and subm. 1970 and 1971 by D. Philibert, Lab. d'Ethnol., Univ. Lyon. Site is at 1200m alt. in a cold region and was probably only a passage shelter for hunters. Dated to guide archaeologic digging and verify correlations of several levels.

Ly-409.	Longetraye	Sq.	D,	Layer	1	0 to 50cm	4640 ± 350 2690 B.C.
Ly-615.	”	”	6E,	”	1	20 to 30cm	3820 ± 140 1870 B.C.
Ly-616.	”	”	6E,	”	2	50 to 60cm	6210 ± 170 4260 B.C.
Ly-617.	”	”	6E,	”	3	70 to 80cm	7320 ± 140 5370 B.C.
Ly-410.	”	”	D,	”	2	80 to 100cm	8420 ± 280 6470 B.C.
Ly-618.	”	”	6E,	”	4	100 to 120cm	8220 ± 190 6270 B.C.
Ly-411.	”	”	D,	”	3	140 to 160cm	8450 ± 310 6500 B.C.
Ly-512.	”	”	6E,	”	4	170 to 190cm	12,720 ± 750 10,770 B.C.

General Comment (D.P.): Ly-409 and -615 prove that upper layers of site are polluted. Other results show that stratigraphy is regular and levels may be followed horizontally. Ly-512 gives Magdalenian age to lowest layer, agreeing with assoc. industry. Middle layers assoc. with Mesolithic industries and dates all generally agree with dates from low alt. sites.

Le Blot series, Cerzat, Haute-Loire

Samples from several levels of Le Blot site at Chambon, near Cerzat, Puy-de-Dôme (45° 18′ N Lat, 3° 28′ E Long). Coll. and subm. by J. P. Daugas.

Ly-563. Le Blot, Level 3 — **14,030 ± 500**
12,080 B.C.

Charred bones: coll. 1967, subm. 1969. Treated as uncharred bones by collagen extraction. Assoc. industry: Magdalenian.

Ly-502. Le Blot, Level 10 b — **11,250 ± 500**
9300 B.C.

Charcoal coll. 1967; subm. 1969. Assoc. industry: Magdalenian.

Ly-501. Le Blot, Level 13 **⩾22,000**

Small amount of charcoal. Coll. 1967; subm. 1969. Assoc. industry Magdalenian.

Ly-564. Le Blot, Level J M **21,700 ± 1200**
19,750 B.C.

Carbonaceous earth. Coll. and subm. 1970. Assoc. industry. Early Proto-Magdalenian.

Ly-565. Le Blot, Level G J **21,500 ± 700**
19,550 B.C.

Carbonaceous earth. Coll. and subm. 1970. Assoc. industry: Early Proto-Magdalenian.

General Comment (J.P.D.): Ly-563 is older than expected but quite possible because industry is rare and not very characteristic. Ly-502 and -501 are incompatible, one is too young, the other, too old: in both levels charcoal may have floated, come from rise deposits of a river, and may have heterogeneous origin. Ly-564 and -565 come from 2 hearths 3m away at same depth. Assoc. industry is Proto-Magdalenian with "Micro-pointes" La Gravette. For both hearths, overlying level also has Proto-Magdalenian industry, but without La Gravette point, *i.e.*, of Laugerie Haute and Abri Pataud types (Delporte, 1970). Expected age was a little older than the dates of these sites: Abri Pataud: GrN-4231: 21,380 ± 340 (R., 1967, v. 9, p. 113-114) and Laugerie Haute: GrN-1876: 21,980 ± 250 (R., 1963, v. 5, p. 167). Ly-564 and -565 are quite comparable but, considering statistical range, the possibility that Le Blot Early Proto-Magdalenian is slightly older is not excluded.

C. Languedoc, Provence Occidentale

Ly-554. Grotte de Boucoiran, Gard **4140 ± 120**
2190 B.C.

Charcoal from Layer 2a in sepulchral grotto at Boucoiran, Gard (44° 00′ N Lat, 4° 11′ E Long). Coll. 1969 by A. Coste and subm. 1970 by J. L. Roudil, Montpellier. *Comment* (J.L.R.): agrees well with assoc. "Fontbouïsse" Chalcolithic industry (Roudil *et al.*, 1970).

Grotte Bourbon series, Gard

Samples from Bourbon grotto at Les Planès, near Cabrières, Gard (43° 54′ N Lat, 4° 29′ E Long). Coll. and subm. 1970 and 1971 by J. L. Roudil, Montpellier.

Ly-412. Grotte Bourbon C2 **6050 ± 120**
4100 B.C.

Charcoal assoc. with Chassean industry. *Comment* (J.L.R.): 500 to 700 yr older than expected for Chassean in region; sample may be contaminated. But lithic industry is close to Late Cardial industry of underlying layer: Ly-538 and ceramic have archaïc characters; such an old age is not excluded.

5300 ± 130
Ly-633. Grotte Bourbon C3 **3350 B.C.**

Bones from same level as Ly-412. *Comment* (J.L.R.): agrees better with ages generally admitted for Chassean in SE France. May be compared to MC-8: 5220 ± 230 from La Madeleine grotto, Hérault (R., 1964, v. 6, p. 195) and to Gif-1485: 5100 ± 130 from Camprafaud site, Hérault, Level 13 (R., 1972, v. 14, p. 286).

6180 ± 180
Ly-538. Grotte Bourbon C5 **4230 B.C.**

Charcoal assoc. with Late Cardial ceramics. *Comment* (J.L.R.): agrees with other dates of Cardial in region: Ly 303/304: 6220 ± 100 from La Baume de Montclus, Layer 4 (R., 1971, v. 13, p. 62).

Montclus series, Gard

Samples from rock shelter La Baume de Montclus, Gard (44° 16′ N Lat, 4° 26′ E Long). Coll. 1960 and subm. 1969 by M. Escalon de Fonton, Marseille.

380 ± 90
Ly-493. Montclus n° 1, Layer 2b **A.D. 1570**

Carbonaceous earth, Late Cardial, beginning of Sub-Boreal. *Comment*: as expected, proves upper levels of site were disturbed.

6230 ± 150
Ly-494. Montclus n° 5, Layer 8 **4280 B.C.**

Charcoal, Late Castelnovian (Late Mesolithic), end of Boreal.

Ly-495. Montclus n° 16a, Layer 14 **⩾6440 ± 230**

Carbonaceous earth, Late Castelnovian, end of Boreal. Minimal age because only one valid count was made. Coll. 1969.

7020 ± 140
Ly-496. Montclus n° 16b, Layer 14 **5070 B.C.**

Carbonaceous earth, Late Castelnovian. Coll. 1964.

7540 ± 160
Ly-542. Montclus n° 19, Layer 16 **5590 B.C.**

Bones, Castelnovian, end of Boreal.

General Comment (M. E. de F.): all dates (except Ly-493) agree with stratigraphy and assoc. industries. Confirm previous dates: Ly-303/304: 6220 ± 100 for Layer 4; Ly-305/306: 7780 ± 140 and Ly-307/308: 7760 ± 260 for lowest Layers 21 F and 22, Sauveterrian (R., 1971, v. 13, p. 62). Montclus series may be compared to Châteauneuf-lès-Martigues series (this list) where Neolithic industries appeared early (Châteauneuf Layer 8 industry is similar to Montclus Layer 14 industry) (Escalon de Fonton, 1967).

Châteauneuf-lès-Martigues series, Bouches-du-Rhône

Charcoal from rock shelter Châteauneuf-lès-Martigues, Bouches-du-Rhône (43° 23′ N Lat, 5° 10′ E Long). Coll. 1960 and subm. 1971, 1972 by M. Escalon de Fonton.

Ly-622. Châteauneuf-lès-Martigues, Foyer 1 **5910 ± 290 3960 B.C.**

Late Cardial (Neolithic) industry, Atlantic period. Other date on same sample: Kn-208: 6700 ± 200.

Ly-623. Châteauneuf-lès-Martigues, Foyer 5 **6070 ± 490 4120 B.C.**

Small piece of charcoal; early Cardial industry, Atlantic period. Other date on same sample: Kn-182: 7520 ± 240.

Ly-446. Châteauneuf-lès-Martigues, Cailloutis 6 **6430 ± 140 4480 B.C.**

Cardial industry, Atlantic period.

Ly-447. Châteauneuf-lès-Martigues, Cailloutis 7 **6420 ± 120 4470 B.C.**

Late Castelnovian (Late Mesolithic), Boreal period.

Ly-624. Châteauneuf-lès-Martigues, Foyer 7 **6780 ± 240 4830 B.C.**

Late Castelnovian; end of Boreal period.

Ly-448. Châteauneuf-lès-Martigues, Cailloutis 8b **7270 ± 220 5320 B.C.**

Castelnovian, Boreal period.

Ly-438. Châteauneuf-lès-Martigues, Cailloutis 8c **7830 ± 170 5880 B.C.**

Castelnovian, Boreal period.

General Comment (M. E. de F.): all dates agree with stratigraphy and assoc. industries, but are younger than age range deduced from the 2 Köln dates. Ly-447 seems a little too young in regard to Ly-446 and -624 and Boreal period, which may be due to eventual stake holes of Neolithic time that pushed down some charcoal from upper layers. Series may be compared to Montclus series (this list and R., 1971, v. 13, p. 62), where Neolithic industries appeared later.

Abri Cornille series, Istres, Bouches-du-Rhône

Samples from several levels in rock shelter Abri Cornille, near Istres, Bouches-du-Rhône (43° 33′ N Lat, 5° 00′ E Long). Coll. and subm. 1969 by M. Escalon de Fonton.

Ly-413. Abri Cornille n° 1, Layer 6 **8100 ± 130 6150 B.C.**

Humic fraction of charcoal, assoc. with Montadian industry (Early Mesolithic) Dryas III pollen.

Ly-414. Abri Cornille n° 3, Layer 9a **10,270 ± 470 8320 B.C.**

Carbonaceous earth, assoc. with Romanelian (Late Magdalenian) industry, end of Alleröd period.

10,870 ± 320
Ly-427. Abri Cornille n° 5, Layer 10a **8920 B.C.**
Carbonaceous earth, Romanelian, Middle Alleröd.

10,540 ± 310
Ly-510. Abri Cornille n° 7, Layer 10c **8590 B.C.**
Carbonaceous earth, Romanelian, Middle Alleröd.

10,920 ± 210
Ly-449. Abri Cornille n° 9, Layer 12 **8970 B.C.**
Carbonaceous earth, Early Romanelian, beginning Alleröd.

General Comment (M. E. de F.): Ly-413, obviously too young for Dryas III, is polluted by recent humus. Ly-510 should also be too young but remains in statistical range. Other results agree perfectly with expected ages of industry and generally accepted dates for Alleröd. However, they are a little younger than dates from levels with same industry at La Baume de Vallorgue, Gard, Layer 9-10: Hv-1344/1345: 11,170 ± 200 and Layer 15: Kn-68: 11,300 ± 115 (Escalon de Fonton, 1966).

Adaouste series, Jouques, Bouches-du-Rhône

Bones from l'Adaouste grotto, near Jouques, Bouches-du-Rhône (43° 41′ N Lat, 5° 37′ E Long). Coll. 1951 and subm. 1971 by M. Escalon de Fonton.

12,280 ± 190
Ly-541. L'Adaouste n° 2, Layer 12 **10,330 B.C.**
Assoc. with Magdalenian V-VI industry of Provence, cold climatic zone attributed to Dryas IIb phase.

12,760 ± 250
Ly-540. L'Adaouste n°1, Layer 17 **10,810 B.C.**
Assoc. with Magdalenian IV of Provence, temperate climatic zone attributed to Boëlling phase.

General Comment (M. E. de F.): both dates agree perfectly with industries and confirm climatic attributions (Escalon de Fonton, 1966). Ly-541 may be compared to Chinchon site, Vaucluse, Layer 15: Ly-597: 12,000 ± 420 (this list) and to Les Deux-Avens, Ardèche: Ly-321/322: 12,340 ± 200 (R., 1971, v. 13, p. 63) where Magdalenian has a N character.

Chinchon series, Saumanes, Vaucluse

Samples from Chinchon rock shelter, near Saumanes, Vaucluse (43° 56′ N Lat, 5° 06′ E Long). Coll. 1963 by M. Paccard and subm. 1972 by J. Brochier.

8980 ± 850
Ly-598. Chinchon, Layer b **7030 B.C.**
Humic fraction of charcoal assoc. with Azilian industry. *Comment* (J. and J. B.): much too young because level corresponds to a cold climatic phase. This sample is probably polluted by recent humus.

Ly-597. Chinchon, Layer 15 **12,000 ± 420**
10,050 B.C.

Bones assoc. with industry attributed either to Magdalenian VIa (Escalon de Fonton, 1970) or to Epigravetian (Paccard, 1964). *Comment* (J. and J. B.): corresponds to Dryas II phase. Seems too young because of several cold climatic oscillations in overlying layers. Expected age was end of Würm III or beginning of Würm IV period (ca. 15,000 B.P.)

Ground water of the Maestrichien du Sénégal series

Sample no.	Sample	N Lat	E Long	$\delta C^{13}/_{oo}$	$C^{14}/_{o}$ modern
Ly-371	Kanel M 20	13° 30′	13° 15′	−10.69	91.7 ± 2.2
Ly-475	Pénélope M 38	13° 02′	13° 39′	− 7.53	84.8 ± 1.7
Ly-473	Ourossogui M 12	15° 37′	13° 20′	− 8.40	84.2 ± 1.1
Ly-369	Thille-Boubacar M 1	16° 32′	15° 06′	− 6.90	51.7 ± 0.9
Ly-365	Michèle M 37	13° 17′	13° 49′	− 0.06	48.5 ± 0.8
Ly-366	Caroline M 35	14° 08′	12° 58′	+ 5.09	39.0 ± 1.4
Ly-380	Loumbi-Saoudiaria M IIa	15° 44′	13° 53′	− 6.99	29.2 ± 0.7
Ly-487	Loumbi-Saoudiaria M IIb	15° 44′	13° 53′	−14.34	29.3 ± 0.8
Ly-476	Niassante M 40	16° 07′	15° 31′	− 1.08	28.1 ± 0.6
Ly-398	Ouro-Mamoud M 28	14° 38′	13° 50′	−11.00	18.6 ± 0.7
Ly-368	Diagle M 2	16° 13′	15° 43′	− 9.71	18.7 ± 0.6
Ly-488	Pete M 7a	16° 07′	13° 56′	−11.01	6.8 ± 0.7
Ly-370	Pete M 7b	16° 07′	13° 56′	−11.98	5.5 ± 0.6
Ly-477	Fatick M 30	14° 21′	16° 24′	− 0.95	3.2 ± 0.5
Ly-332	Bowde-doudal M 5	16° 02′	15° 40′	−16.96	2.6 ± 0.6
Ly-372	Dendoudi M 19	15° 24′	13° 31′	−14.98	2.4 ± 0.4
Ly-329	Yare-Lao M 8	16° 02′	14° 32′	−14.06	2.1 ± 0.5
Ly-331	Tatqui M 3	16° 14′	15° 17′	− 8.78	2.0 ± 0.4
Ly-330	M'Biddi M 6	16° 09′	14° 56′	−13.08	2.0 ± 0.4
Ly-377	Joal M 29	14° 10′	16° 50′	− 7.97	2.0 ± 0.4
Ly-472	Lagbar M 10	15° 50′	14° 47′	− 4.54	≦ 3.2

III. HYDROGEOLOGIC SAMPLES

The following water samples were subm. for a general study of the two most important aquifer systems of Sénégal, made for the Atomic Energy International Agency (AEIA) in 1970-1971. Samples coll. by M. Diattara and analysis of results were made by H. Moussu and Y. Vuillaume, Bur. Recherches Géol. et Min. Orléans La Source, Loiret. Carbonate species were extracted at sampling sites by $BaCO_3$ precipitation, adding NaOH and $BaCl_2$ in a 100L metal tank, sent to the radiocarbon lab. as a 2L flask filled with $BaCO_3$ mixed with NaOH solution. Radiocarbon

Ground water of the Maestrichien du Sénégal series (cont'd.)

Sample no.	Sample	N Lat	E Long	$\delta C^{13}/_{oo}$	C^{14} % modern	
Ly-471	Kotiedia M 9	15° 47′	15° 34′	— 9.07	,,	2.0
Ly-374	Ranerou M 17	15° 19′	13° 58′	—13.88	,,	2.3
Ly-375	Yonofere M 16	15° 16′	14° 28′	—15.86	,,	2.0
Ly-373	Loumbol M 18	15° 19′	15° 43′	—14.20	,,	2.0
Ly-474	Ouapa M 23	15° 03′	14° 25′	—11.60	,,	2.0
Ly-480	M'Bar M 25	14° 33′	15° 45′	— 6.33	,,	2.5
Ly-481	Diaga-Kelkom M 26	14° 37′	15° 24′	— 8.75	,,	2.0
Ly-483	Loumbi-sud M 27	14° 27′	14° 15′	—10.97	,,	1.5
Ly-376	Guirnda M 31	15° 59′	16° 36′	—13.86	,,	1.8
Ly-478	N'Doffane M 32	13° 56′	15° 55′	— 5.59	,,	2.0
Ly-479	Kaffrine M 33	14° 06′	15° 33′	— 6.23	,,	2.0
Ly-482	Guente-Pate M 34	14° 17′	14° 55′	— 8.58	,,	1.5
Ly-486	Gayekadar M 41	15° 54′	14° 21′	—13.58	,,	2.0
Ly-485	Revane M 42	15° 40′	14° 27′	—14.28	,,	2.0
Ly-484	Fourdou M 43	15° 14′	14° 11′	—13.42	,,	2.0
Ly-470	Atch-Bali M 4	16° 14′	14° 34′	—11.99	,,	1.6
Ly-341	N'Diagne M 13	15° 25′	16° 04′	—11.71	,,	1.6
Ly-328	Linguere M 15	15° 24′	15° 08′	—11.30	,,	1.6
Ly-340	Darou-Mousti M 21	15° 03′	16° 03′	—15.81	,,	1.6
Ly-342	Sanghue M 22	15° 04′	15° 23′	—11.13	,,	1.6

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content is reported as % of modern without δC^{13} correction. Up to Ly-382, δC^{13} was measured by R. Letolle, Lab. Géol. Dynamique, Univ. Paris VI, with a ±0.15‰ precision, and from Ly-394, at the radiocarbon lab. with a ±0.05‰ precision.

General Comment (Y.V.): C^{14} contents confirm existence of recent recharge in SE part of aquifer and show another feeding zone, previously unknown, in the Senegal R. sweep, especially in the NW region. Leakage exchanges exist upward, to the overlying ground water (Continental terminal of Senegal). Average flow velocities are ca. 10 to 30m per yr horizontally and 1 to 2cm/yr upright (Moussu and Vuillaume, 1972).

Ground water of the Continental Terminal du Sénégal series

Sample no.	Sample	N Lat	W Long	δC^{13}‰	C^{14}% modern
Ly-395	Loubol-Lana C 7	15° 14′	14° 41′	−14.09	≦180.4 ± 4.5
Ly-401	Dialacoumbi C 22	12° 43′	14° 26′	−13.63	129.3 ± 1.5
Ly-534	Goulombo C 23	13° 29′	13° 45′	−15.56	125.4 ± 2.7
Ly-528	Thilogne C 29	15° 57′	13° 34′	−10.37	123.1 ± 2.0
Ly-400	Koutiakoto C 16	14° 00′	13° 59′	−11.82	116.0 ± 3.5
Ly-402	Medina-Yorofoula C 20	13° 17′	14° 40′	−15.91	112.8 ± 1.3
Ly-399	Sare-Volon C 19	13° 30′	14° 16′	−13.67	109.4 ± 0.9
Ly-532	Toubere-Bafal C 25	14° 21′	13° 31′	−15.05	100.2 ± 1.1
Ly-326	Massembe C 17	13° 50′	14° 33′	−20.65	98.2 ± 1.6
Ly-367	Tambacounda C 18	13° 47′	13° 40′	−20.44	95.3 ± 1.0
Ly-327	Fafakourou C 21	13° 08′	14° 30′	−16.06	95.2 ± 2.2
Ly-381	Vendou-Bouli-Tiane C 4	15° 52′	14° 04′	−16.89	93.6 ± 1.2
Ly-397	Longue-Tekodi C 12	14° 38′	13° 57′	−14.96	93.6 ± 2.9
Ly-533	Ouro-Demba-Binta C 24	14° 00′	13° 41′	−17.33	93.4 ± 1.2
Ly-378	Tionok-Sangue C 11	14° 39′	14° 44′	−15.18	93.4 ± 0.9
Ly-325	Koupentoum C 15	13° 59′	14° 34′	−19.33	92.9 ± 1.1
Ly-396	Darou-Naïm C 8	15° 12′	14° 17′	— —	90.1 ± 1.8
Ly-379	Dayane-Laoniadi C 10	14° 53′	14° 40′	− 7.91	89.4 ± 3.0
Ly-324	Sill-Tiarene C 14	14° 16′	14° 34′	−19.91	84.1 ± 1.1
Ly-529	Beel C 28	15° 45′	13° 37′	− 8.98	84.1 ± 1.7
Ly-531	Pete-Bowe C 26	14° 56′	13° 29′	−12.64	82.4 ± 2.3
Ly-323	Darou-Minam C 13	14° 30′	14° 32′	−17.20	66.5 ± 0.9
Ly-394	Khol-Khol C 5	15° 29′	15° 01′	— —	64.5 ± 1.0
Ly-382	Loumbel-Tiolam C 3	16° 17′	14° 56′	−10.03	30.6 ± 0.7
Ly-530	Lambamgo C 27	15° 27′	13° 31′	− 3.35	14.6 ± 0.9

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General Comment (Y.V.): in this aquifer, more heterogeneous than ground water of Senegal Maestrichian, radiocarbon values show a feeding zone in central part of basin (Ferlo basin). However, water supply from underlying ground water has not been verified (Moussu and Vuillaume, 1972).

Corrections

Ly-135, R., 1971, v. 13, p. 59, should read: Ly-133.
Ly-303, " " " p. 61, " " Ly-302.
Ly-12 , " " " p. 64, " " Ly-312.

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