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LYON NATURAL RADIOCARBON MEASUREMENTS III

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INTRODUCTION

The present list includes most of the samples measured since the establishment of the laboratory in 1965 and not yet published in the two previous dates lists.

Almost all the following samples were measured in the two proportional counters (0.5 effective volume filled with 3 atm CO_2 already described (R., 1969, v. 11, p. 112). The other measurements were made, using a liquid scintillation device, Model 3320 Tricarb. For routine counting the solution introduced in this detector is: 2 cc sample benzene, 13 cc inactive toluene, 0.4% PPO, 0.01% Dime POPOP. With this scintillator solution, background rate is about 10.1 cpm and the modern standard about 21.3 cpm. For each measurement a quenching correction is made with a ratio of 2 counting channels. The maximum determinable age is equal to 30,000 yr.

Chemical treatments remain unchanged except for adoption of a purification procedure by adsorption on Al_2O_3. Benzene preparation is performed according to the method of Tamers (1965) *i.e.,* Li_2C_2 formation at 625°C, C_6H_6 production by trimerization of C_2H_2 on catalyst (K. C. Perl Catalysator neu, Kalic Chemic Cie). Preparation yields are 95% for C_2H_2 and 90% for C_6H_6. The detection yield in the scintillator is ca. 65% and does not vary much with preparations.

The organic or carbonated samples are prepared in the classic way. For the bone samples we use the method of collagen extraction by solubilization in acid hot water. This method has been set up in the laboratory by R. Longin and summarized in (R., 1971, v. 13, p. 60-61) (see also Longin, 1971).

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

δC^{13} values of geologic and archaeologic samples were measured with a mass spectrometer Model A.E.I. MS 20 Isotopic, which ensures the routine C^{13} measurements since 1970 with a $\pm$ 0.05 per mil precision. Age corrections have not been made on these results.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Ly-280. Glacier du Chardon, Isère **750 ± 130 A.D. 1200**

Fragment of tree trunk from marginal moraine, right bank of Glacier du Chardon, near La Bérarde, Isère (44° 54′ N Lat, 6° 18′ E Long). Coll. and subm. 1970 by R. Vivian, Inst. Géog. alpine, Grenoble. *Comment* (R.V.): presence of pine trunk, much higher than actual forest, marks warming phase, preceding "little glacial-age" *sensu stricto*, ca. 16th to 19th centuries. Optimal warming phase occurred in Middle ages, and date agrees well.

Gorner Glacier series, Valais, Switzerland

Pieces of wood from alt. ca. 2000 m in marginal moraine, right bank of Gorner Glacier, near Zermatt, Valais, Switzerland (45° 59′ N Lat, 7° 44′ E Long). Coll. and subm. 1970 by R. Vivian.

Ly-297. Gorner Glacier 1 **7360 ± 180 5410 B.C.**

Coll. at alt. of existing ice limit.

Ly-298. Gorner Glacier 2 **8160 ± 220 6210 B.C.**

Coll. at alt 2050 m.

General Comment (R.V.): samples are oldest from moraines of alpine glaciers of Valais, at alt. where trees no longer exist. Theses results and Ly-299 date ice retreat, higher than now, between 8000 and 5000 B.P. Dates may be compared to measurements from Mont-Blanc Massif (France-Italy) VRI-106: 5250 ± 110 and VRI-107: 6400 ± 100 (R., 1970, v. 12, p. 310).

Ly-299. Glacier de Ferpècle, Valais, Switzerland **6950 ± 150 5000 B.C.**

Tree trunk from alt. 1500 m in Les Haudières low valley, Val d'Herens, Valais (46° 5′ N Lat, 7° 31′ E Long) moved from alt. 1900 m by a debacle of Glacier Ferpècle. Coll. and subm. 1970 by R. Vivian. *Comment* (R.V.): as Ly-297 and Ly-298, date warming phase which caused maximal retreat of alpine glaciers.

Ly-490. Massif du Marsaou, Var **Modern**

$\delta C^{13} = -19.35‰$

Bits of charcoal and woody fragments (*Sphagnum plumosum* and *Polythium commune* roots), included in red earth of rhyolite alteration from N side Massif du Marsaou, Esterel Massif, Var (43° 31′ N Lat, 6° 55′ E Long). Coll. and subm. 1971 by H. Triat, Lab. Bot. Hist. Palynol., Fac. Sci. Saint-Jérôme, Marseille. *Comment* (H.T.): sample from 36 cm depth in pollen-analyzed soil. Analysis was made in order to follow

forest evolution and to explain surprising presence of certain plant species at site. Result excludes hypothesis of ancient origin of *Sphagnum*.

460 ± 100

Ly-363. Albigny, Rhône **A.D. 1490**

Ox and ass bones from ditches of a castle at Albigny, Rhone (45° 51′ N Lat, 4° 50′ E Long). Coll. and subm. 1969 by C. Guérin, Dept. Sci. de la Terre, Univ. Lyon I. *Comment* (C.G.): bones come from either a geologic deposit in low terrace of Saône R., or, as suggested by this post-Gallo-Roman fauna, from an artificial earthwork. Date confirms later hypothesis.

1980 ± 130

Ly-463. Costeplane, Alpes de Haute Provence **30 B.C.**

Charcoal from under landslide at Costeplane near Le Lauzet, Alpes de Haute Provence (44° 26′ N Lat, 6° 26′ E Long). Coll. and subm. 1970 by R. Chalavoux, Lyon. *Comment* (R.C.): age is maximum for landslide overlying charcoal whose age agrees with presence of indications of Roman occupation in region.

4630 ± 140

Ly-426. Hière sur Amby, Isère **2680 B.C.**

$\delta C^{13} = -24.32‰$

Fine charcoal debris included in calcareous tufa in Val d'Amby, near Hière sur Amby, Isère (45° 48′ N Lat, 5° 68′ E Long). Coll. and subm by J. Flandrin, Dept. Sci. de la Terre, Univ. Lyon I. *Comment* (J.F.): proves calcareous tufa is ancient as expected from thickness of deposit, rather than modern.

5380 ± 180

Ly-461. Laives, Saône et Loire **3430 B.C.**

Wood from argillaceous sediment at Laives, Saône et Loire (46° 40′ N Lat, 4° 49′ E Long). Coll. 1969 by P. Ciry and subm. by J. Combier, Dir. Antiquités préhistoriques, Romanèche-Thorins, Saône et Loire. *Comment* (J.C.): wood was part of accumulation of big tree trunks in low terrace of R. Grosne valley. Deposit indicates large development of vegetation which, as expected, is postglacial and more precisely, of Atlantic Period. No pollen analysis was made.

5600 ± 150

Ly-364. Le Pont des Clapets, Bouches du Rhône **3650 B.C.**

Peat at 4.10 m depth from boring in bog at Le Pont des Clapets, near Fos-sur-Mer, Bouches du Rhône (43° 27′ N Lat, 4° 52′ E Long). Coll. and subm. by H. Triat. *Comment* (H.T.): date supports pollen analysis in corresponding to Atlantic Period, with general forest expansion including species such as *Quercus pubescus, Q. ilex, Pinus, Corylus,* etc.

Polliat series, Ain

Wood from gravel pit excavated in Irance R. alluvia at Polliat,

Ain (46° 14′ N Lat, 5° 7′ E Long). Coll. and subm. 1967 by A. Billard, Centre de Recherches géog., Paris.

Ly-240. Polliat 1 **1810 ± 100**
A.D. 140

From 1 m depth, base of silt layer.

Ly-333. Polliat 2 **2130 ± 110**
180 B.C.

From same horizon at same depth as Ly-240.

Ly-241. Polliat 3 **8760 ± 140**
6810 B.C.

From center of trunk 1.7 m deep in coarse alluvia filling bottom of Irance R. valley.

Ly-334. Polliat 4 **8490 ± 180**
6540 B.C.

From another trunk in same level as Ly-241.

General Comment: Ly-241 and -334 date Boreal period, main filling of valley. Ly-240 and -333 prove upper silt layer of valley is recent.

Ly-387. Meyzériat, Ain **Modern**

Wood from spoil created by dredging of Veyrle R. (same alluvial plain as Irance R.), near Meyzériat, Ain (46° 14′ N Lat, 5° 3′ E Long). Coll. and subm. 1967 by A. Billard. *Comment*: despite similarity to preceding samples, measurement proves, contrary to collector's supposition, sample does not come from dredged ancient alluvia.

Ly-112. Enghien-les-Bains, Val d'Oise **11,240 ± 330**
9290 B.C.

Peat included in argilaceocalcareous sand from 6 m depth at Enghien-les-Bains, Val d'Oise (48° 56′ N Lat, 2° 15′ E Long). Coll. 1967 by Solétanche Cie and subm. 1968 by A. Marcé, Bur. Recherches géol. et min., Orléans La Source. *Comment* (A.M.): sample from Quaternary formation just overlying Saint-Ouen Tertiary limestone. Age may correspond to Allerød interstade but no pollen analysis was made.

Grotte Hué series, Alpes Maritimes

Calcium carbonate from stalactite on roof of submarine grotto at −25 m depth. Grotte Hué, is offshore in Juan-les-Pins Gulf, Alpes Maritimes (43° 38′ N Lat, 7° 6′ E Long). Coll. 1970 by H. de Lumley, Fac. Sci. St. Charles, Marseille. Stalactite has 3 plain concentric growth rings.

Ly-404. Grotte Hué, external part **10,500 ± 150**
8550 B.C.
$\delta C^{13} = -4.12‰$

From external ring of stalactite.

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14,690 ± 550

Ly-403. Grotte Hué, median part **12,740 B.C.**

$\delta C^{13} = -11.10‰$

From median ring of stalactite. No measurement from central ring, which had central hole with traces of recrystallization.

General Comment: ages are calculated using 64.5% NBS standard as contemporary C^{14} value, according to G. Delibrias' measurements on stalactites from Aven of Orgnac, Ardèche (J. Labeyrie *et al.*, 1967). Despite the fact that calculation is only approximate, dates agree with expected age of sea-level rise.

18,800 ± 490

Ly-360. Saint Maurice l'Exil, Isère **16,850 B.C.**

Bones of mammal jaw from gravel pit near Saint-Maurice l'Exil, Isère (45° 23′ N Lat, 4° 46′ E Long). Coll. and subm. 1969 by C. Guérin. Pit is open in Rhône R. low terrace. *Comment* (C.G.): age, corresponding to end of Würm III, agrees with late Würm age for all low terraces of middle Valley of Rhône R. (David *et al.*, 1972).

Montrevel series, Ain

Wood extracted by dredging from Reyssouze R. lowest alluvia near Montrevel Ain (46° 20′ N Lat, 5° 8′ E Long). Coll. and subm. 1967 by A. Billard.

21,100 ± 500

Ly-246. Montrevel 5 **19,150 B.C.**

From ca. 8 m depth. Measurements made in normal conditions of CO_2 pressure in a proportional counter.

2800

25,700 ±

2400

Ly-386. Montrevel 6 **23,750 B.C.**

From ca. 10 m depth, ca. 400 m downstream from Ly-246. Measurement made with scintillator detector used for preparing C_6H_6, the only quantity of CO_2 normally used in a proportional counter. The experiment was made to compare statistical errors obtained.

General Comment: dates show deepest filling of this valley is much older than that of Irance R. (see Ly-241 and Ly-334, this list). It should correspond to cold phase in Würm III, considering *Elephas primeginus* and *Rhinoceros ticorhinus* found in same place at same depth.

Ly-242. Les Pierrets-Viriat, Ain **⩾32,000**

Fragments of big tree trunk coll. by boring between 9 and 14 m depth in Reyssouze R. lowest alluvia at Les Pierrets, near Viriat, Ain (46° 15′ N Lat, 5° 11′ E Long). Coll. and subm. 1967 by A. Billard. Site is 10 km downstream from Montrevel (Ly-246 and Ly-286, this list). *Comment*: expected age: same as Montrevel series, but appearance suggests it is redeposited Tertiary wood, such as already found on surface in Ain R. alluvia (see Ly-14, R., 1969, v. 11, p. 114).

Ly-437. Velars-Etrigny, Saône et Loire **⩾32,000**

Mammal vertebrae from grotto at Velars. Coll. by "Les Blaireaux" Soc. and subm. by C. Guérin. *Comment* (C.G.): fauna seems to be Würmian. Result eliminates attribution to Würm III or Würm IV.

Ly-339. Fossil wood of Martigues, Bouches du Rhône **⩾35,000**

Fossil wood from 18 m depth in bedrock of Etang de Berre under Martigues Bridge, Bouches du Rhône (45° 24′ N Lat, 5° 3′ E Long). Coll. 1966 by P. Couprie and subm. by Y. Thommeret, Lab. Radiocarbone de Monaco. *Comment*: limit age agrees with the date MC-100: 35,000 ± 4000 (R., 1969, v. 11, p. 119) from the same sample.

Ly-166. Carotte T 3 **31,300 ± 2100/1700 29,350 B.C.**

Calcareous-clayey marine mud from 1.85 m to 2.10 m below base of Mediterranean Sea, near Mallorca I. Coll. 1963 and subm. 1968 by L. Leclaire, Lab. Géol. du Mus., Paris. Measurement on total carbonate fraction; too little organic material to be extracted. *Comment* (L.L.): date a little older than expected, but part of carbonate fraction may be of terrigenous origin (Leclaire, 1972).

II. ARCHAEOLOGIC SAMPLES

A. Historical and Bronze age periods

Ly-456. Sées, Orne **Modern**

$\delta C^{13} = -15.77‰$

Human bones found near Saint-Martin church at Sées, Orne (48° 36′ N Lat, 0° 10′ E Long). Coll. and subm. 1970 by F. Evin, Sées, Orne. *Comment*: expected age was Middle age due to importance of Saint-Martin monastery during that period. Date proves maximal age is last century.

Sévrier series, Haute Savoie

Samples from coastal sta. submerged in Annecy Lake, near Sévrier, Haute Savoie (49° 39′ N Lat, 6° 9′ E Long). Coll. and subm. 1969 by R. Laurent, Centre de recherches archéol. lacustres, Tréserves Savoie.

Ly-117. Sévrier, 267 A 2 **490 ± 170 A.D. 1460**

Charcoal mixed with siliceous slag and iron oxide found with lacustrian chalk.

Ly-273. Sévrier, 267 A 5 **320 ± 100 A.D. 1630**

Little woody twigs from lacustrian chalk layer near preceding sample.

General Comment: Ly-273 dated to confirm Ly-117. Both dates confirm hypothesis that slag and iron oxides were contemporary with Bronze

Final occupation of coastal sta. (Laurent, 1968). But presence of such material remains unexplained at this site.

720 ± 105

Ly-450. Le Plessis Grimoult, Calvados **A.D. 1230**

Charcoal from under a wall of medieval edifice at Le Plessis-Grimoult, Calvados (48° 47′ N Lat, 0° 37′ W Long). Coll. and subm. 1971 by M. de Boüard, Centre de recherches archéol. médiévales, Caen, Calvados. *Comment* (M. de B.): a little younger than expected, but, considering 200 yr statistical range, a true age at start of 11th century is quite consistent with other archaeol. data on site.

1500 ± 110

Ly-68. Parc de la Tête d'Or, Lyon Rhône **A.D. 450**

Wood from a monoxyl barge found in 1862 in Rhône R. alluvia at Brénier-Cordon, Ain (Cordier, 1963), and now exhibited in town park La Tête d'Or, Lyon (45° 47′ N Lat, 4° 51′ E Long). Coll. 1967 by J. Evin. Average of 2 measurements. *Comment*: barge expected to be from Bronze age, then date seems much too young, which may be due to an eventual impregnation of organic components made in order to preserve the timber. Date is possible; monoxyl barges remained in use until High Middle age.

Ly-455. Château de Saint-Germain d'Ambérieu, Ain **1160 ± 150** **A.D. 790**

Charred corn found over burial in Saint-Germain Castle, near Ambérieu en Bugey, Ain (45° 57′ N Lat, 5° 23″ E Long). Coll. and subm. 1971 by J. F. Reynaud, Centre de recherches médiévales, Univ. Lyon II. *Comment*: date agrees with expected age of burials, end of 7th century.

L'Hortus series, Hérault

Charcoal from several levels of Paleochristian site in grotto of l'Hortus, near Valflaunès, Hérault (43° 48′ N Lat, 3° 50′ E Long). Coll. 1970 by G. Démians d'Archambault and subm. 1970 by H. de Lumley.

1400 ± 180

Ly-284. L'Hortus Zone 120, Level RC bis **A.D. 550**

Sample form Paleochristian offering-pit overlain by tumulus.

1610 ± 190

Ly-283. L'Hortus Zone F8, Level B F **A.D. 340**

Sample from one of upper levels of large pit, E part of grotto, assoc. with Paleochristian material.

1680 ± 100

Ly-282. L'Hortus Zone E7, Level F 4 **A.D. 270**

Sample from one of lower levels of same pit as Ly-283, assoc. with older industry.

General Comment: comparison between Ly-284 and -282 seems to confirm that offering pits is younger than large pit. Both Ly-283 and -282

are 100 yr older than expected (5th and 4th century) but remain in statistical range.

Briord series, Ain

Human bones from graves in several levels of Gallo-Roman cemetery at Les Plantis, near Briord, Ain (45° 46′ N Lat, 5° 27′ E Long). Coll. and subm. 1967 by R. Perraud, La Mure-sur-Azergues, Rhône.

Ly-454. Briord 284 **1670 ± 160** **A.D. 280**

Bones from grave 40 cm below actual soil. *Comment*: confirms late occupation of cemetery but older than expected age (7th century) for that type of grave.

Ly-61 bis. Briord 261 bis **1875 ± 100** **A.D. 75**

Bones from same grave as Ly-61: 2060 ± 200 B.P. (R., 1969, v. 11, p. 114). Grave ca. 1.20 m below actual soil. *Comment*: new collagen preparation gives more precise date which better agrees with Emperor Tiberius' coins from another grave at same level.

Ly-406. La Sartanette, Gard **2120 ± 170** **170 B.C.**

Charred acorns from Layer X, entrance of La Sartanette grotto, near Remoulins, Gard (43° 57′ N Lat, 4° 35′ E Long). Coll. and subm. 1970 by A. Bonnet, Nimes. *Comment* (A.B.): assoc. with ceramic industries of "Ferrière" type but possibilities of mixing exist and are confirmed by date which agrees with Roman occupation of site, only 1 km from famous Pont du Gard bridge (Bonnet *et al.*, 1971).

Ly-500. L'Etoile d'Alaï, Lyon, Rhône **2370 ± 160** **420 B.C.**

Charcoal from Gallo-Roman settlement under modern building in Etoile d'Alaï urban quarter, Lyon, Rhône (45° 45′ N Lat, 4° 47′ E Long). Coll. and subm. 1969 by L. Jeancolas, Tassin-la-demi-Lune, Rhône. *Comment* (J.L.): older than expected but with large statistical range; result can only mean that settlement was from 1st Roman occupation in Lyon.

Camp de Bierre series, Orne

Charcoal from base of wall of promontory site Le Camp de Bierre, near Merri, Orne (48° 50′ N Lat, 0° 3′ W Long). Coll. and subm. 1970 by G. Verron, Dir., antiquités préhistoriques, Caen, Calvados.

Ly-464. Camp de Bierre 1 **2320 ± 100** **370 B.C.**

$\delta C^{13} = -17.69‰$

From top of Layer IV from 110 cm to 120 cm depth.

Ly-465. Camp de Bierre 2 **2810 ± 120**
860 B.C.
$\delta C^{13} = -20.42‰$

From base of Layer IV from 120 cm to 130 cm depth.

Ly-466. Camp de Bierre 3 **2740 ± 110**
790 B.C.
$\delta C^{13} = -21.26‰$

From Layer IV.

General Comment (G.V.): Ly-465 and -466 give Bronze Final age for building of promontory site. Ly-464, 400 yr younger, indicates occupation of settlement continued till La Tène period (Vimont, 1884).

Ly-95. Culoz Square II, Layer IV **3410 ± 200**
1460 B.C.

Human bones from top Layer IV in W part of Sous-Balme site at Culoz, Ain (45° 51′ N Lat, 5° 47′ E Long). Coll. 1961 and subm. 1966 by R. Vilain, Dépt. Géol., Univ. Lyon I. *Comment* (R.V.): agrees with expected age but presence of Hallstatt and La Tène industries proves site was deeply excavated by recent tillage (Vilain, 1966).

Ly-279. Shrew of Ashmin, Low Egypt **2400 ± 140**
450 B.C.

Mummified shrews (*Crocidura* sp., group dolichura) from an hypogeum at Ashmin, Low Egypt (30° 26′ N Lat, 30° 58′ E Long). Coll. 1900 by Lortet and Chantre and subm. 1969 by P. Mein, Dépt. Sci. de la Terre, Univ. Lyon I. *Comment* (P.M.): shrew species belongs to warm fauna of Guinean type, extinct in Egypt. Older date would suggest evolution of shrew species to extant species, but relatively recent value proves shrew subsisted a long time before becoming extinct (de Balzac and Mein, 1971).

Ly-383. Nobles' Grave, Assouan, High Egypt **4010 ± 130**
2060 B.C.

Wood from Nobles' Grave at Assouan, High Egypt (24° 1′ N Lat, 32° 45′ E Long). Coll. by M. Baligan and subm. 1970 by R. Margrita, Centre d'études nucléaires de Grenoble, Isère.

B. Neolithic and Mesolithic periods

Ly-193. Le Rond du Lévrier, Haute Loire **3810 ± 230**
1860 B.C.

Burnt bones from rock shelter Le Rond du Lévrier, near Salette, Haute Loire (44° 51′ N Lat, 3° 58′ E Long). Coll. and subm. 1968 by A. Crémilleux, Le Monastier-sur-Gazeille, Haute Loire. *Comment* (A.C.): same value as Ly-196: 4380 ± 280 (R., 1971, v. 13, p. 59) was expected. Younger date means either presence of Late Neolithic previously dated in another part of site: Ly-195: 3570 ± 130 (R. 1971, v. 13, p. 59), or mixing with bones coming from overlying levels.

Ly-385. Ilôt des Roseaux, Lac de Chalain, Jura **4640 ± 140 / 2690 B.C.**

Wood from upper level, Level 0 of coastal sta. in Les Roseaux Islet, Chalain Lake near Doucier, Jura (46° 40′ N Lat, 5° 46′ E Long). Coll. and subm. 1969 by P. Pétrequin, Dir. Antiquités préhistoriques de Franche-Comté, Besançon. Coastal sta. has several Late Neolithic levels (Levels 4 to 1) and base of Level 0 (Late Bronze) is last occupation of coastal sta. *Comment* (P.P.): instead of expected Late Bronze age date is Late Neolithic, indicating, after last occupation of coastal sta., lake eroded its banks and deposited above Bronze level charcoal from underlying levels. Moreover, charcoal had floated aspect, and this type of apparent reversing of archaeologic layers is frequent in all coastal stas. dependent on lake-level fluctuations.

Ly-384. La Motte aux Magnins, Lac de Clairvaux, Jura **4640 ± 270 / 2690 B.C.**

Charcoal from Late Neolithic hearth from upper part of La Motte aux Magnins coastal sta., Grand Lac, near Clairvaux, Jura (46° 34′ N Lat, 5° 45′ E Long). Coll. and subm. 1969 by P. Pétrequin. *Comment* (P.P.): date seems a little too old for Late Neolithic and fits with Middle Neolithic, but both civilizations might be partially contemporaneous in that country.

Ly-335. Gondenans-lès-Montby, Doubs **5490 ± 140 / 3540 B.C.**

Charcoal from Level IX of La Tuilerie grotto at Gondenans-lès-Montby, Doubs (47° 26′ N Lat, 6° 27′ E Long). Coll. and subm. 1969 by P. Pétrequin. *Comment* (P.P.): level contains ceramic industry with stamped decoration, characteristic of "Rubané Récent Rösen" civilization. Same value as Gif-468: 5380 ± 250 (R., 1970, v. 12, p. 429) from Level E 6, La Baume de Gonvillars, Jura, site which is in same region and has same industry (Pétrequin, 1970).

La Hoguette series, Fontenay le Marmion, Calvados

Charcoal and bones from Neolithic tumulus with a dry-stone dolmen, at La Hoguette, near Fontenay le Marmion, Calvados (49° 6′ N Lat, 0° 22′ W Long). Coll. 1966, 1968 and subm. 1967 and 1970 by R. Caillaud and E. Lagnel, Caen, Calvados.

Ly-132. Tumulus de La Hoguette O/43 **4580 ± 150 / 2630 B.C.**

Charcoal from hearth overlying filling of Chamber V.

Ly-420. Tumulus de La Hoguette Ch VII **5050 ± 260 / 3100 B.C.**

Human bones from Chamber VII.

Ly-421. Tumulus de La Hoguette Ch V **5160 ± 190 / 3210 B.C.**

Human bones from Chamber V.

5560 ± 150

Ly-131. Tumulus de La Hoguette R/36 **3610 B.C.**

Charcoal and hearth ash from Chamber VI.

General Comment (R.C. and E.L.): Ly-131, -420, and -421 correspond to construction and utilization of tumulus and are in range of expected ages. Three values agree with date of charcoal from Chamber V made by Gif-sur-Yvette Radiocarbon lab.: 5000 ± 130 (R., 1972, v. 14, p. 280). Ly-131, however, is ca. 500 yr older than Ly-420, and Gif-1345. Difference can only be explained by statistical deviation. But Ly-132, 500 yr younger, corresponds to subsequent occupation of Chamber V (Caillaud and Lagnel, 1971).

3890 ± 140

Ly-422. Bois Sacré, Gard **1940 B.C.**

Charcoal from 30 cm to 80 cm depth in Bois-Sacré site, near Saint-Côme and Maruéjols, Gard (43° 53′ N Lat, 4° 11′ E Long). Coll. and subm. 1969 by J. L. Roudil, Montpellier, Hérault. Assoc. with rich ceramic industry. *Comment* (J.L.R.): level is presumed contemporary of "Fontbouïsse" civilization and the date agrees well. Cf. date on Prével grotto at Montclus, Gard: Gif-191: 3880 ± 180 (R., 1966, v. 8, p. 84) (Roudil, 1969).

4630 ± 110

Ly-462. Aven des Corneilles, Lozère **2680 B.C.**

Charcoal from center of hearth assoc. with "Fontbouïsse" industry at l'Aven des Corneilles, near Prades, Lozère (44° 19′ N Lat, 3° 27′ E Long). Coll. and subm. 1970 by G. Fages, Sainte Enimie, Lozère. *Comment* (G.F.): hearth is between Middle Bronze burial level and Chalcolithic settlement. Expected date was similar to Ly-422: 3890 ± 140, this list, Bois sacré site. Other measurements on "Fontbouïsse" civilization suggest Ly-462 is too old but rodent burrows might have carried charcoal in from underlying Chalcolithic horizon.

5510 ± 200

Ly-458. Limonesque, Hérault **3560 B.C.**

$\delta C^{13} = -20.49‰$

Charcoal from La Baume II of Limonesque site, near Le Caylar, Hérault (44° 25′ N Lat, 3° 31′ E Long). Coll. and subm. 1970 by G. B. Arnal, Montpellier, Hérault. Assoc. with Epicardial pottery industry, probably Atlantic period. *Comment* (G.B.A.): in expected range. Two other measurements on same type of industry from Levels 2A and 4A of Saint-Pierre-de-la-Fage site, 11 km from Limonesque: Gif-2180: 5520 ± 150 and Gif-1922: 6200 ± 400.

5560 ± 170

Ly-491. Grotte du Maquis, Ardèche **3610 B.C.**

$\delta C^{13} = -20.06‰$

Charcoal from Level 4A, Grotte du Maquis, near Vallon Pont d'Arc, Ardèche (44° 23′ N Lat, 4° 24′ E Long). Coll. and subm. 1970 by E. Tscherter, Roche de Molière, Loire. *Comment* (E.T.): levels of

grotto contain industries from Chassean until Protohistoric time, but sample is from level without characteristic industry. Level 3 has 3 Chassean layers; date agrees with stratigraphic position of Level 4A underlying Level 3.

Ly-423. Grotte de Combe Obscure **6400 ± 160 4450 B.C.**

Charcoal from Level 5, Grotto de Combe Obscure, near Sallèles, Ardèche (44° 29′ N Lat, 4° 8′ E Long). Coll. 1969 by H. Saumade and subm. 1969 by J. L. Roudil. Assoc. with early Cardial industry. *Comment* (J.L.R.): Combe Obscure Grotto is most N settlement where Early Cardial industry has been found. Date conforms to expected result, and may be compared with Ly-303/304:6220 ± 100 (R., 1971, v. 13, p. 62): Layer 4 Late Cardial, La Baume de Montclus, Gard (Escalon de Fonton, 1970).

Seuil des Chèvres series, Savoie

Samples from several levels of Seuil des Chèvres grotto, near La Balme, Savoie (45° 41′ N Lat, 5° 21′ E Long) (Vanbrugghe and Bill, 1968). Coll. and subm. 1969 by R. Vanbrugghe, Hellemes, Nord.

Ly-388. Seuil des Chèvres **5300 ± 180 3350 B.C.**

Fine charcoal powder from top of Layer IC. *Comment* (R.V.): assoc. with Neolithic pottery with decoration comparable to Cardial or to Augy Sainte-Pollaye pottery (Desbrosse, 1969). Same value as Ly-69: 5240 ± 100 (R., 1969, v. 11, p. 116) from base of same layer. Both dates may be also compared with Neolithic Level E 6X at La Baume de Gonvillard, Doubs: Gif-468: 5380 ± 250 with similar assoc. pottery (R., 1970, v. 12, p. 429).

Ly-389. Seuil des Chèvres E 7 **6320 ± 260 4370 B.C.**

Charcoal from hearth in Layer IV, assoc. with indeterminable pottery. *Comment* (R.V.): proves Ly-388 and Ly-389 hearths are not contemporary. Date seems too old for pottery in region but may be compared with Layer G 10 XIb, La Baume de Gonvillard, Jura: Gif-469: 6250 ± 300 (R., 1970, v. 12, p. 429) end of Early Neolithic.

Ly-405. Seuil des Chèvres C 9 **9700 ± 150 7750 B.C.**

Bones from lower part of Layer V, assoc. with industry attributable to Epi-Paleolithic. *Comment* (R.V.): confirms previous less precise measurement from same level, Seuil des Chèvres E 6: Ly-70: 8980 ± 400 (R., 1969, v. 11, p. 116). Agrees well with assoc. fauna.

Cours Moreau series, Macon, Saône et Loire

Charcoal from digging 7 m deep under Cours Moreau, Saône et Loire (46° 18′ N Lat, 4° 50′ E Long). Coll. and subm. 1966 by S. Dacher, Charnay-lès-Macon, Saône et Loire.

5150 ± 200
Ly-35. Cours Moreau, Level I **3200 B.C.**

7400 ± 200
Ly-73. Cours Moreau, Level II **5450 B.C.**

General Comment: both dates much older than expected, levels being attributed to "Roman" and "Celtic" ages.

Laang Spean series, Cambodia

Charcoal and bones from Laang-Spean grotto, Prov. Battambang, Cambodia (12° 51′ N Lat, 102° 55′ E Long). Coll. and subm. 1969 by C. Mourer, Dept. Sci. de la Terre, Univ. Lyon I.

3380 ± 150
Ly-265. Laang-Spean, Layer CRM **1430 B.C.**
From 10 to 30 cm depth.

4740 ± 100
Ly-266. Laang-Spean, Layer CN **2790 B.C.**
From 30 to 50 cm depth.

8750 ± 900
Ly-439. Laang-Spean, Layer CB **6800 B.C.**
From 50 to 70 cm depth.

General Comment: Layers CRM and CN contain Hoabinhian (Neolithic) industry with ceramics. Other charcoal from Layer CN was dated by Monaco Radiocarbon Lab.: MC-273: 6270 ± 70. Layer CB contains earlier industry without ceramics which then appears between MC-273 and Ly-439 (Mourer *et al.*, 1970).

5420 ± 130
Ly-408. Erg Admer, Sahara, Algeria **3470 B.C.**

Burnt bovine bones found lying on sand dune in Tahor Passage in Erg Admer, W Djanet, Algeria (24° 29′ N Lat, 9° 10′ E Long). Coll. and subm. 1970 by A. Bonnet, Nîmes. Assoc. with industries (ceramics, millstones, and flint) remained unaltered on sand dune. *Comment* (A.B.): date is minimum for dune formation. It is close to measurement of sample from 30 to 60 cm depth in Amekni site, Hoggar: Gif-464: 5500 ± 250 (R., 1970, v. 12, p. 436) with assoc. Neolithic ceramic of Sudan tradition; it is also close to Meniet site: Gif: 5400 ± 300 and Jabbaren I: Gif: 5470 ± 300 (Camps *et al.*, 1968).

6870 ± 150
Ly-407. Erg Tichodaïne, Sahara, Algeria **4920 B.C.**
$\delta C^{13} = -18.19‰$

Humic black soil from Passage of Erg Tichodaïne between Amguid and Fort-Gardet, Sahara, Algeria (26° 22′ N Lat, 6° 50′ E Long) Coll. and subm. 1970 by A. Bonnet. *Comment* (A.B.): agrees with expected age and with other dates of Sudan Neolithic tradition (Camps *et al.*, 1968). Sample assoc. with pottery was found on hillock isolated by deflation. Thus it is contemporary of oldest layer of Abouleg site, Hoggar:

UW-89: 6860 ± 100, and of Deleba en Emedi site, Tchad: Gif-352: 6900 ± 300 (R., 1970, v. 12, p. 438).

C. Magdalenian period

Ly-430. Grotte Colomb, Isère **8960 ± 420**
7010 B.C.
$\delta C^{13} = -18.31‰$

Marmot bones from Grotte Colomb, near Méaudre, Isère (45° 9′ N Lat, 5° 33′ E Long). Coll. 1921 by H. Muller and subm. 1971 by R. Desbrosse, Blanzy, Saône et Loire. *Comment* (R.D.): assoc. industry was assumed Romanelian (Late Magdalenian and Azilian) (Bourdier and de Lumley, 1956) and contemporary of Dryas III period. Date does not fit with these assumptions but stratigraphy of digging is not well known and sampling remains questionable.

Ly-451. Les Freydières, Drôme **11,380 ± 180**
10,430 B.C.
$\delta C^{13} = -14.47‰$

Bones from only layer of Les Freydières grotto site, near Saint-Agnan en Vercors, Drôme (44° 58′ N Lat, 5° 26′ E Long). Coll. 1965 and subm. 1971 by A. Bocquet, Inst. Dolomieu, Grenoble, and R. Desbrosse. *Comment* (A.B., R.D.): layer is attributed to Magdalenian VI. Date is younger than Ly-436: 12,800 ± 300, this list, from Campalou, site of same region. Difference may be due to more isolated geographic position and to alt. of Les Freydières site (Bocquet, 1969).

Ly-452. La Baume Loire II, Haute Loire **3950 ± 120**
2000 B.C.
$\delta C^{13} = -14.38‰$

Black earth from Rock Shelter II at La Baume Loire, near Solignac, Haute Loire (44° 56′ N Lat, 3° 54′ E Long). Coll. and subm. 1970 by A. Crémilleux, Le Monastier sur Gazeille, Haute Loire. *Comment* (A.C.): this black earth contains Late Paleolithic industry but archaeologic level is composed of rubble stones between which elements of overlying levels might be descended.

Ly-356. Grotte des Romains Niveau III, Ain **12,980 ± 240**
11,030 B.C.

Bones from Level III at Grotte des Romains Near Virignien, Ain (45° 41′ N Lat, 5° 21′ E Long). Coll. and subm. 1969 by R. Desbrosse. *Comment* (R.D.): date agrees better with expected age than previous measurement, Ly-16: 14,380 ± 380 (R., 1969, v. 11, p. 116) of charcoal from same level (Evin and Desbrosse, 1971).

Pont des Douattes series, Haute Savoie

Bones from Late Magdalenian level at Le Pont des Douattes rock shelter, near Mussiège, Haute-Savoie (46° 0′ N Lat, 5° 58′ E Long).

12,480 ± 260
Ly-435. Les Douattes, Level 7 **10,530 B.C.**
$\delta C^{13} = -15.04‰$

Coll. 1931 and subm. 1971 by A. Jayet, Geneva (Jayet, 1932).

10,680 ± 450
Ly-453. Les Douattes, Level b **8730 B.C.**
$\delta C^{13} = -14.08‰$

Coll. 1959 by L. Pradel and subm. 1971 by R. Desbrosse (Pradel and Pradel, 1960).

General Comment (R.D.): both Levels 7 and b correspond to same Late Magdalenian horizon. Then Ly-453 is probably contaminated and Ly-435 agrees well with industry and may be compared with Ly-356: 12,980 ± 240, this list, from Level III Les Romains grotto.

12,040 ± 270
Ly-440. Blois-sur-Seille, Jura **10,090 B.C.**

Bones from only level of Le Chamois Boivin grotto, near Blois-sur-Seille, Jura (46° 45′ N Lat, 5° 40′ E Long). Coll. 1953 by M. Vuillemey and subm. 1971 by R. Desbrosse. *Comment* (R.D.): agrees with expected Magdalenian VI age and with fauna which indicates a dry and cold climate, end of Wurm IV (Gauthier, 1955).

12,800 ± 300
Ly-436. Campalou, Drôme **10,850 B.C.**
$\delta C^{13} = -16.17‰$

Bones from Campalou rock shelter near Saint-Nazaire-en-Royan, Drôme (45° 15′ N Lat, 5° 12′ E Long). Coll. and subm. 1970 by J. and J. Brochier, Romans, Drôme. Assoc. with Late Magdalenian industry with Azilian characters. *Comment* (J. and J.B.): date proves, despite Azilian character, this Magdalenian is rather old. Cf. Les Deux-Avens grotto: Ly-321/322: 12,340 ± 200 (R., 1971, v. 13, p. 63).

Solutré series, Saône et Loire

Bones from Level P. 16, Sq. 88-89, Solutré site, Saône et Loire (46° 18′ N Lat, 4° 43′ E Long). Coll. and subm. 1969 by J. Combier, Dir. régionale Antiquités préhistoriques, Romanèche-Thorins, Saône et Loire. Site is mainly composed of thick mass of horse bones in large rock rubble at foot of limestone cliff.

3350 ± 350
Ly-392. Solutré 15 **1400 B.C.**

Burned bones treated as unburned bones, *i.e.*, by collagen extraction. *Comment* (J.C.): unexplained high pollution.

12,580 ± 250
Ly-393. Solutré 16 **10,600 B.C.**

Unburned bones. *Comment* (J.C.): perfect agreement with assoc.

Late Magdalenian industry. Date marks last occupation of site and end of formation large rock rubble with horse bones whose same levels were previously dated: see Ly-313/315/316 and Ly-317 (R., 1971, v. 13, p. 63-64).

Ly-425. Enval Layer XII, Puy de Dôme **13,000 ± 300** **11,050 B.C.** $\delta C^{13} = -22.73‰$

Earth with fine charcoal fragments from Layer XII in Enval site, near Vic-le-Comte, Puy-de-Dôme (45° 29′ N Lat, 3° 14′ E Long). Coll. and subm. 1970 by Y. Bourdelle, Clermont-Ferrand, Puy-de-Dôme. *Comment* (Y.B.): layer corresponds to beginning of Late Magdalenian. It is in rock rubble which might be contemporary with volcanic explosion phase dated ca. 12,800 B.P. Date is maximum for statuette "Venus of Enval" 5 cm above hearth dated here (Bourdelle *et al.*, 1971).

Saint-Roman series, Isère

Bones from 2 levels in Le Calvaire rock shelter, near Saint-Roman, Isère (45° 7′ N Lat, 5° 20′ E Long). Coll. 1921 by H. Muller and by F. Bourdier 1938, and subm. by R. Desbrosse and A. Bocquet (Bourdier and de Lumley, 1956).

Ly-431. Saint-Roman Series III **12,970 ± 300** **11,020 B.C.** $\delta C^{13} = -17.21‰$

Ly-432. Saint-Roman Series IV **13,450 ± 300** **11,500 B.C.** $\delta C^{13} = -16.20‰$

General Comment (R.D.): both dates agree with stratigraphy and with Late Magdalenian industry. As expected, Series III (Ly-431) may be contemporary with Level III of La Grotte des Romains site. But expected age of Series IV (Ly-432) was a little younger.

Ly-433. La Colombière, Ain **13,390 ± 300** **11,440 B.C.** $\delta C^{13} = -17.44‰$

Fragment of mammoth bone from Level D in La Colombière rock shelter, near Neuville-sur-Ain, Ain (46° 5′ N Lat, 5° 22′ E Long). Coll. 1913 by L. Mayet and J. Pissot (Mayet et Pissot, 1915) and subm. 1971 by R. Desbrosse. Assoc. with art work (specially engraved pebbles). *Comment* (R.D.): 4 other C^{14} measurements exist from site. The nearest result is: L-177: 14,150 ± 400 (Science, v. 126, p. 1329); other results are W-150: 11,750 ± 600 (Science, v. 121, p. 487); L: 15,500 ± 700 and L: 14,700 ± 300 (Movius and Judson, 1956). Ly-433 seems a little too young to archaeologists who attribute industry of site to Leroi-Gourhan's Style IV Magdalenian.

La Croze-sur-Suran series, Ain

Mammoth bone from only level, attributed to Magdalenian III of La Croze-sur-Suran site, near Saint-Martin-du-Mont, Ain (46° 5′ N Lat, 5° 21′ E Long). Coll. 1913 by J. Tournier and T. Costa de Beauregard (Tournier et Costa de Beauregard, 1922) and subm. 1971 by R. Desbrosse.

Ly-357. La Croze-sur-Suran 1 **14,330 ± 260**
12,380 B.C.

Ly-434. La Croze-sur-Suran 2 **14,850 ± 350**
12,900 B.C.
$\delta C^{13} = -15.15‰$

General Comment (R.D.): both dates correspond to each other. The difference of 1000 to 1500 yr between these 2 Magdalenian III dates and those of preceding Late Magdalenian sites is quite possible. But connections between La Croze-sur-Suran and neighboring site, La Colombière, remain indeterminate.

Ly-361. Esclauzure, Corrèze **14,540 ± 300**
12,600 B.C.

Mammal bones from filling of grotto at Esclauzure, near Lissac, Corrèze (45° 18′ N Lat, 1° 28′ E Long). Coll. 1970 by P. Andrieu and subm. 1970 by C. Guérin. *Comment* (C.G.): estimated age was Early Magdalenian or Solutrean considering similarity of lithic industry of site with that of neighboring grotto Badegoule. Date rather suggests a Magdalenian age (Andrieu, 1971).

III. HYDROGEOLOGIC SAMPLES

The following samples come from several aquifers of France or Africa, coll. 1967-70 by Bur. Recherches Géol. et Min. Selection of sampling points, supervision of chemical preparations on ground, and analysis of results were made by Y. Vuillaume, Dept. Géol. Aménagement, Bur. Recherches Géol. et Min. Orléans La Source, Loiret. Carbonate species were extracted at sampling sites by $BaCO_3$ precipitated, adding NaOH and $BaCl_2$ in a 100 L metal tank, then sent to the radiocarbon lab. either as a dry $BaCO_3$ precipitate, or a 2 L flask filled with $BaCO_3$ unseparated from NaOH solution. Radiocarbon content is reported as % of modern without correction from δC^{13} measured by R. Letolle, Lab. Géol. Dynamique, Univ. Paris VI.

Rhône delta series, France

Ground water samples in Rhône R. alluvia in its delta, near Fos-sur-Mer, Bouches du Rhône. Dated 1969 to determine extent of a "salt-intrusion" in alluvia bordering Gulf of Fos, W Mediterranean Sea.

	Samples	N Lat E Long	Ions Cl^- ppm	δC^{13} ± 0.15	C^{14}% modern
Ly-182.	La Fromagère Well X 2. Fresh free ground water	(43°28′ 4°53′)	32	−10.55‰	81.2% ± 1.4
Ly-200.	Les Clapets Well X Ibis. Fresh water underlying salt confined ground water	(43°27′ 4°52′)	106	−14.09‰	79.1% ± 0.9
Ly-199.	Raffinerie de Fos Well X 3. Brackish confined ground water	(43°26′ 4°56′)	6780	−17.61‰	74.3% ± 1.9
Ly-198.	Salin de Caban Well X 6. Salt confined ground water	(43°25′ 4°43′)	20,200	− 5.38‰	45.8% ± 1.7

General Comment (Y.V.): C^{14} contents indicate that apparent age of water increases with ion Cl^- content. Water from X 6 well (Ly-198) seems trapped since some millennia likely since aquifer was formed.

Ground water of Calcaire Carbonifère of Bassin du Nord series, France and Belgium

The following samples, subm. 1969-70 come from ground water in calcareous aquifer, ca. 100 m deep, Lille region, Nord. Coll. April, 1969 during a general study of ground water to determine its supply and renewal conditions.

Some C^{14} measurements of boring-cutting from the aquifer were also made to determine an eventual exchange between water and calcareous matrix of aquifer.

	Ground water samples	N Lat E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-259.	Antoine 363, Belgium	(50°34′ 3°27′)	−18.57‰	65.5% ± 1.0
Ly-258.	Saint-Léger 362, Belgium	(50°42′ 3°18′)	—	41.1% ± 0.8
Ly-251.	Annapes Sen 351, France	(50°38′ 3°9′)	−11.74‰	41.4% ± 0.8
Ly-252.	Roubaix A. Motte 353, France	(50°42′ 3°10′)	−10.36‰	32.9% ± 0.7
Ly-253.	Lille Grande Brasserie 354, France	(50°38′ 3°2′)	− 2.48‰	21.9% ± 0.9
Ly-257.	Mouscron 361, Belgium	(50°45′ 3°12′)	−11.62‰	15.6% ± 0.6
Ly-256.	Mouscron 360, Belgium	(50°45′ 3°12′)	−10.48‰	12.6% ± 0.6
Ly-255.	Frelingheim Gillet Thaon 358, France	(50°43′ 2°56′)	+ 0.25‰	12.6% ± 2.3
Ly-268.	Commines 357, France	(50°46′ 3°0′)	− 3.77‰	<1.6%
Ly-254.	Halluin Cratry 356, France	(50°47′ 3°6′)	− 2.48‰	<1.9%

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Cutting samples	N Lat E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-291. Lille Grande Brasserie, −54 m 364, France	(50°38′ 3°2′)	—	<1.9%
Ly-292. Lille Grande Brasserie, −80 m 365, France	(50°38′ 3°2′)	−5.35‰	<1.6%
Ly-293. Lille Grande Brasserie, −97 m 366, France	(50°38′ 3°2′)	+4.37‰	<1.7%
Ly-294. Wambrechies Dièves, −91 m 368, France	(50°41′ 3°3′)	+1.82‰	<1.9%
Ly-295. Wambrechies Calcaire −125 m 369, France	(50°41′ 3°3′)	+1.52‰	<2.1%

General Comment (Y.V.): a dissolution of carbonates, confirmed by δC^{13} values, entails very old apparent ages. Radioactivity decreases toward W part of basin in opposite direction of supply zone, localized toward E. Null values of cutting samples indicate that any exchange of detectable amounts of C^{14} active carbonate occurred in the aquifer between rocks and water.

Ground water of the Craie of Bassin du Nord series, France

Samples subm. 1969, 1970, from ground water in a chalky aquifer. Coll. April, 1969 during a general study of ground water to determine its supply and renewal conditions. This ground water is above Calcaire Carbonifère ground water. Its depth increases from E to W parts of basin where it becomes confined.

Water samples	N Lat E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-262. Lille Grande Brasserie 355	(50°38′ 3°2′)	—	79.0% ± 1.0
Ly-261. Annapes Sen 352	(50°38′ 3°9′)	—	56.1% ± 0.9
Ly-263. Frelingheim La Houlette 359	(50°43′ 2°56′)	−12.98‰	20.5% ± 0.9
Ly-260. Wambrechies Distillerie 350	(50°41′ 3°3′)	− 0.78‰	<2.0%

General Comment (Y.V.): in its free part, ground water is normally supplied by rain water. C^{14} contents indicate that in confined part, the supply of ground water is slow. As in Calcaire Carbonifère ground water, radioactivity decreases to W part of aquifer.

Ground water of the Albian of Sahara series

Samples subm. in 1968 and 1969 from ground water in sands of N Sahara Albian. Study was to determine supply conditions of aquifer.

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Water samples	N Lat	E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-153. Laghouat II 276	(33°46′	2°53′)	−11.50‰	108.6% ± 2.1
Ly- 77. Laghouat I 275	(33°46′	2°53′)	− 7.76‰	58.5% ± 1.2
Ly-158. Ouargla Fittante 311	(32°0′	5°18′)	—	18.6% ± 1.1
Ly-159. Tougourt Aïn Thaleb 312	(33°5′	6°6′)	—	18.4% ± 1.5
Ly- 75. Bou Azoua 279	(33°46′	7°28′)	—	17.0% ± 0.8
Ly-155. Tougourt Sidi Mandi 295	(33°5′	6°6′)	−11.60‰	13.3% ± 1.3
Ly- 76. Zelfana II 280	(32°24′	4°12′)	− 7.61‰	11.2% ± 0.7
Ly-154. Berriane II 278	(32°50′	3°47′)	− 5.70‰	10.5% ± 1.4
Ly-156. Tougourt Ranou 301	(33°5′	6°6′)	− 3.70‰	10.7% ± 1.2
Ly-157. Ouargla II 294	(32°0′	5°18′)	—	10.1% ± 0.7

General Comment (Y.V.): values indicate gradient of apparent ages from N part of aquifer (waters the youngest) to SE part (water the oldest).

Several aquifers in Tchad series

Samples subm. 1967, 1968 by Bur. Recherches Géol. et Min. Fort-Lamy, Tchad, and coll. by J. L. Schneider of the Bureau.

Water samples	N Lat	E Long	δC^{13} ± 0.20	C^{14}% modern
Ly- 53. Koro-Toro 248 Free ground water in Pliocene	(18°30′	16°5′)	ca. −7.50‰	81.1% ± 1.5
Ly- 52. Abou-Garga 204-247 Confined ground water in Pliocene	(16°25′	11°50′)	−5.27‰	64.2% ± 1.0
Ly- 54. Iféna R 2 203-237 Confined ground water in Continental	(18°45′	13°30′)	ca. −7.50‰	64.6% ± 1.2
Ly-160. Largeau 261-265 Artesian ground water in Primary	(19°5′	17°55′)	—	37.5% ± 0.9
Ly- 65. Bokoyo 241 Deep confined ground water in Pliocene	(15°40′	12°0′)	—	5.5% ± 0.5
Ly- 51. Abou-Bazan 244 Deep confined ground water in Pliocene	(15°50′	12°10′)	ca. −7.50‰	4.2% ± 0.6

General Comment (Y.V.): measurements performed on several aquifers to determine approx. recharge date. No general conclusion can be drawn, without more results.

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Ly-232. Zouerat, Mauritania **46.6 ± 0.9% modern**

$\delta C^{13} = -10.63 \pm 0.20‰$

Water sample from ferruginous quartzite of Zouerat, Mauritanie. Sample coll. to study water supply of iron mines. *Comment* (Y.V.): this only result suggests water is renewed slowly which is propitious element for mining.

References

Andrieu, P., 1971, La Grotte d'Esclauzure près de Lissac, Corrèze; étude paléontologique par C. Guérin: Mélange Vazeille; E. Ogier Imp. Tulle.

de Balzac, H. and Mein, P., 1971, Les musaraignes momifiées des hypogées de Thèbes: Mamalia, v. 35, p. 220-224.

Bocquet, A., 1969, L'Isère pré et protohistorique: Gallia Préhist., v. 12, no. 2, p. 315-316.

Bonnet, A., Bonnet, E., and Malaval, M., 1971, Résultats préliminaires obtenus au cours de nouvelles fouilles réalisées dans la grotte de La Sartanette à Remoulins, Gard: Soc. Etudes Sci. Nat. Nimes Bull., v. 51, p. 381-403.

Bourdelle, Y., Delporte, H., and Vernon, J., 1971, Le gisement magdalénien et la "Vénus" d'Enval, commune de Vic-le-Comte: l'Anthropologie, v. 75, p. 119-128.

Bourdier, F. and de Lumley, H., 1956, Magdalénien et Romanello-Azilien en Dauphiné: Mus. Anthropol. Préhist. de Monaco Bull., v. 3, p. 128-176.

Broecker, W. S. and Kulp, J. L., 1957, Lamont natural radiocarbon measurements IV: Science, v. 126, p. 1324-1334.

Caillaud, R. and Lagnel, E., 1971, Le Tumulus de La Hoguette: Gallia Préhist., in press.

Camps, G., Delibrias, G., and Thommeret, J., 1968, Chronologie absolue et succession des civilisations préhistoriques dans le Nord de l'Afrique: Lybica, v. 16, p. 9-28.

Cordier, G., 1963, Quelques mots sur les pirogues monoxyles de France: Soc. française Préhist. Bull., v. 60, p. 307.

David, L. *et al.*, 1972, Datation par le radiocarbone de la terrasse quaternaire de Saint-Rambert-d'Albon, Drôme: Acad. sci. [Paris] Comptes rendus, ser. D, v. 274, p. 2007-2008.

Delibrias, G., Guillier, M. T., and Labeyrie, J., 1966, Gif natural radiocarbon measurements II: Radiocarbon, v. 8, p. 74-95.

———— 1970, Gif natural radiocarbon measurements V: Radiocarbon, v. 12, p. 421-443.

———— 1972, Gif natural radiocarbon measurements VII: Radiocarbon, v. 14, p. 280-320.

Desbrosse, R., 1969, Les fouilles préhistoriques en Bugey en 1968-1969: Annales du Bugey, v. 56, p. 43-59.

Escalon de Fonton, M., 1970, Les civilisations Néolithiques du Midi de la France: Cong. Préhist. Proc., Narbonne, Feb. 1970, in press.

Evin, J. and Desbrosse, R., 1971, Datations au C^{14} de gisements Magdaléniens du Jura et des Préalpes du Nord: 8th internatl. cong. Union Préhist. and Protohist. sci. Proc., Belgrade, Sept. 1971, in press.

Evin, J., Longin, R., and Pachiaudi, Ch., 1969, Lyon natural radiocarbon measurements I: Radiocarbon, v. 11, p. 112-117.

Evin, J., Longin, R., Marien, G., and Pachiaudi Ch., 1971, Lyon natural radiocarbon measurements II: Radiocarbon, v. 13, p. 52-73.

Felber, Heinz, 1970, Vienna Radium Institute radiocarbon dates I: Radiocarbon, v. 12, p. 298-318.

Gauthier, H., 1955, Information des antiquités historiques de la Franche-Comté: Gallia Préhist., v. 13, p. 110.

Jayet, A., 1932, Le paléolithique de la région de Genève: Le Globe, v. 22.

Labeyrie, J. *et al.*, 1967; Etude des températures des climats anciens par la mesure O^{18}, C^{13}, C^{14}, dans les concrétions des cavernes: I.A.E.A., conf. on radioactive dating and methods of low-level counting Proc., Monaco, p. 153-159.

Laurent, R., 1968, Apparition de la métallurgie du fer dans les stations littorales du Bronze final: Soc. linnéenne Lyon Bull., 37ème année, no. 4, p. 150-158.

Leclaire, L., 1970, Aspect of late quaternary sedimentation on the Algerian precontinent and the adjacent Algerian-Balearic bassin: 8th internatl. sedimentology cong. Proc., Heidelberg, in press.

Longin, R., 1971, New method of collagen extraction for radiocarbon dating: Nature, v. 230, p. 241-242.
Mayet, L. and Pissot, J., 1915, Abri sous roche préhistorique de La Colombière près de Poncin, Ain: Annales Univ. Lyon, ser. 1, v. 39, 205 p.
Mourer, C., Mourer, R., and Thommeret, Y., 1970, Premières datations absolues de l'habitat préhistorique de la Grotte de Laang-Spean (Cambodge); Acad. sci. [Paris] Comptes rendus, v. 270, p. 471-473.
Movius, H. L. and Judson, S., 1956, The rockshelter of La Colombière: Archeological and geological investigations of an Upper Perigordian site near Poncin, Ain: Cambridge, Peabody Mus. Press.
Pétrequin, P., 1970, La Grotte de La Balme de Gonvillard: Annales lit., Univ. Besançon, 1970, 186 p.
Pradel, L. and Pradel, J. H., 1960, Magdalénien et Azilien de l'Abri des Douattes, commune de Mussièges, Haute-Savoie: Soc. française Préhist. Bull., v. 57, p. 75-79.
Roudil, J. L., 1969, L'habitat campaniforme de Saint-Come et Maruéjols, Gard: Soc. française Préhist. Bull., v. 66, no. 3, p. 88-91.
Rubin, Meyer and Suess, H. E., 1955, U.S. Geological Survey radiocarbon dates II: Science, v. 121, p. 481-488.
Tamers, M. A., 1965, Routine C^{14} dating using liquid scintillation technique: 6th internatl. conf. on C^{14} and T^{3} dating Proc., Pullman, Washington, 1965.
Thommeret, J. and Thommeret, Y., 1969, Monaco radiocarbon measurements III: Radiocarbon, v. 11, p. 118-129.
Tournier, J. and Costa de Beauregard, T., 1922, Deux stations préhistoriques du Jura dans la vallée de l'Ain et dans la vallée du Suran: l'Anthropologie, v. 32, p. 383-408.
Vanbrugghe, R. and Bili, J., 1968, La grotte du Seuil des Chèvres à La Balme, Savoie, fouilles de 1967: Soc. linnéenne Lyon Bull., 37è année, no. 4, p. 150-158.
Vilain, R., 1966, Le gisement de Sous-Balme à Culoz (Ain) et ses industries microlithiques: Lab. Géol., Fac. Sci. Lyon doc., v. 13, 220 p.
Vimont, E., 1884, Le camp de Bierre: Soc. hist. archéol. Orne Bull., v. 3, p. 198-210.