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LYON NATURAL RADIOCARBON MEASUREMENTS II

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INTRODUCTION

The Radiocarbon Dating Laboratory of the Department of Geology, University of Lyon, is going on with work since its foundation in 1965, in the basement of the Nuclear Physics Institute.

The present list includes geologic and archaeologic samples measured from 1968 to 1970, most of the water samples measured since 1966 and a range of bone samples measured to try a new collagen preparation method which the abstract is given below.

The wood and shell samples preparation method and the counting technique (CO_2 in 0.5 L proportional counter) have not been really modified and were already described in Lyon I (R., 1969, v. 11, p. 112-117). The background of the two counters has been lowered and better stabilized by a new setting of discrimators. The new backgrounds are respectively 3.20 ± 0.05 and 2.20 ± 0.05 cpm.

Two new detectors will be set up. One is a proportional counter of large effective volume ca. 40,000 yr limit ages; the other one is a Packard liquid scintillation spectrometer Model 3320 Tricarb. The characteristics of these two detectors and a description of the chemical bench for benzene preparation will be given in the next date list. The Radiocarbon Laboratory has, since May 1970, a mass spectrometer Model A.E.I., MS 20 Isotopic, which will ensure C^{13} measurements for all the samples.

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

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Rhône Alpes region

Ly-113. Rouelbeau, Canton de Genève **7950 ± 180 6000 B.C.**

Wood from peaty layer with volcanic ash, interbedded in lacustrine chalk, at Rouelbeau, near Jussy, canton of Genève (46° 14′ N Lat, 6° 14′

E Long). Coll. 1964 and subm. 1967 by A. Jayet, Chemin du Pré Catellier 9, Genève. *Comment*: much younger than expected by assoc. volcanic ash which supposedly were from Laachersee (Eifel) of Allerød age (Martini and Duret, 1965).

Ly-116. Veigy, Haute-Savoie **9180 ± 200 / 7230 B.C.**

Pinus sylvestris cone included in lacustrine chalk 10 cm below volcanic ash at Veigy, Haute-Savoie (46° 16′ N Lat, 6° 15′ E Long). Coll. 1964 by J. Martini and J. J. Duret; subm. 1967 by A. Jayet. Before subm. sample was kept in glycerin. *Comment*: ash suggested Allerød age. Date is too young but may be due to defective elimination of the glycerin.

Ly-277. Cuculianne, Hautes-Alpes **11,250 ± 250 / 9300 B.C.**

Fragment of tree trunk from a thick detrital deposit in Le Buech torrent bed at Cuculianne near Eyguians, Hautes-Alpes (44° 21′ N Lat, 5° 46′ E Long). Coll. and subm. by G. Montjuvent, Inst. Dolomieu, Grenoble. *Comment* (G.M.): agrees with Postglacial or Allerød age of the main alluviation phase of Le Buech torrent.

Ly-237. Quaix, Isère **⩾31,500**

Fragment of larch trunk inbedded in a clayey, sandy layer during Würm retreat at Peteysset near Quaix, Isère (45° 15′ N Lat, 5° 44′ E Long). Coll. by M. Collardel and subm. 1968 by A. Bocquet, Grenoble. *Comment*: date older than expected; implies earlier Würm glacier retreat or redeposition of old wood.

Ly-114. Saint Jean, Genève **⩾31,000**

Fragment of tree-trunk inbedded in an interglacial deposit —40 m below Saint-Jean dist., Genève, Switzerland (45° 14′ N Lat, 6° 07′ E Long). Coll. 1964 by J. Duret and subm. 1967 by A. Jayet. *Comment*: as expected, (Jayet, 1966) date seems to exclude Würm IV age for overlying glacial deposits.

Chevillys series, Haute-Savoie

Samples from clayey, sandy interglacial sediment 15 m thick at Chevillys near Lathuile, Haute-Savoie (45° 48′ N Lat, 6° 12′ E Long). Coll. and subm. 1967 by A. Brun, Lab. de Géol. Dynam., Fac. Sci., Paris.

Ly-139. Chevillys I **⩾34,000**

Wood from a lignitic layer in upper part of interglacial series (alt 510 m).

Ly-140. Chevillys 3C **⩾33,000**

Fine lignitic debris from the lower part of the series (alt 500 m).

General Comment: interglacial series is overlain by a supposed Würm moraine (Bourdier, 1963). Minimum age eliminates attribution of series to interstadial found at Armoy, Haute-Savoie (Blavoux and Brun, 1966) and dated Gif-333: 23,500 ± 1200.

B. Other regions

8660 ± 160

Ly-281. La Maxe, Moselle **6710 B.C.**

Wood from alluvions in Moselle R. lower terrace at La Maxe, Moselle (48° 51′ N Lat, 6° 12′ E Long). Coll. and subm. 1969 by R. Haghighate, Bur. Recherches Géol. et Min., Metz. *Comment*: agrees with expected Postglacial age of terrace.

Ly-243. Vik, Cameroun **⩾30,000**

Oyster shells from −20 m depth in a well dug in a clayey, sandy Quaternary series at Vik, Dept. de Logone et Chari, N Cameroun (12° 31′ N Lat, 14° 36′ E Long). Coll. and subm. 1969 by R. Biscaldi, Bur. de Recherches Géol. et Min., Montpellier.

Golfe de Gascogne series

Unbroken marine shells assoc. with sand and gravel, from continental plateau of Gascogne Gulf between Ré I. and Rochebonne Plateau. Coll. 1968 and subm. 1969 by J. P. Barusseau, Centre de Recherches de Séd. Marine, Perpignan.

6080 ± 200

Ly-168. T H E 22 **4130 B.C.**

(46° 25′ N Lat, 1° 59′ W Long) −32 m

⩾6280 ± 200

Ly-171. T H E 146 **4330 B.C.**

(46° 20′ N Lat, 2° 05′ W Long) −53 m

Comment: value calculated only after 20 hr counting before elimination of eventual Radon activity.

8240 ± 220

Ly-169. T H E 128 **6290 B.C.**

(46° 12′ N Lat, 2° 08′ W Long) −46 m

19,960 ± 400

Ly-170. T H E 139 **18,010 B.C.**

(46° 13′ N Lat, 1° 59′ W Long) −41 m

General Comment (J.P.B.): all measured shell species are shallow-water or littoral. Their fragility excludes any important transport. Dates make evident several ancient shores between 6000 and 20,000 B.P. (Barusseau, 1969). Ly-168 and Ly-171 should be contemporary with Salpausselkä episode.

II. ARCHAEOLOGIC SAMPLES

A. Historic and Bronze-age periods

1210 ± 100

Ly-272. Doué la Fontaine, Maine et Loire **A.D. 740**

Charcoal from a building inside a feudal clod at La Motte de la Chapelle near Doué la Fontaine, Maine et Loire (47° 11′ N Lat, 0° 18′ W Long). Coll. and subm. 1969 by M. de Boüard, Centre de Recherche Archéol., Univ. de Caen. *Comment* (M.deB.): a little older than sup-

posed destruction of building (ca. A.D. 900); but measurement was performed in order to invalidate ca. A.D. 1120, which was also possible.

1645 ± 80

Ly-267. Les Kéllia Qouçour 'Isā, Sud I 5.50 W A.D. 315

Charcoal from kitchen of coptic monastery Les Kéllia near Markaz de Dilingat, Egypt (30° 45′ N Lat, 30° 22′ E Long). Coll. 1967 and subm. 1968 by D. Weidmann, Lausanne, Switzerland. *Comment* (D.W.): kitchen was occupied till A.D. 600, date seems to prove that woods from an old building was burnt later in kitchen. Compare with B-988: 1530 ± 100 (R., 1970, v. 12, p. 381).

1690 ± 100

Ly-152. Saint Romain en Gal, Rhone A.D. 260

Charcoal from a timber, burned at destruction time (ca. A.D. 250) of Gallo-Roman town at Saint-Romain en Gal, Rhône (45° 32′ N Lat, 4° 51′ E Long). Coll. and subm. by R. Chalavoux, Lyon.

2450 ± 200

Ly-72. Magny sur Tille, Cote d'Or 500 B.C.

Charcoal from refuse pit assoc. with Hallstatt industry at Le Marais near Magny sur Tille, Côte d'Or (47° 12′ N Lat, 5° 11′ E Long). Coll. and subm. 1966 by R. Ratel, Lab. de Géol., Fac. Sci., Dijon. *Comment*: agrees with expected age and assoc. industry.

Chaumes les Baigneux series, Cote d'Or

Charcoal from supposed Late Bronze tumulus at La Forêt near Chaumes les Baigneux, Côte d'Or (47° 38′ N Lat, 4° 35′ E Long). Coll. and subm. 1966 by R. Ratel.

370 ± 150

Ly-80. Chaumes les Baigneux, Central hearth A.D. 1580

Sample from hearth found in middle of tumulus, no assoc. industry.

2320 ± 100

Ly-94. Chaumes les Baigneux, Basal hearth 370 B.C.

Samples from hearth found at bottom of tumulus.

General Comment: Ly-80 is obviously wrong, Ly-94 seems too young for expected Late Bronze age, but agrees with Gif-1109 (550 B.C.) measured on the same sample.

2880 ± 220

Ly-135. Chène de la Balme, Savoie 930 B.C.

Fragment of branch of oak tree found in alluvions of Rhône bed at La Balme, Savoie (45° 43′ N Lat, 5° 43′ E Long). Coll. 1883 and subm. by L. Lagier-Bruno Yenne, Savoie (Lagier-Bruno, 1970). *Comment*: compare with Gif-386: 2870 ± 200 (R., 1969, v. 11, p. 332).

Les Sarrasins series, Isère

Charcoal from grotto Les Sarrasins near Seyssinet-Pariset, Isère (45° 10′ N Lat, 5° 41′ E Long). Coll. and subm. 1969 by A. Bocquet, Grenoble.

2940 ± 170

Ly-238. Les Sarrasins, Level 4C **990 B.C.**

Assoc. with Late Bronze II industry.

3240 ± 120

Ly-239. Les Sarrasins, Level 5 **1290 B.C.**

Assoc. with industry of beginning of Late Bronze age.

General Comment: both dates confirm that Grenoble region Late Bronze age is contemporaneous and not delayed with respect to other French regions (Bocquet and Papet, 1966).

2030 ± 150

Ly-84. Lithaire, Manche **80 B.C.**

Charcoal lying on flagging of an "Allée Couverte" at Le Plessis near Lithaire, Manche (49° 17′ N Lat, 1° 36′ W Long). Coll. and subm. 1967 by B. Edeine, Caen. *Comment* (B.E.): date proves that "Allée Couverte" was reoccupied much later than erection.

2660 ± 220

Ly-83. Flamanville, Manche **710 B.C.**

Charcoal from −60 cm level in hearth at Le Castel, near Flamanville, Manche (49° 32′ N Lat, 1° 44′ W Long). Coll. and subm. by B. Edeine. *Comment* (B.E.): agrees with assoc. Bronze industry.

3260 ± 100

Ly-233. Sous-Sac, Ain **1310 B.C.**

Calcareous tuffa from rock-shelter Sous-Sac, near Craz de Michaille, Ain (46° 02′ N Lat, 5° 46′ E Long). Coll. 1962 by G. Sanlaville and subm. 1967 by R. Vilain, Lab. de Géol., Fac. Sci. Lyon. *Comment*: tuffa contained fragment of Middle Bronze age pottery with which the date agrees well despite fact that a calcareous tuffa theoretically contains some dead carbon.

B. Pile dwellings of French alpine lake

The following samples come from several coastal stations submerged in French alpine lakes. They were coll. and subm. in 1967 or 1968 by R. Laurent, Centre de Recherche Archeol. Lacustre, Tréserves, Savoie.

1860 ± 70

Ly-189. Aiguebelette, 145 B2, Savoie **A.D. 90**

Fragment of wood submerged near island La Tour de Beauphare, S part of Aiguebelette Lake near Lepin, Savoie (45° 33′ N Lat, 5° 48′ E Long). *Comment*: object was found close to, but outside, a Chalcolithic settlement. Date suggests occupation of Tour de Beauphare I. in Roman times.

Meymart series, Savoie

Samples from settlement, central part of Le Bourget Lake near Brisson-Saint-Innocent, Savoie (45° 42′ N Lat, 5° 53′ E Long). This site is complex and presents several successive occupations.

4060 ± 120

Ly-190. Meymart, 59 C1 **2110 B.C.**

Fragment of wooden cup from supposed Chalcolithic part of site. *Comment* (R.L.): date confirms Chalcolithic attribution and agrees with Ly-20: 4150 ± 180 (R., 1969, v. 11, p. 115) from coastal sta. in Aiguebelette Lake.

2140 ± 110

Ly-276. Meymart, 59 C2 **240 B.C.**

Wood from pile foundation from S part of site. *Comment* (R.L.): this unexpected young pile might have been fixed by Gallo-Roman fishermen.

Chatillon series, Savoie

Samples from coastal sta. at Chatillon underlying ca. 5 m in N part of Le Bourget Lake near Chindrieux, Savoie (45° 46′ N Lat, 5° 50′ E Long).

2670 ± 110

Ly-274. Chatillon, 85 A4 **720 B.C.**

Wood from pile fixed in central part of sta. *Comment* (R.L.): same value as Ly-17: 2700 ± 110 (R., 1969, v. 11, p. 115) which confirms expected Late Bronze age.

2380 ± 100

Ly-275. Chatillon, A5 **430 B.C.**

Wood from isolated settlement outside sta. *Comment* (R.L.): settlement was built after destruction of main village, supposedly ca. 700 B.C.

Sévrier series, Haute-Savoie

Sample from coastal sta. submerged in Annecy Lake near Sévrier, Haute-Savoie (45° 39′ N Lat, 6° 9′ E Long).

2760 ± 150

Ly-191. Sévrier, 267 A 3 **810 B.C.**

Wood from inner part of pile foundation.

3030 ± 150

Ly-192. Sévrier, 267 A 4 **1080 B.C.**

Wood from top of another pile.

General Comment: Ly-191 and Ly-192, respectively, agree with Ly-17: 2700 ± 100 and Ly-9: 3060 ± 100 from coastal sta. Chatillon in Le Bourget Lake. Thus, occupation length of these 2 Late Bronze settlements seems the same.

C. Neolithic and Mesolithic periods

Tureng Tepe series, Iran

Charcoal from 2 levels of Tell Tureng Tepe near Gorgan, Iran (36° 55′ N Lat, 54° 35′ E Long). Coll. 1963 and subm. 1968 by J. Deshayes, Fresnes, Hauts-de-Seine.

4550 ± 140
Ly-97. Tureng Tepe, No. 3 **2600 B.C.**
Sample from Level 12.

4400 ± 130
Ly-96. Tureng Tepe, No. 1 **2450 B.C.**
Sample from Level 15.

General Comment: allowing for statistical errors, both dates may agree with Gif-301: 4325 ± 250, from Level 14 and with Gif-302: 4090 ± 250 from Level 18, and these 4 values with stratigraphic order of levels.

5700 ± 100
Ly-229. Les Romains, Ain **3750 B.C.**
Charcoal from Level E14 N. Part of site La Grotte des Romains near Virignien, Ain (45° 41′ N Lat, 5° 21′ E Long). Coll. and subm. by R. Desbrosse, Blanzy, Saône et Loire. *Comment* (R.D.): agrees well with assoc. Neolithic industry.

5950 ± 340
Ly-264. Les Hotteaux, Ain **4000 B.C.**
Small fragments of charcoal extracted from calcareous tuffa from grotto Les Hotteaux near Rossillon, Ain (45° 41′ N Lat, 5° 35′ E Long). Coll. 1963 and subm. 1968 by R. Vilain. *Comment* (R.V.): expected age was Magdalenian or Azilian but stratigraphic relationship between tuffa and industries is not established.

Culoz Sous Balme series, Ain

Charcoal from several levels in rock-shelter Sous-Balme near Culoz, Ain (45° 51′ N Lat, 5° 47′ E Long). Coll. and subm. 1968 by R. Vilain (1966).

4600 ± 480
Ly-288. Culoz Sous Balme, W site, Level 3 **2650 B.C.**
Comment (R.V.): may be little too young but agrees with Neolithic assoc. industry.

7360 ± 1080
Ly-289. Culoz Sous Balme, W site, Level 1 **5410 B.C.**
Comment (R.V.): despite large statistical error due to small sample, date fits with assoc. Sauveterrian industry.

9150 ± 160
Ly-286. Culoz Sous Balme, E shelter, Level 1E **7200 B.C.**
Comment (R.V.): in good agreement with age expected by assoc. Sauveterrian triangles and microburins.

4790 ± 140
Ly-287. Culoz Sous Balme, E shelter, Level 3E **2640 B.C.**
Comment (R.V.): Level 3E underlying Level 1E, Ly-287 confirms contamination from overlying levels as suspected during excavation.

La Brèche au Diable and Longrais series, Calvados

Charcoal from several levels at Chasséan settlement, La Brèche au

Diable and Rubané Récent site (Danubian) Les Longrais. Both sites near Soumont-Saint-Quentin, Calvados (48° 39′ N Lat, 0° 13′ W Long). Coll. 1966 and subm. 1967 by B. Edeine.

Ly-134. La Brèche au Diable, Layer m, Level-97 **4560 ± 120 2610 B.C.**

Ly-135. La Brèche au Diable, Layer n, Level-102 **4940 ± 200 2990 B.C.**

Ly-148. La Brèche au Diable, Layer p, Level-110 **4540 ± 140 2590 B.C.**

Ly-149. La Brèche au Diable, Layer q, Level-116 **5140 ± 140 3190 B.C.**

Comment (B.E.): these 4 values confirm relatively old age attributed to Chasséan of Normandie by Gsy-39: 4790 ± 150 (R., 1966, v. 8, p. 131). They prove settlement was occupied for at least ca. 500 yr.

Ly-150. Les Longrais, Hole X 7, Layer a **5290 ± 180 3340 B.C.**

Comment (B.E.): this age for Rubané Récent (Danubian) seems to correspond with Neuvy en Dunnois incinerations (Gif-785: 5250 ± 140 B.P.) which might be also Danubian (Masset, 1968).

General Comment (B.E.): comparing Ly-150 and Ly-149, there is no interruption between Rubané Récent and Chasséan in Normandie; dates "Cerny" civilization underlying Chasséan at La Brèche au Diable (Edeine, 1970).

Ly-164. La Baume Loire 2, Haute Loire **3670 ± 130 1720 B.C.**

Charcoal from overlying level in rock-shelter La Baume Loire, near Solignac, Haute Loire (44° 56′ N Lat, 3° 54′ E Long). Coll. and subm. 1968 by A. Crémilleux, Le Monastier sur Gazeille, Haute Loire. *Comment* (A.C.): agrees well with assoc. Late Neolithic industry; comparison with Ly-50: 4230 ± 300 (R., 1969, v. 11, p. 116) shows occupation time of site for Middle and Late Neolithic.

Le Rond du Lévrier séries, Haute Loire

Charcoal from levels at rock-shelter Le Rond du Lévrier, near Salette, Haute Loire (44° 51′ N Lat, 3° 58′ E Long). Coll. and subm. 1968 by J. P. Daugas and A. Crémilleaux.

Ly-194. Le Rond du Lévrier, Level III **3370 ± 210 1420 B.C.**

Ly-195. Le Rond du Lévrier, Level IIb **3570 ± 130 1620 B.C.**

Ly-196. Le Rond du Lévrier, Level I **4380 ± 280 2430 B.C.**

General Comment (A.C.): Ly-196 comes from same Middle Neolithic level as Ly-82: 4750 ± 300 (R., 1969, v. 11, p. 115). Comparison between

Ly-196 and Ly-194, assoc. with metallic remains, shows a site occupation > 1000 yr long. Ly-195 comes from another part of the site; its assoc. Late Neolithic industry shows Mediterranean influences.

Prélétang series, Isère

Charcoal from several sectors of upper layers in long cave, Prélétang, near Presle, Isère (45° 05′ N Lat, 5° 25′ E Long). Coll. and subm. by P. Lequatre, Saint-Marcellin, Isère. Lower layers of site contain a large *Ursuslic. Spelaeus* fauna assoc. with Mousterian industry (Lequatre, 1966). See Ly-167, this list.

Ly-118. Prélétang No. 4, Sector XIII **Modern**

Comment: charcoal from upper stalagmitic floor in which branch traces demonstrate a temporary occupation.

Ly-81. Prélétang No. 1, Sector XVIII **10,400 ± 300 8450 B.C.**

Ly-93 Prélétang No. 3, Sector XIX **11,730 ± 260 9780 B.C.**

Comment on Ly-81 and Ly-93: both samples come from bellow stalagmitic floor overlying *Ursuslic. Spelaeus* fauna. As expected, similar dates show that formation of stalagmitic floor began at end of Glacial time.

III. ARCHAEOLOGIC CHECK SAMPLES FOR A NEW BONE COLLAGEN PREPARATION METHOD

The following samples were measured to test a new method of bone treatment for their dating. Many studies were made to find methods of preparation, e.g., Haynes (1966), Berger, Horney, and Libby (1964), and Kruegger (1965) that would eliminate, by different chemical processes, many contaminants which can change results. These methods have disadvantages—either treatment is too strong (contaminants are well eliminated, but very often much collagen is destroyed), or contaminants are not fully eliminated.

The method perfected and described by R. Longin (1970) consists in extracting bone collagen selectively by using one of its specific physicochemical properties—its solubility in water at a very determined temperature and pH, after an acid pretreatment of bones. Bones, after crushing, are attacked with a solution of HCl 8% to eliminate the most important part of mineral substances (especially carbonates) and one of the main contaminants of fossil bones; pretreatment time is limited for not rendering soluble collagen. Extraction of collagen is obtained by heating and mixing the acidification residue with water at pH 3.0, for many hours. Only collagen goes through the solution and the impurities stay in the residue. Then, collagen is recovered by drying of the solution in an oven.

The number of bones to be treated is determined by a Kjedhal dosage. The yield of the total extraction is about 65 to 70%; it especially

depends on crushing, acid pretreatment time, and dissolution time in water. Then, the pure gelatin obtained is burnt.

This method has the following advantages: rapidity of preparation (ca. 2 hr), simplicity of operations and employed substances, full elimination of contaminants, and an important yield. The technical process is fully described in the thesis and an abstract of this method will be published elsewhere.

To check the validity of dates obtained by this method (and elimination of any impurity), samples were chosen from different types of archaeologic sites (rock shelter or open air sites and calcareous or sandy layers) and the dated bones were assoc. with charcoals or burned bones on which the classical method of preparation had been made.

All measurements below show a perfect agreement between the obtained dates with bones and charcoals, and also with archaeologic data. The following table shows an easy comparison between the obtained results.

Sites	Collagen	Charcoal residue	Humic fraction
La Couronne Martigues	3970 ± 130	4060 ± 220	
Montclus layer 4	6140 ± 140	6300 ± 140	
Montclus layer 21	7780 ± 250	7890 ± 170	
Montclus layer 22	7750 ± 340	7770 ± 410	
St Remèze 378	11,500 ± 380	11,750 ± 300	12,080 ± 310
Les 2 Avens	12,350 ± 200	12,320 ± 600	
Solutré 9b, 8b	17,150 ± 300	16,740 ± 300	10,900 ± 400
St Martin sous Montaigu	22,900 ± 600	24,150 ± 550	21,100 ± 1300

La Couronne, Bouches du Rhone series

Samples from Layer 3D, Habitat 1 of the late Neolithic (Couronnien) village of Le Collet Redon at La Couronne, Bouches du Rhône (43° 21′ N Lat, 5° 4′ E Long). Coll. 1968 and subm. 1969 by M. Escalon de Fonton, Marseille (Escalon de Fonton, 1956). Samples coll. 80 cm below a permeable calcareous soil, were subject to rain water leaching for a long time.

Ly-301. La Couronne, I/3D, charcoal 4060 ± 220

Pretreatment with HCl 2% and twice 15 h with NaOH 2% at 80°C.

Ly-303. La Couronne, I/3D, bone 3970 ± 130

In spite of bone leaching, 300 g were sufficient to get 4.6 g of collagen. Average of Ly-301 and Ly-302: 4000 ± 110 B.P. = 2050 B.C. *General Comment* (M.E. deF.): agrees with expected age which corresponds to desertion of village and not to its foundation.

Montclus, Gard series

Samples from several levels of Rock-shelter La Baume de Monclus, Gard (44° 16′ N Lat, 4° 26′ E Long). Coll. 1960 and subm. 1969 by M. Escalon de Fonton. Layers contain Sauveterrian (Middle Mesolithic), Castelnovian (Late Mesolithic), Cardial and Epicardial (Late Neolithic) industries (Escalon de Fonton, 1967). Rock shelter is near La Cèze R. and deposits often overflowed.

Ly-303. Montclus, No. 3a, Layer 4, charcoal 6300 ± 140

Ly-304. Montclus, No. 3b, Layer 4, bone 6140 ± 140

4.35 g; collagen from 320 g bone. Average of Ly-303 and Ly-304: 6220 ± 100 B.P. = 4270 B.C. *Comment* (M.E.F.): this layer contains a late Cardial industry with which date agrees well.

Ly-305. Montclus, No. 25a, Layer 21 F, charcoal 7890 ± 170

Ly-306. Montclus, No. 25b, Layer 21 F, bone 7780 ± 250

1.8 g; collagen from ca. 200 g bone. Average of Ly-303 and Ly-306: 7780 ± 140 B.P. = 5830 B.C.

Ly-307. Montclus, No. 27a, Layer 22, charcoal 7770 ± 410

Ly-308. Montclus, No. 27b, Layer 22, bone 7750 ± 340

1.5 g collagen from 190 g bone. Large statistical errors are due to small size of sample. Average of Ly-307 and Ly-308: 7760 ± 260 B.P. = 5810 B.C. *Comment on Ly-307 and Ly-308* (M.E.F.): Layers 21 F and 22 contain a regional Sauveterrian (Montclusian) industry. Dates may be compared with Kn-58: 8130 ± 240 from the same Layer 22. They are a little younger than Upper Sauveterrian dates at Rouffignac, Dordogne, GrN-2913: 8370 ± 100 (R., 1963, v. 5, p. 175).

Saint Remèze, Ardèche series

Samples from Layer D at Rock-shelter le Saut du Loup (or Abri Dumas) near Saint Remèze, Ardèche (44° 20′ N Lat, 4° 32′ E Long). Coll. and subm. 1969 by J. Combier Romanèche-Thorins, Saône et Loire. Layer contains a large rabbit fauna assoc. with Azilian industry (Combier, 1963). Samples come from 1.07 m below calcareous pebbles without any water circulation.

Ly-318. Saint-Remèze, a) charcoal 11,750 ± 300

Ly-319. Saint Remèze, b) humus fraction 12,080 ± 310

Ly-320. Saint Remèze, c) bone 11,500 ± 380

155 g bone treated in several parts gave 2.1 g collagen. Average of Ly-318 and Ly-320: 11,650 ± 240 B.P. = 9700 B.C. *Comment* (J.C.): date a little older than expected with respect to regional Late Magdalenian dates (e.g., Ly-321, 322, this list). It seems very possible because this old Azilian industry might succeed to Late Magdalenian at end of Allerød period.

Les Deux Avens, Ardèche series

Samples from Level C in Les Deux Avens grotto near Vallon-Pont-d'Arc, Ardèche (44° 23′ N Lat, 4° 24′ E Long). Coll. and subm. 1969 by J. Combier. Assoc. with industry precisely dated Late Magdalenian VI^2 and certainly before Allerød period (Combier, 1963). Level is inside a deep calcareous cave; it is sandy with recrystallized calcite.

Ly-321. Les Deux Avens, a) charcoal 12,320 ± 600

Very small sample.

Ly-322. Les Deux Avens, b) bone 12,350 ± 200

5.0 g collagen from 545 g bone. Average of Ly-321 and Ly-322: 12,340 ± 200 B.P. = 10,390 B.C. *Comment* (J.C.): agrees with other Late Magdalenian dates, as expected, just before Allerød period (ca. 12,000 to 11,000 B.P.) Compare with Layer 2 at La Grotte de la Vache near Alliat, Ariège, GrN-2025: 12,540 ± 105 (R., 1963, v. 5, p. 168).

Solutré series, Saone et Loire

Samples from several places and levels of the site Solutré, Saône et Loire (46° 18′ N Lat, 4° 43′ E Long). Coll. and subm. 1969 by J. Combier. Site is mainly composed of a thick mass of horse bones in a large rock-rubble at foot of a limestone cliff. Some layers below a few thicknesses of soil were subject to rain-water leaching. Settlement was occupied from Mousterian to Late Magdalenian.

Ly-314. Solutré No. 8 b1) burned bone, residue 16,740 ± 300

Ly-315. Solutré No. 8 b2) burned bone humic fraction 10,900 ± 400

Ly-316. Solutré No. 9 b) Unburned bone 17,150 ± 300

Average of Ly-314 and Ly-316: 16,950 ± 220 B.P. = 15,000 B.C. Comparison between Ly-315 and Ly-316 proves that humic fraction is fully eliminated in bone collagen. *Comment* (J.C.): samples come from upper part of layer containing a Middle Solutrean industry. Date, 2000 yr younger than Middle Solutrean at Laugerie-Haute Dordogne (GrN-4442: 19,600 ± 140, R., 1967, v. 9, p. 116). Date needs confirmation, but late age is possible in region.

Ly-317. Solutré No. 11, Sondage C, unburned bone 24,050 ± 600 22,100 B.C.

Comment (J.C.): expected age was Aurignacian, but those bones may belong to Upper Perigordian layers called "Magma de Cheval". This date agrees with Dordogne, e.g., Perigordian VI at Abri Pataud, GrN-4721: 23,010 ± 170 (R., 1967, v. 9, p. 114) and agrees also with Saint-Martin Sous Montaigu, Ly-309-311.

Ly-12. Solutré No. 4, Layer 6, small unburned broken bones **28,650 ± 1100 / 26,700 B.C.**

3.4 g collagen from 300 g bone.

Ly-313. Solutré No. 5, Layer 6, unburned bone **22,650 ± 500**

3.5 g collagen from 300 g bone. *Comment* (J.C.): both samples from Upper Perigordian "Magma de Cheval" level. Ly-313 agrees with Ly-317. Ly-312 is too old but these small bones come from a place in site where they might be mixed with older small bones (may be Aurignacian).

Saint Martin Sous Montaigu series, Saone et Loire

Samples from hearth at Les Vignes du Chateau Beau, near Saint Martin sous Montaigu, Saône et Loire (46° 49′ N Lat, 4° 42′ E Long). Coll. and subm. by J. Combier. Site is similar and close to Solutré. Samples were from level resembling "Magma de Cheval" of Solutré and assoc. with Upper Perigordian Pointe de Font-Robert faciès (Combier, 1962).

Ly-309. Saint Martin Sous Montaigu, a) burned bone residue **24,150 ± 550**

Ly-310. Saint Martin Sous Montaigu, b) burned bone humic fraction **21,100 ± 1300**

Ly-311. Saint Martin Sous Montaigu, c) unburned bone **22,900 ± 600**

Average of Ly-309 and Ly-311: 23,550 ± 400 B.P. = 21,600 B.C. Comparison between Ly-310 and Ly-311 proves full elimination of humic fraction by bone collagen preparation. *Comment* (J.C.): agrees with expected age and confirms similarity with "Magma de Cheval" level of Solutré. Compare with Ly-317 and with Layer 3, Lens 2a, Abri Pataud, GrN-4721: 23,010 ± 170 (R., 1967, v. 9, p. 114).

Abri Pataud series, Dordogne

Unburned bone from Layer 5 (Perigordian IV) at Abri Pataud, near Les Eyzies, Dordogne (44° 56′ N Lat, 1° 0′ E Long). Coll. by H. L. Movius and subm. 1968 by J. C. Lerman, Radiocarbon Lab., Groningen. That sample previously measured, GrN-4631: 21,780 ± 215 (R., 1967, v. 9, p. 114) was estimated too young with respect to other measurements 5000 yr older from same Level 5.

23,800 ± 800

Ly-100. Abri Pataud, Layer 5, No. 1 **21,850 B.C.**

Collagen extracted by H_2SO_4 and Na_2SO_4.

22,000 ± 1000

Ly-300. Abri Pataud, Layer 5, No. 2 **20,050 B.C.**

Collagen extracted by method described above. *Comment*: Ly-300 agrees better than Ly-100 with GrN-4631. Both new values confirm younger than expected age of that sample.

Prélétang series, Isère

Very calcified bones, from Mousterian *Ursuslic. Spelaeus* level in Grotte de Prélétang near Presle, Isère (45° 04′ N Lat, 5° 25′ E Long). Coll. and subm. 1969 by P. Lequatre, Saint-Marcellin, Isère.

Ly-167. Prélétang, Layer 9, bone collagen fraction ⩾32,000

Ca. 2 g collagen from 100 g bone.

Ly-167 bis. Prélétang, Layer 9, bone carbonate fraction 3810 ± 160

Comment: amount of collagen shows that calcification by recent water (Ly-167 bis) did not affect bone organic fraction. Null activity of Ly-167 proves that bone collagen extraction method eliminates carbonate fraction completely.

IV. WATER SAMPLES

Le Chène series, Vaucluse

The following samples were pumped from a well at Le Chène near Apt, Vaucluse (43° 41′ N Lat, 5° 20′ E Long) in 1968 and 1969 to practice a periodical C^{14} and T^3 surveillance. This well, bored at the end of 1967, gives water from the old-water reserve which contributes to the feeding of the huge intermittent spring, Fontaine de Vaucluse, at the low-water period (Margrita *et al.*, 1970). δC^{13} was measured by R. Letolle, Lab. de Géol. Dynamique, Fac. Sci., Paris. Results are given as % of modern without any correction.

Sample	Collection date (mo/day/yr)	C^{13}	C^{14} (% of modern)
Ly-98. Le Chène I	4/17/68		35.5% ± 1.0
Ly-99. Le Chène II	4/17/68	−8.80‰	48.5% ± 1.1
Ly-136. Le Chène III	11/13/68		39.9% ± 0.9
Ly-137. Le Chène IV	11/13/68		49.3% ± 1.2
Ly-184. Le Chène V	03/05/69	−9.19‰	48.8% ± 1.3
Ly-230. Le Chène VI	04/30/69		44.1% ± 0.8
Ly-231. Le Chène VII	07/09/69		43.7% ± 0.8
Ly-244. Le Chène VIII	10/28/69		46.8% ± 1.7
Ly-245. Le Chène IX	11/17/69		45.1% ± 0.8

General Comment: first values (Le Chène I to Le Chène IV) show perturbations caused by boring the well. Afterwards, C^{14} content of the water remains constant (ca. 45% of modern), but T^3 values show mixing with ca. 20% of modern water in the well.

Ly-138. Fontaine de Vaucluse 93.8 ± 1.6% of modern

Water from the spring Fontaine de Vaucluse (43° 44′ N Lat, 5° 07′ E Long) coll. 1968 by J. Evin. *Comment*: may be compared to Ly-29:

91.5 ± 3.0% and Ly-30: 93.7 ± 3.0%, both samples coll. in 1967 (R., 1969, v. 11, p. 116).

Ground water of the Albien in the Paris Bassin series

Measurements listed here were made in 1966-1970 in a hydrogeologic study of confined ground water of the Albien in the Paris Bassin. This study, set up by the Bureau de Recherches Géol. et Min., (which assumed financial support), was made to test the use of C^{14} in a wide (several hundred km^2) and sandy aquifer.

Selection of sampling points, samplings, supervision of chemical preparations and hydrogeologic and chemical studies were made by Y. Vuillaume, of the Bureau La Source-Orléans, Loiret.

Most samples were treated classically by metallic tank to precipitate $BaCO_3$ at the sampling place. But for Ly-224/249-247/250-223/248, the CO_2 was extracted from the water by acidification in the radiocarbon lab. to test the tank for pollution which could be sensitive in case of low activity. Almost all the samples come from the Albien aquifer, except Ly-66, 67, 188, 221, and 203 which come from an underlying aquifer, and Ly-225 and 227, from an overlying one.

Radiocarbon content is reported as % of modern without correction from the δC^{13} measured by R. Letolle.

SE region: Bourgogne

Sample	Collection date	C^{13}	C^{14} % of modern
Ly-21. Parly-Chenons A1b2 (47° 46′ N Lat, 3° 21′ E Long)	10/66		94.7 ± 0.7
Ly-32. Parly-Bernier Alb4 (47° 46′ N Lat, 3° 21′ E Long)	10/66		86.7 ± 0.7
Ly-22. Poilly S/Thollon Alb3 (47° 52′ N Lat, 3° 23′ E Long)	10/66		91.7 ± 1.0
Ly-226. Dracy 401 (47° 45′ N Lat, 3° 15′ E Long)	7/69	−13.9‰	66.7 ± 1.0
Ly-213. Chichery 397 (47° 54′ N Lat, 3° 31′ E Long)	4/66	−17.7‰	53.2 ± 1.8
Ly-208. Chichery 391/395 (47° 54′ N Lat, 3° 31′ E Long)	7/69	−13.0‰	58.0 ± 1.1
Ly-85. Migennes 263 (47° 58′ N Lat, 3° 31′ E Long)	10/67		46.6 ± 1.0
Ly-210. Migennes 392 (47° 58′ N Lat, 3° 21′ E Long)	7/69		67.3 ± 0.9

Sample	Collection date	C^{13}	C^{14} % of modern
Ly-108. Montbouy 262/269 (47° 52′ N Lat, 2° 49′ E Long)	10/67		28.9 ± 0.5
Ly-186. Neuilly 371/374 (48° 04′ N Lat, 3° 25′ E Long)	3/69	−15.0‰	15.9 ± 0.6
Ly-109. Fleury 268 (47° 52′ N Lat, 3° 26′ E Long)	11/67		14.9 ± 0.7
Ly-187. Champvallon 375/376 (47° 56′ N Lat, 3° 20′ E Long)	3/69	−12.8‰	13.6 ± 0.7
Ly-66. Appoigny 264 A (47° 53′ N Lat, 3° 31′ E Long)	10/67		12.7 ± 1.0
Ly-67. Appoigny 264 B (47° 53′ N Lat, 3° 31′ E Long)	10/67		11.6 ± 0.8
Ly-188. Appoigny 377/378 (47° 53′ N Lat, 3° 31′ E Long)	3/69	−18.3‰	0.6 ± 0.4
Ly-86. Grande Paroisse 258 (48° 23′ N Lat, 2° 35′ E Long)	10/67		10.6 ± 0.6
Ly-125. Grande Paroisse 304/305 (48° 23′ N Lat, 2° 35′ E Long)	3/68		9.5 ± 0.8
Ly-228. Grande Paroisse 403 (48° 23′ N Lat, 2° 35′ E Long)	7/69	−10.2‰	3.2 ± 0.5
Ly-209. Bussy en Othe 393 (48° 01′ N Lat, 3° 30′ E Long)	7/69	−10.2‰	4.5 ± 0.4
Ly-225. Grand-Chaumont 402 (47° 51′ N Lat, 3° 19′ E Long)	7/69	−13.2‰	95.6 ± 1.1
Ly-227. Froville 400 (47° 51′ N Lat, 3° 16′ E Long)	7/69	−12.7‰	72.5 ± 0.9
E region: Champagne			
Ly-219. Nuisement 387 (48° 35′ N Lat, 4° 44′ E Long)	6/69	−11.7‰	84.3 ± 1.1
Ly-218. Humbécourt 386 (48° 35′ N Lat, 4° 54′ E Long)	6/69	−12.1‰	76.9 ± 0.8
Ly-222. Chaudefontaine 390 (49° 66′ N Lat, 4° 52′ E Long)	6/69	−13.3‰	74.8 ± 0.9
Ly-220. Voilecomte 388 (48° 41′ N Lat, 4° 51′ E Long)	6/69	−14.8‰	66.3 ± 1.0

Sample	Collection date	C^{13}	C^{14} % of modern
Ly-217. Montier en Der 385 (48° 29′ N Lat, 4° 46′ E Long)	6/69		52.8 ± 0.8
Ly-216. Dompremy 384 (48° 44′ N Lat, 4° 43′ E Long)	6/69	−9.0‰	17.9 ± 0.9
Ly-221. Sainte Menehould 389 (49° 06′ N Lat, 4° 53′ E Long)	6/69		1.4 ± 0.4
S and W regions: Orléannais and Normandie			
Ly-71. Barlieu 266 (47° 30′ N Lat, 2° 38′ E Long)	10/67		82.1 ± 1.3
Ly-205. Bemecourt 381 (48° 51′ N Lat, 0° 53′ E Long)	5/69	−13.7‰	75.5 ± 1.0
Ly-204. Thiberville 380 (49° 08′ N Lat, 0° 27′ E Long)	5/69	−13.0‰	65.3 ± 0.8
Ly-206. Brou 382 (48° 13′ N Lat, 1° 10′ E Long)	5/69	−9.0‰	52.0 ± 0.8
Ly-207. Chateaudun 383 (48° 03′ N Lat, 1° 24′ E Long)	5/69	−5.7‰	40.9 ± 0.8
Ly-74. Blancafort 267 (47° 32′ N Lat, 2° 32′ E Long)	10/67		42.2 ± 1.2
Ly-111. La Chapelle d'Angillon 274 (47° 22′ N Lat, 2° 26′ E Long)	11/67		34.2 ± 0.9
NW regions: Haute-Normandie			
Ly-146. Gauciel 318 (49° 02′ N Lat, 1° 14′ E Long)	7/68	−9.9‰	37.5 ± 0.8
Ly-141. Le Marais Vernier 326 (49° 26′ N Lat, 0° 28′ E Long)	7/68	−14.3‰	36.9 ± 0.9
Ly-147. Vernon 317 (49° 06′ N Lat, 1° 26′ E Long)	7/68	−8.3‰	21.7 ± 0.6
Ly-144. Les Loges 322 (49° 42′ N Lat, 0° 17′ E Long)	7/68	−9.6‰	15.9 ± 0.4
Ly-143. Saint Pierre en Port 323 (49° 48′ N Lat, 0° 29′ E Long)	8/68	−11.4‰	16.0 ± 2.0
Ly-145. Le Trait 319 (49° 28′ N Lat, 0° 49′ E Long)	7/68	−10.9‰	12.4 ± 0.7

Sample	Collection date	C^{13}	C^{14} % of modern
Ly-215. Mantes 399 (48° 59′ N Lat, 1° 40′ E Long)	3/69		11.8 ± 1.4
Ly-110. Pont de l'Arche 272 (49° 18′ N Lat, 1° 09′ E Long)	11/67		7.2 ± 0.7
Ly-181. Honfleur 325 (49° 25′ N Lat, 0° 14′ E Long)	7/68	−13.3‰	78.6 ± 1.4
Ly-142. Le Crotoy 324 (50° 13′ N Lat, 3° 04′ E Long)	7/68	−17.1‰	31.7 ± 0.9
Ly-203. Incarville 379 (49° 14′ N Lat, 1° 10′ E Long)	5/69	+2.9‰	1.4 ± 0.4
Central region: Ile de France			
Ly-121. Epinay 298 (48° 57′ N Lat, 2° 19′ E Long)	3/68	−14.2‰	9.7 ± 1.4
Ly-40. Villeneuve La Garenne 236 (48° 56′ N Lat, 2° 20′ E Long)	6/67		9.1 ± 0.5
Ly-124. Achères 302 (48° 58′ N Lat, 1° 53′ E Long)	3/68	−16.3‰	8.9 ± 0.2
Ly-119. Ivry (48° 49′ N Lat, 2° 23′ E Long)	1/68	−13.3‰	8.5 ± 0.1
Ly-120. Orsay 284 (48° 43′ N Lat, 2° 10′ E Long)	1/68	−10.7‰	7.8 ± 0.8
Ly-126. Le Pecq 303 (48° 53′ N Lat, 2° 06′ E Long)	3/68	−14.3‰	7.3 ± 1.3
Ly-37. Pantin 214/226 (48° 54′ N Lat, 2° 15′ E Long)	12/66	−15.3‰	6.4 ± 0.1
Ly-211. Issy 394 (48° 50′ N Lat, 2° 16′ E Long)	7/69	−15.0‰	3.7 ± 0.4
Ly-122. Noisy le Grand 299 (48° 48′ N Lat, 2° 32′ E Long)	3/68	−14.1‰	3.5 ± 0.5
Ly-224/249. Noisy le Grand L. 310 (48° 48′ N Lat, 2° 32′ E Long)	8/69		3.7 ± 0.4
Ly-23. Paris O.R.T.F. Alb1 (48° 52′ N Lat, 2° 18′ E Long)	10/66		8.8 ± 0.3
Ly-214. Paris O.R.T.F. 398 (48° 52′ N Lat, 2° 18′ E Long)	2/67	−12.2‰	3.2 ± 0.5

Sample	Collection date	C^{13}	C^{14} % of modern
Ly-123. Aulnay Sous Bois 300 (48° 57′ N Lat, 2° 30′ E Long)	3/68	−16.4‰	2.7 ± 0.1
Ly-212. Aulnay Sous Bois 396 (48° 57′ N Lat, 2° 30′ E Long)	7/69	−9.5‰	1.0 ± 0.4
Ly-247/250. Aulnay Sous Bois L. 382 (48° 57′ N Lat, 2° 30′ E Long)	10/69	−10.6‰	2.6 ± 0.3
Ly-223/248. Viry Chatillon L. 309 (48° 40′ N Lat, 2° 23′ E Long)	8/69	−12.8‰	2.1 ± 0.5

General Comment (J.E. and Y.V.): a map of these results in isorad curves shows the feeding zones along the entire periphery of the bassin and the general flow in the direction of the central or the NW regions. In the SE region, great differences of radioactivity along short distances show that feeding of the reservoir occurs through clay overlying the aquifer (Evin and Vuillaume, 1970).

Ground water of the Calcaires de Champigny series, Seine et Marne

The following samples measured in 1967-1969 were sent by the Dept. d'Hydrogéol. du Bur. de Recherches Géol. et Min. All come from free ground water in the limestone Calcaire de Champigny, ca. 20 km SE of Paris. Y. Vuillaume assumed sampling and chemical treatment.

Sample	Collection date	C^{14} % of modern
Ly-78. Brie Comte Robert 292 (48° 41′ N Lat, 2° 26′ E Long)	3/68	126.8 ± 1.2
Ly-172. Brie Comte Robert 339 (48° 41′ N Lat, 2° 26′ E Long)	1/69	139.2 ± 2.0
Ly-102. Presles en Brie 286 (48° 43′ N Lat, 2° 44′ E Long)	3/68	97.6 ± 1.5
Ly-179. Presles en Brie 330 (48° 43′ N Lat, 2° 44′ E Long)	1/69	102.6 ± 1.6
Ly-175. Mardilly 336 (48° 39′ N Lat, 2° 38′ E Long)	1/69	94.7 ± 1.5
Ly-174. Saint Hillier 337 (48° 38′ N Lat, 3° 15′ E Long)	1/69	93.0 ± 1.4
Ly-107. Combe la Ville 291 (48° 40′ N Lat, 2° 33′ E Long)	3/68	84.7 ± 1.5
Ly-176. Pont du Diable 335 (48° 39′ N Lat, 2° 38′ E Long)	1/69	83.2 ± 1.4

Sample	Collection date	C^{14} % of modern
Ly-104. Rouilly 288 (48° 36′ N Lat, 3° 17′ E Long)	3/68	70.1 ± 1.1
Ly-173. Rouilly 338 (48° 36′ N Lat, 3° 17′ E Long)	1/69	77.5 ± 1.5
Ly-103. Neufmoutier 287 (48° 46′ N Lat, 2° 50′ E Long)	3/68	72.5 ± 1.1
Ly-178. Neufmoutier 332 (48° 46′ N Lat, 2° 50′ E Long)	1/69	52 ± 6
Ly-46. Nangis 242/243 (48° 33′ N Lat, 3° 01′ E Long)	9/67	58.6 ± 1.4
Ly-44. Nangis 249 (48° 33′ N Lat, 3° 01′ E Long)	9/67	66.7 ± 0.5
Ly-105. Nangis 289 (48° 33′ N Lat, 3° 01′ E Long)	3/68	64.4 ± 1.1
Ly-101. Chevry Cossigny 285 (48° 43′ N Lat, 2° 41′ E Long)	3/68	45.6 ± 0.9
Ly-177. Chevry Cossigny 333 (48° 43′ N Lat, 2° 41′ E Long)	1/69	43.0 ± 1.0

Samples from the same well at La Ferté Alais (48° 29′ N Lat, 2° 21′ E Long).

Ly-56. La Ferté 250	9/67	12.5 ± 0.5
Ly-57. La Ferté 251	9/67	9.6 ± 0.7
Ly-58. La Ferté 253	9/67	6.0 ± 0.9
Ly-59. La Ferté 255	9/67	7.7 ± 0.6
Ly-79. La Ferté 293	3/68	8.2 ± 1.6
Ly-106. La Ferté 290	3/68	9.1 ± 0.1
Ly-161. La Ferté 348	1/69	4.4 ± 0.6
Ly-162. La Ferté 347	1/69	3.4 ± 0.7
Ly-163. La Ferté 346	1/69	8.2 ± 0.6

General Comment: most of these values are rather high. This fits with the fact that the ground water is free and with rather quick renewal except at La Ferté Alais, where radioactivity is low and ground water is confined without flow.

Villeneuve La Garenne series, Hauts de Seine

Samples from Lutetien and Sparnacien aquifer at Villeneuve La Garenne (48° 56′ N Lat, 2° 20′ E Long).

Sample	Collection date	C^{14} % of modern
Ly-45. Villeneuve-Lutetien 235	9/67	58.9 ± 1.0
Ly-39. Villeneuve-Sparnacien 234	9/67	56.4 ± 1.1
Ly-127. Villeneuve-Lutetien 297	3/68	61.2 ± 2.2
Ly-128. Villeneuve-Sparnacien 296	3/68	56.9 ± 2.1
Ly-183. Villeneuve-Lutetien 341	1/69	63.3 ± 1.2
Ly-180. Villeneuve-Sparnacien 340	1/69	62.8 ± 1.0

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