

LYON NATURAL RADIOCARBON MEASUREMENTS I

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INTRODUCTION

The Radiocarbon Dating Laboratory was founded in 1965 by the Department of Geology, University of Lyon, to study the Late Quaternary geology of the Rhône-Alps Region, and to contribute to hydrogeologic and archaeological studies. It has been installed in the basement of the Nuclear Physics Institute. Preparation began in 1966 and first dates obtained in June 1967.

We used proportional counters filled with pure CO₂, as detectors (De Vries, 1953). During the first months of 1967, we had a quartz counter coated inside with gold (Vogel, 1967), specially built by Prof. J. C. Vogel, Radiocarbon Laboratory of Groningen. Afterwards, we changed the mounting of that type of detector and we now use two counters with an effective volume of 0.5 L, filled at 21°C to a pressure of 225 cm Hg.

The counters are shielded by 10 cm of selected lead, 10 cm of boroparaffin and 3 cm of old lead. Anticoincidence shielding consists of two layers of 24 G.M. counters each. The electronic circuits are of commercial origin, or made in the Institute. An automatic system prints out the count rates every 100 minutes.

Backgrounds of the two detectors are respectively 4.7 and 3.8 cpm. These values do not change appreciably with barometric pressure, but a very good stability of humidity and temperature are controlled in the counting room.

The detectors yield a counting rate of 9.5 and 10.2 cpm for 95% NBS oxalic acid standard, which is prepared by direct combustion. Determination of isotopic fractionation of this preparation has been kindly made by W. G. Mook, C¹³ laboratory at Groningen, who got $\delta C^{13} = -19.78\%$ PDB standard. In order to test our equipment we measured some samples sent by Prof. Vogel. We got the following results:

Groningen samples		Lyon measurements	
GrN-5307	160 ± 30	Ly-90	220 ± 120
GrN-5262	8060 ± 65	Ly-87	7840 ± 300
GrN-5309	19,240 ± 160	Ly-88	18,900 ± 500
GrN-5237	47,700 ± 2350	Ly-89	>35,000

All samples are counted at least twice for periods of 1200 min. Ages are calculated using the Libby 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. C¹³ corrections have not been carried out.

The samples are pretreated in the classic way: HCl 2% and NaOH

2%. A new technique for extraction of bone-collagen is used and will be described later. CO₂ is purified according to a modified De Vries method; (De Vries, 1956): CO₂ passes, by thermal convection, over red copper and silver at 450°C, and through a dry-ice trap.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Chamagnieu series, Isère

Samples from peat bog in Bourbre R. valley, at Les Cariaux near Chamagnieu, Isère (45° 39' N Lat, 5° 9' E Long). Coll. 1966 by J. Evin.

Ly-36. Chamagnieu I	1800 ± 200
Peat from 30 to 40 cm below surface.	A.D. 150
Ly-13. Chamagnieu II	2200 ± 100
Peat from 70 to 80 cm below surface.	250 B.C.
Ly-91. Chamagnieu III	2780 ± 160
Wood found in peat 150 cm below surface.	830 B.C.
Ly-92. Chamagnieu IV	4040 ± 400
Humus fraction of clayey peat from bottom of peat bog 190 cm below surface.	2090 B.C.
<i>General Comment:</i> pollen analysis has been done on these samples. Growth rate may be compared with other peat bogs (Oeschger, 1965).	
Ly-34. Le Vernay, Isère	4070 ± 120
From bore hole at Le Vernay near Ruy Isère (45° 34' N Lat, 5° 19' E Long). Coll. 1966 and subm. by A. Peguin, 35 Rue Arago, Villeurbanne-Rhône. <i>Comment:</i> date may be compared with Ly-92, in same valley 10 km below.	2120 B.C.

5520 ± 270**3570 B.C.****Ly-24. Veyrins, Isère**

From bore hole at Veyrins, Isère (45° 38' N Lat, 5° 32' E Long). Coll. 1966 and subm. by A. Peguin. *Comment*: boring was in alluvions of old Rhône channel.

>35,000**Ly-14. Gourdon, Ain**

Charred wood from gravel bank in Ain R. at Gourdon near Saint Jean de Niois, Ain (45° 49' N Lat, 5° 14' E Long). Coll. 1965 and subm. by Ph. Artru, Dept. of Geol., Univ. of Lyon. *Comment*: date is proof that wood comes from old continental sediments (may be late Miocene) which are carried away unaltered by river.

II. ARCHAEOLOGIC SAMPLES

A. Historical Period

630 ± 200**A.D. 1320****Ly-7. Vallée de Vallonge, Basses Alpes**

Charcoal from old lime-kiln in Vallonge R. valley near La Palud de Moutiers, Basses Alpes (43° 48' N Lat, 6° 18' E Long). Coll. 1965 and subm. by J. Flandrin. *Comment* (J.F.): younger than expected considering thickness of sediments overlaying kiln.

1870 ± 170**A.D. 80****Ly-25. Busserolles, Côte d'Or**

Charcoal from framework of Gallo-Roman villa at Busserolles, Côte d'Or (47° 39' N Lat, 4° 58' E Long). Coll. 1966 and subm. by R. Ratel, Dept. of Geol., Univ. of Dijon. *Comment*: agrees with supposed destruction time of villa: ca. A.D. 200.

2060 ± 200**110 B.C.****Ly-61. Briord 261, Ain**

Bones from grave in Gallo-Roman cemetery at Les Plantis near Briord, Ain (45° 46' N Lat, 5° 27' E Long). Coll. 1967 and subm. by R. Perraud, Le Vanel La Mure-sur-Azergue, Rhône. *Comment*: agrees with Emperor Tiberius' coins found in another grave in same cemetery.

B. Bronze and Neolithic Periods

Samples from coastal stations, "Palaffites" of French alpine lakes.

Chatillon series, Savoie

Charcoal and wood from coastal sta. underlying ca. 5m water in N part of Le Bourget Lake at Chatillon near Chindrieux, Savoie (45° 46' N Lat, 5° 50' E Long). Coll. 1966 and 1967 and subm. by R. Laurent, Centre de Recherches Archéolog. Lacustres, Tresserves, Savoie.

2730 ± 160**780 B.C.****Ly-18. Chatillon 85 AI**

Wood from hearth.

Ly-17. Chatillon 85 A2 **2700 ± 100**
750 B.C.
Wood supposedly from hut.

Ly-9. Chatillon 85 A3 **3060 ± 100**
1110 B.C.

Wood from inner part of large pile foundation.

General Comment: as expected Ly-9 is slightly older than Ly-18 and Ly-17. These 3 dates agree well with assoc. Late Bronze industry.

Ly-20. Aiguebelette 219 A2, Savoie **4150 ± 180**
2200 B.C.

Wood from pile foundation of coastal sta. underlying ca. 5m of water in Aiguebelette Lake, near Saint-Alban, Savoie (45° 34' N Lat, 5° 48' E Long). Coll. 1966 and subm. by R. Laurent. *Comment:* very much older than Ly-19 and Gif-222 (2480 ± 150 B.P.) which were taken from 2 other coastal sta. in S part of lake.

Ly-19. Aiguebelette 219 A3, Savoie **3040 ± 140**
1090 B.C.

Wood from pile foundation of coastal sta. submerged in SW part of Aiguebelette Lake near Saint-Alban, Savoie (45° 32' N Lat, 5° 47' E Long). Coll. 1966 and subm. by R. Laurent. *Comment:* closer to Gif-222 which comes from another sta. in SE part of Lake (Delibrias, 1966).

Ly-63. Sévrier 267 AI, Haute-Savoie **3400 ± 600**
1450 B.C.

Small fragments of handle of a bronze dagger found in coastal sta. submerged in Lake of Annecy near Sévrier, Haute-Savoie (45° 53' N Lat, 6° 9' E Long) (Laurent, 1968). Coll. 1967 and subm. by R. Laurent. *Comment:* agrees with supposed Late Bronze age, in spite of large statistical error.

C. Neolithic and Paleolithic Periods

Ly-48. Peylenc, Haute-Loire **1950 ± 190**
A.D. 0

Charcoal from supposed Paleolithic site at Peylenc near Saint-Pierre, Eynac, Haute-Loire (45° 38' N Lat, 4° 12' E Long) (Bayle des Hermens, 1966). Coll. 1966 and subm. by A. Crémilleux, 6 Rue Faget, Le Monastier sur Gazeille, Haute-Loire. *Comment:* this value confirms suspected sliding of overlying levels and mixing of industries after previous diggings.

Ly-82. Le Rond du Lévrier, Haute-Loire **4750 ± 300**
2800 B.C.

Charcoal from level underlying Hallstatt grave at Abri du Rond du Lévrier near Salette, Haute-Loire (44° 51' N Lat, 3° 58' E Long). Coll. 1967 and subm. by A. Crémilleux. *Comment:* older than expected but in good agreement with Ly-50.

- 4230 ± 300**
2280 B.C.
- Ly-50. La Baume, Loire, Haute-Loire**
Charcoal from Layer 80 at Abri de la Baume, Loire near Solignac, Haute-Loire (44° 56' N Lat, 3° 54' E Long). Coll. 1966 and subm. by A. Crémilleux. *Comment:* agrees with assoc. Neolithic industry.
- Seuil des Chèvres series, Savoie**
Charcoal from site occupied from Upper Paleolithic until Roman time in Seuil des Chèvres grotto near La Balme, Savoie (45° 41' N Lat, 5° 21' E Long) (Vanbrugghe, 1968). Coll. 1967 and subm. by R. Vanbrugghe, 55 Rue C. Desmoulins, Hellemes Nord.
- 5240 ± 100**
3290 B.C.
- Ly-69. Seuil des Chèvres D7**
Charcoal from Layer IV. *Comment:* agrees with assoc. Neolithic industries.
- 8980 ± 400**
7030 B.C.
- Ly-70. Seuil des Chèvres E6**
Small bits of charcoal scattered in Layer V. *Comment:* assoc. with cold fauna of elks and marmots.
- 14,380 ± 380**
12,430 B.C.
- Ly-16. Les Romains, Savoie**
Small bits of charcoal from Magdalenian site at La Grotte des Romains near Virignien, Ain (45° 41' N Lat, 5° 21' E Long). Coll. and subm. 1967 by R. Desbrosses, Les Sapins, Blanzly, Saône et Loire. *Comment:* in general agreement with industry despite fact that sample was sifted from great volume of sediments.

III. WATER SAMPLES

The following samples were coll. and measured in a general study of the Fontaine de Vaucluse. (Evin, 1968) The reservoir of this huge intermittent spring in a tributary to the Rhône is a calcareous region with an area of several hundred sq. km.

- Ly-29. Fontaine de Vaucluse, Source principale** $\delta C^{14} = 91.5 \pm 3\%$
Water from main spring (43° 54' N Lat, 5° 7' E Long). Coll. April, 1967 by J. Evin. *Comment:* this water was drawn during low-water stage; the spring had not been flowing since February.
- Ly-30. Fontaine de Vaucluse, Source secondaire** $\delta C^{14} = 93.7 \pm 3\%$
Water from small spring. Coll. April, 1967 by J. Ervin. *Comment:* this spring is perennial.
- Ly-15. Salignan, Vaucluse** $\delta C^{14} = 56.2 \pm 2\%$
Water from well, depth 135m, at Salignan near Apt Vaucluse (43° 46' N Lat, 5° 18' E Long). Coll. July, 1966 and April, 1967 by J. Evin.

Comment: average of 2 measurements. Unexpectedly low activity; ground water supposedly supplied the spring directly.

Ly-27. Villemoirieu, Isère

$$\delta C^{14} = 94.9 \pm 3\%$$

Water from well at Villemoirieu, Isère (45° 43' N Lat, 5° 13' E Long). Coll. April, 1967 by J. Evin. *Comment:* well taps ground water of calcareous reservoir at Cremieu, Isère.

Ly-28. Dizimieu, Isère

$$\delta C^{14} = 100 \pm 5\%$$

Water from well at Dizimieu, Isère (45° 42' N Lat, 5° 17' E Long). Coll. April, 1967 by J. Evin. *Comment:* like Ly-27 and from same ground-water body.

General Comment: on comparing Ly-27–Ly-30, it can be seen that Vaucluse spring water does not seem to be mixed either with old water or with water whose bicarbonates had undergone isotopic exchange in one reservoir. Low activity of Ly-15 indicates, however, that such types of water exist at Salignan, where hydrogeologic relations, if any, with Vaucluse spring, can only be indirect.

Date lists:

Bern IV
Gif II
Groningen VII

REFERENCES

- Oeschger and Riesen, 1965
Delibrias, Gullier, and Labeyrie, 1966
Vogel and Waterbolk, 1967
- Bayle des Hermens, R. and Crémilleux, A., 1966, L' abri préhistorique de Peylenc commune de Saint-Pierre Eynac, Haute-Loire: Soc. Préhist. Fr. Bull. 63, p. 208-219.
Delibrias, G., Gullier, M. T., and Labeyrie, J. 1966, Gif natural radiocarbon measurements II: Radiocarbon, v. 8, p. 74-95.
Evin, J., Flandrin, J., and Margrita, R., 1968, Le forage de Salignan: International congress of Hydrogeology, Istanbul, 1967, in press.
Laurent, R., 1968, Apparition de la métallurgie du fer dans les stations littorales du Bronze Final: Soc. linnéenne de Lyon Bull., 37ème année n°2, p. 54-65.
Oeschger, H. and Riesen, T. 1965, Bern radiocarbon dates IV: Radiocarbon, v. 7, p. 1-19.
Vanbrugghe, R. and Bill, J., 1968, La grotte du Seuil des Chèvres à la Balme Savoie Fouilles de 1967: Soc. linnéenne de Lyon Bull., 37ème année n°4, p. 150-158.
de Vries, H. L., 1956, Purification of pure CO₂ for use in a proportional counter for C¹⁴ age measurements: Appl. Sc. Res., sect. B, 5, p. 387-400.
de Vries, H. L. and Barendsen, G. W., 1953, Radiocarbon dating by a proportional counter filled with carbon dioxide: Physica, 19, p. 987-1003.
Vogel, J. C., 1963, The use of carbon isotopes in ground water studies: Radio-isotopes in Hydrology, I.A.E.A., Vienna, p. 383-396.
Vogel, J. C. and Waterbolk, H. T., 1967, Groningen radiocarbon dates VII: Radiocarbon, v. 9, p. 107-155.