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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 archaeologic 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 CO_2, 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, C^{13} 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. C^{13} 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. CO_2 is purified according to a modified De Vries method; (De Vries, 1956): CO_2 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** / **A.D. 150**

Peat from 30 to 40 cm below surface.

Ly-13. Chamagnieu II — **2200 ± 100** / **250 B.C.**

Peat from 70 to 80 cm below surface.

Ly-91. Chamagnieu III — **2780 ± 160** / **830 B.C.**

Wood found in peat 150 cm below surface.

Ly-92. Chamagnieu IV — **4040 ± 400** / **2090 B.C.**

Humus fraction of clayey peat from bottom of peat bog 190 cm below surface.

General Comment: 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** / **2120 B.C.**

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. *Comment*: date may be compared with Ly-92, in same valley 10 km below.

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.

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

Charred wood from gravel bank in Ain R. at Gourdon near Saint Jean de Niost, 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, Blanzy, 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.

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