

LYON NATURAL RADIOCARBON MEASUREMENTS VI

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INTRODUCTION

This list includes most of the samples measured during 1974 and most of those measured previously but not published in the preceding date list (R, 1975, v 17, p 4-34.)

Up to the end of 1974 no changes were made to counting techniques or to chemical treatments. Two proportional detectors filled with 2 atm CO₂ and a liquid scintillation spectrometer with a 5cm lead shield continued to be used. Normally the liquid scintillation vessel is filled with 3ml C₆H₆, but with 10ml C₆H₆, a dating limit of 50,000 yr is possible (see Ly-900, below).

Ages are calculated using 1950 as reference year and the half-life value 5570. It has not been thought necessary to add ± 30 yr uncertainty to this half-life value which is purely conventional. Statistical errors corresponding to one standard deviation include contemporary standard, background, and sample counts.

Generally no age corrections were made either from the $\delta^{13}\text{C}$ values or from the calibration table of dendrochronology. A ^{13}C correction was made for bones using measured $\delta^{13}\text{C}$ values or using $\delta^{13}\text{C} = -20 \pm 4\%$ according to Lerman (1972).

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Samples from fluvial sediments: France, Italy, Spain, and Cambodia

Ly-31. Bokeo, Cambodia **Modern**
 $\delta^{14}\text{C} = +5.5\% \pm 4.9$

Wood from Bokeo Ratanakiri Prov, Cambodia (13° 41' N, 107° 42' E). Coll from a prospecting shaft and subm 1966 by M Lacombe, Ecole Mines, Saint-Etienne. Believed from gravel lying between a basalt flow and volcanic ash. *Comment*: date proves wood is recent and probably comes from a pit-prop.

Ly-185. Pozo Valls 1, Spain **310 \pm 90**
AD 1640

Wood from a mine shaft at Pozo Valls near Hostalrich, Barcelona

Prov (41° 44' N, 2° 37' E). Coll and subm 1967 by B Plus, Paris. *Comment*: although expected to be interstadial, sample is recent.

300 ± 200

Ly-957. Caldaro 2, Bolzano, Italy

AD 1650

Wood from fluvio-glacial drift near Caldaro, Bolzano Prov (46° 23' N, 11° 15' E). Coll by M Fresche and subm 1973 by R Vivian, Inst Géog Alpine. *Comment*: expected age was ca 5000 BP; wood may have been buried by a landslide.

190 ± 110

Ly-765. Aubenasson, Drôme

AD 1760

Wood from an erosion slope adjoining a terrace of Drôme R at Aubenasson, Drôme (44° 41' N, 5° 8' E). Coll 1970 and subm 1972 by M Archambault, Univ Orléans. *Comment* (MA): date proves wood is modern; possibly a tree root.

400 ± 110

Ly-764. Le Petit Signol, Lorient sur Rhône, Drôme AD 1550

Wood from a terrace of Rhône R at Le Petit Signol near Lorient sur Rhône, Drôme (44° 41' N, 4° 49' E). Coll 1970 and subm 1972 by M Archambault. May also be a root that has penetrated into terrace gravel. *Comment* (MA): date confirms last hypothesis. Wood cannot be used for dating terrace.

370 ± 120

Ly-762. Rourebeau, Upaix, Hautes-Alpes

AD 1080

Fragment of tree trunk from 3.5m depth in alluvium of Durance R at Rourebeau, near Upaix, Hautes-Alpes (44° 19' N, 6° 53' E). Coll and subm 1972 by M Archambault. *Comment* (MA): date does not agree with expected age; shows enclosing alluvia are recent and overlay retreat alluvia of Würm Glacier.

4370 ± 130

Ly-901. La Bernardière, Le Grand Serre, Drôme

2420 BC

Wood from highest terrace of Galaure R at La Bernardière near Le Grand Serre, Drôme (45° 16' N, 5° 5' E). Coll and subm 1972 by G Montjuvent, Inst Dolomieu, Grenoble. *Comment* (GM): younger than expected, proves rapid alluviation in valley.

Le Grand Rochefort series, Varcès, Isère

Samples from boring in postglacial clayey sediments of Grenoble region at Le Grand Rochefort near Varcès, Isère (45° 51' N, 5° 40' E). Coll and subm 1972 by G Montjuvent. Dated to determine rate of post-glacial alluviation.

4090 ± 130

Ly-902. Grand Rochefort de Varcès, bois

2140 BC

Wood from 12m depth embedded at base of a clayey layer.

- Ly-903. Grand Rochefort de Varcès, tourbe** **10,080 ± 180**
8130 BC
Peat from a sandy clayey layer.

General Comment (GM): dates agree with prehistoric and sedimentologic data.

- Ly-969. Voiron, Isère** **9900 ± 160**
7950 BC

Calcareous tufa found under foundations of a house in Voiron, Isère (45° 21' N, 5° 34' E). Coll and subm 1974 by G Montjuvent. *Comment (GM)*: some paleosols are embedded in tufa. Although original ¹⁴C value for this type of material is doubtful, as expected, date indicates beginning of post-Würmian period.

- Ly-876. Tuf des Barbiers, Lazer, Hautes-Alpes** **10,900 ± 280**
8950 BC

Calcareous tufa, from bank of Les Barbiers R near Lazer, Hautes-Alpes (44° 21' N, 5° 50' E). Coll and subm 1973 by M Archambault. Tufa overlies a clayey layer with wood previously dated, Ly-555: 9250 ± 190 (R, 1973, v 15, p 516). *Comment (MA)*: age considered maximum; using 80% modern as ¹⁴C original value for this continental calcareous material, date, ca 9000 BP is obtained, which confirms previous value.

B. Peat bog samples: France and Italy

- Ly-819. Val di Sangro I Pescara, Italy** **2740 ± 110**
790 BC

Carbonaceous earth from 18m depth in boring in lacustrine deposits in Val di Sangro, Pescara Prov (47° 2' N, 14° 21' E) (Del Prete & Gerichio, 1974). Coll 1973 by M Del Prete and subm 1973 by G S Tazioli, Fac ingegneria, Univ Bari, Italy. *Comment (GST)*: date confirms paleontologic and geologic data.

L'Isle sur la Sorgue series, Vaucluse

Clayey peat from 2 layers in a road drain near L'Isle sur la Sorgue, Vaucluse (45° 55' N, 5° 2' E). Coll 1972 and subm 1973 by H Triat, Lab Palynol, Univ Marseille III.

- Ly-911. L'Isle sur la Sorgue 210** **4450 ± 150**
2500 BC
Expected climatic phase: Sub-Boreal, 210cm above reference level.

- Ly-910. L'Isle sur la Sorgue, 10** **6880 ± 180**
4930 BC
10cm above reference level. Expected climatic phase: end of Atlantic.

General Comment (HT): both dates are older than expected. Ly-910 places the *Quercus pabescens* Willd increase in pollen diagram in middle of Atlantic period, whereas Ly-911 dates an early deforestation at Sub-Boreal.

Le Plan du Laus, Sondage 772 series, Alpes de Haute Provence

Peat from several layers in boring in Le Plan du Laus peat bog near Allos, Alpes de Haute Provence (44° 14' N, 6° 42' E). Coll 1972 and subm 1973 by J L de Beaulieu, Lab Palynol, Univ Marseille III.

- | | |
|--|-------------------|
| | 5820 ± 150 |
| Ly-995. Plan du Laus, Sondage 772, 245cm | 3870 BC |
| Marks beginning of Sub-Boreal with start of <i>Larix</i> pollen curve. | |
| | 7310 ± 140 |
| Ly-960. Plan du Laus, Sondage 772, 305cm | 5360 BC |
| Marks <i>Abies</i> maximum in Atlantic period. | |
| | 8630 ± 200 |
| Ly-996. Plan du Laus, Sondage 772, 463cm | 6680 BC |
| Marks middle of Boreal before beginning of <i>Abies</i> . | |
| | 8320 ± 180 |
| Ly-997. Plan du Laus, Sondage 772, 475cm | 6370 BC |
| Same layer as Ly-996. | |
| | 8970 ± 210 |
| Ly-998. Plan du Laus, Sondage 772, 525cm | 7020 BC |
| Marks preponderance of <i>Pinus</i> at beginning of Boreal. | |
| | 8820 ± 370 |
| Ly-961. Plan du Laus, Sondage 772, 585cm | 6870 BC |
| Same layer as Ly-998. | |

General Comment (JLB): all results agree with stratigraphy and expected date range. Pollen diagrams show *Abies* occurred at beginning of Atlantic period as usual in all W Alps. *Larix* forest in area of site grew at end of Atlantic period.

Lac de Creno series, Corsica

Peat from 2 neighboring boreholes (1 and 6) in Lac de Creno peat bog near Orto, Corsica (43° 12' N, 8° 56' E). Coll 1973 and subm 1974 by M Reille, Lab Palynol, Univ Marseille III (Reille, 1975).

- | | |
|--|-------------------|
| | 1650 ± 160 |
| Ly-915. Lac de Creno, Sondage 1, 45 to 50cm | AD 300 |
| Young peat from 45 to 50cm depth. Beginning of <i>Fagus sylvatica</i> increase on slope of Rotondo Massif, Sub-Atlantic. <i>Comment</i> (MR): results confirm Ly-964: 1550 ± 65 BP (unpub) which dates same event in pollen diagram of neighboring Borehole 5. | |
| | 5600 ± 230 |
| Ly-965. Lac de Creno, Sondage 6, 417 to 422cm | 3650 BC |
| Peat and wood from 417 to 422cm depth. End of Atlantic period. Beginning of decline of <i>Erica arborea</i> and <i>Alnus glutinosa</i> in Corsica. | |

Ly-912. Lac de Creno, Sondage 6, 505 to 510cm **8000 ± 160**
6050 BC

Greenish organic clay from 505 to 510cm depth. According to pollen spectra, layer dates from beginning of Atlantic period. *Comment* (MR): because of a hiatus corresponding to all Boreal period, layer overlies Pre-Boreal, which probably causes date to be too old. A comparable layer, but one stratigraphically more extended in Atlantic period, gives a normal younger date in Lac de Creno Borehole 2, Ly-643: 7570 ± 120 BP (unpub).

Ly-914. Lac de Creno, Sondage 6, 515 to 525cm **10,420 ± 260**
8470 BC

Greenish organic clay from 515 to 525cm depth. End of Dryas III or beginning of Pre-Boreal. *Comment* (MR): as in Greece (Bottema, 1974, GrN-4875: 10,190 ± 90 BP) date marks fall of *Artemisia* pollen curve.

Ly-964. Lac de Creno, Sondage 6, 533 to 540cm **10,250 ± 420**
8300 BC

Greenish organic clay from 533 to 540cm depth. End of Dryas III, beginning of fall of *Artemisia* pollen curve. *Comment* (MR): Ly-914 and -964 appear stratigraphically inverted but remain in statistical ranges.

Ly-913. Lac de Creno, Sondage 6, **12,080 ± 230**
540 to 550cm **10,130 BC**

Greenish organic clay from 540 to 550cm. *Comment* (MR): minimum of *Artemisia* pollen curve, attributed either to a wet climatic fluctuation during Dryas III period or Alleröd period; in both cases, date is too old.

C. Samples from glacial or periglacial sediments: France and Switzerland

Entre deux Eaux series, Termignon, Savoie

Wood from alt 2100m above present timberline at Entre Deux Eaux near Termignon, Savoie (45° 22' N, 6° 50' E). Coll by C Ponson and subm 1973 by R Vivian.

Ly-956. Entre Deux Eaux 2 **450 ± 200**
AD 1500

Wood splinter from an old chalet in Dôme de Chassefort, Alpage.

Ly-955. Entre Deux Eaux 1 **420 ± 180**
AD 1520

Wood embedded in a peat bog near Les Richard, Alpage.

General Comment (RV): both dates indicate arboreal vegetation on slopes of Dôme de Chassefort during historic period, and demonstrate rapid peat bog growth.

Ly-891. Saint Martin de Belleville, Savoie **4470 ± 150**
2220 BC

Fragment of a tree trunk embedded in a peat bog at alt 1970m in glacial alluvium of Pecllet-Thorens Glacier near Saint Martin de Belle-

ville, Savoie (45° 22' N, 6° 30' E). Coll and subm 1973 by R Vivian. *Comment* (RV): agrees with expected age and indicates timberline rise previously dated in France and Switzerland (see R, 1975, v 17, p 7).

Ly-877. Praz Rodet, Le Brassus, Vaud, Switzerland **12,270 ± 210**
10,250 BC

Fragments of mammoth tusk (*Elephas primigenius*) from Praz-Rodet near Le Brassus, Vaud (46° 35' N, 6° 13' E). Coll 1969 and subm 1973 by M Weidman, Geol Mus, Lausanne. Complete mammoth skeleton was found at alt 1070m, at 1m depth in redeposited morainic sediments. May be contemporaneous with last retreat of Würm glacier (Aubert, 1970). Expected age: 10,000 to 15,000 BC. Skeleton is now exhibited in Lausanne Geol Mus (Weidmann, 1969; 1974). *Comment* (MW): corresponds well with expected age; shows end melting of Jura ice cap occurred fairly early.

3400

Ly-1002. Vautubière n° 3-13, Bouches du Rhône **30,100 ± 2600**
28,150 BC

Charcoal from Level 13 in Coudoux quarry in Vautubière valley near Lançon, Bouches du Rhône (43° 34' N, 5° 13' E). Coll 1972 and subm 1974 by P Ambert, Lab géog phys, Aix Marseille II. Level 13 lies between 2 series of Würmian eolian sediments (Ambert *et al*, 1974).
1900

Comment (PA): in statistical range of Ly-769: 31,900 ± 1500, confirms attribution to beginning of Würm III (R, 1975, v 17, p 9).

Ly-875. Les Sauziers, Lazer, Hautes-Alpes **31,100 ± 1000**
29,150 BC

Fragment of tree trunk rooted in slope of a hill overlain by a moraine, at Les Sauziers near Lazer, Hautes-Alpes (44° 21' N, 5° 52' E). Coll 1967 and subm 1973 by M Archambault (1968). *Comment* (MA): confirms previous measurement, I-5023: 31,450 ± 1300 BP and attributes a Würm III or IV age to moraine unless enclosing sediments were redeposited from moraine as slope deposits.

Verinay series, Ain

Wood from upper and lower part of an interglacial series lying between 2 moraines at Verinay near Chanay, Ain (45° 59' N, 5° 47' E). Coll and subm 1968 (Verinay I) or 1970 (Verinay II) by J Evin and P Donze, Geol Dept, Univ Lyon I.

Ly-236. Verinay I, sommet **3100**
26,250 ± 2200
From upper layer.

Ly-235. Verinay I, base **2300**
33,600 ± 1350
From lower layer.

Ly-338. Verinay II, sommet **≥32,000**
From upper layer.

Ly-337. Verinay II, base **≥33,600**

General Comment (PD): comparison of Vérinay I and Vérinay II results shows insufficient chemical treatment of Verinay I samples infinite; age implies sediments are not Würm III/IV. To demonstrate that it is not Würm II/III interstadial, other measurements will be made with a more precise detector. All the geologic features of the sediments suggest, rather, the Riss/Würm interglacial according to geologic data in France and Switzerland (Donze *et al*, 1971).

Ly-959. Col du Pignon, Aspres sur Buech, Hautes-Alpes **≥32,700**

Small pieces of charcoal from clayey lacustrine sediments at Le Pignon Pass near Aspres sur Buech (44° 30' N, 5° 45' E). Coll 1972 by M Duluc and subm 1973 by G Montjuvent. *Comment* (GM): date does not invalidate Riss/Würm interglacial attribution.

Ly-900. La Flachère, Isère **≥45,000**

Wood from clayey layer with lignite lying between 2 moraines in a quarry near La Buissière and La Flachère, Isère (45° 23' N, 5° 57' E) (Bourdier, 1961). Coll and subm 1972 by G Montjuvent. Dated with 10ml benzene and 1ml scintillating toluene in especially shielded spectrometer. *Comment* (GM): shows practical limit of dating; seems to exclude a Würm II/III interstadial attribution to the lignite; it can only be either Würm I/II or Riss/Würm.

D. Bone samples from grottoes: France

Ly-820. Le Plo Del May, Verdalle, Tarn **28,400 ± 700**
26,450 BC

Bone from clayey layer with rich fauna underlying a stalagmitic floor in Plo del May grotto near Verdalle, Tarn (43° 20' N, 2° 9' E). Coll 1973 by R P Pierre-Marie and subm 1973 by F Prat, Inst Quaternaire, Bordeaux. *Comment* (FP): despite fairly old age, bones still contained 8% organic matter, perhaps due to upper stalagmitic floor that reduced water infiltrations. Result attributes fauna to Würm III concurring with sedimentologic and paleontologic data (Laville *et al*, 1972).

Jaurens series, Corrèze

Bones from Jaurens grotto near Nespouls, Corrèze (45° 2' N, 1° 41' E). Coll and subm by C Guerin, 1969 & 1972, Geol Dept, Univ Lyon I. Bones were embedded in clayey floor of grotto, assoc with rich Late Würm fauna (Guerin, 1970).

Ly-359. Jaurens I **29,300 ± 1400**
27,350 BC

3000
30,350 ± 1900
28,400 BC

Ly-892. Jaurens 2

Both dates agree statistically and indicate beginning of Würm III. Although different, Jaurens and Siréjol (see below) fauna are contemporaneous.

Siréjol series, Lot

Bones from Siréjol grotto, near Gignac, Lot (44° 59' N, 1° 29' E). Coll 1971 and 1973 by M Philippe and subm 1972 and 1973 by C Guérin. Grotto contains filling of fossiliferous clayey lumps. It is presently entered only through a narrow gallery which opens 1st into a small cave containing Hallstatt burials. Inside the main cave, underlying the entrance of the gallery, is a little rubbish-cone whose sediments seem younger than main clayey filling (Guérin & Philippe, 1971).

2590 ± 140
640 BC

Ly-928. Siréjol, sépulture n° 4
From Hallstatt sepultures.

4290 ± 350
2340 BC

Ly-927. Siréjol, petit éboulis n° 3
From rubbish-cone.

1800
31,300 ± 1600
29,350 BC

Ly-614. Siréjol, remplissage principal n° 1
From main filling.

1600
29,100 ± 1300
27,150 BC

Ly-767. Siréjol, remplissage principal n° 2
From main filling.

General Comment (CG): Ly-928 confirms archaeological attribution of burial. Ly-927 confirms rubbish-cone is younger than main clayey filling. Ly-614 and -767 are in statistical agreement and their average is: Ly-614/767: 30,100 ± 1200 BP, indicating beginning of Würm III, consistent with faunal study.

Ly-979. Nauterie, La Romieu, Gers **≥29,000**

Bones from Level 2 in Nauterie Grotto near La Romieu, Gers (44° 2' N, 0° 30' E). Coll and subm 1973 by F Prat et C Thibault, Inst Quaternaire, Univ Bordeaux I. Clayey layer enclosing bones is overlain by a stalagmitic floor, the upper part of the grotto filling. *Comment (FP & CT):* older than expected; grotto was probably filled before Würm III.

E. Shell samples from coastal sediments: Italy, Senegal and Mauritania

Sibari series, Italy

Samples from Casa Bianca at Sibari, Calabria, Italy (39° 47' N, 16° 27' E). Coll 1973 by G Melidoro and subm 1973 by G S Tazioli.

Ly-878. Sibari 1 **860 ± 120**
Cerastoderma shells. **AD 1090**

Ly-879. Sibari 2 **2330 ± 120**
 Fragment of a tree trunk (*Tamarix Gallia-Webb*). **380 BC**

General Comment (GM): both measurements made to confirm archaeological dating of old buried town of Sibari and to study subsidence process of the coastal plain (Guerricchio & Melidoro, 1975). Results approximate subsidence and help date archaeological layers.

Lac Retba series, Sénégal

Shells from marine terrace and kitchen midden on Retba lakeside 28km NE Dakar, Sénégal (14° 50' N, 17° 13' W). Coll and subm 1974 by P Elouard, Dept Géol, Univ Lyon I.

Ly-887. Lac Retba, base, kitchen **680 ± 130**
midden WS 4 **AD 1270**
Arca senelis and *Dorinia* sp.

Ly-888. Lac Retba, sommet, kitchen **1170 ± 100**
midden WS 5 **AD 780**
Arca senelis.

Ly-889. Lac Retba, poterie WS 6 **1130 ± 470**
AD 880
 Small amount of charred organic matter included in pottery.

Ly-885. Lac Retba, terrasse WS 2 **1140 ± 100**
AD 810
Arca senelis.

Ly-886. Lac Retba, sable blanc WS 3 **2140 ± 110**
AD 190
Arca senelis and *Dorinia* sp.

General Comment (PE): dates prove that salt-water lagoon sediments around Retba Lake are recent and contemporaneous with human occupation. A similar date for a shell-fishing settlement was previously dated in mid-west Sénégal at Bangalaré Bolon in Salaun R Delta (see 4 Ly dates: R, 1975, v 17, p 13). Retba lake is at present very salty due to evaporation since closing, <1000 yr ago.

Ly-890. Lac Tanma, Sénégal **2630 ± 110**
250 BC

Arca senelis from .40m depth in a marine terrace near Tanma lake, 45km NW Dakar (14° 54' N, 17° 5' W). Coll and subm 1974 by P Elouard. *Comment* (PE): younger than expected, shows Tanma lake, like Retba Lake, remained in connection with the sea until recently. Such a recent age for marine sediments is found also in uplifted beaches

in Dakar region at Cap Manuel: T-725: 2470 ± 70 BP (unpub) and at Les Almandies beach: Ly-812: 3130 ± 240 BP (R, 1975, v 17, p 14).

Ly-884. Sondage en mer, Baie de Han WS15 **4280 \pm 160**
2330 BC

Pitaria tumens from -4 to -5 m layer in cuttings of offshore boring at 8.5m depth in Han bay, between Mbaou and Tiaroye sur Mer, 15km SE Dakar, Sénégal ($14^{\circ} 40' N$, $17^{\circ} 20' W$). Coll and subm 1973 by P Elouard. *Comment* (PE): date corresponds to late Nouakchottian and shows that sedimentation rate in Han bay is low.

Rao Peul and Gandon series, Mauritania

3 pairs of shell samples from tops and bases of marine terraces with *Arca senelis* near Rao Peul ($15^{\circ} 54' N$, $16^{\circ} 26' W$), Gandon II ($15^{\circ} 57' N$, $16^{\circ} 26' W$), or Gandon III ($15^{\circ} 56' N$, $16^{\circ} 25' W$), near Saint Louis Sénégal. Coll 1973 by J Monteillet, Saint-Louis and subm 1974 by P Elouard.

Ly-982. Rao Peul sommet NK a 1 **4670 \pm 120**
2720 BC
Arca senelis, alt +2m.

Ly-983. Rao Peul base NK e 5 **5250 \pm 120**
3300 BC
Arca senelis, alt +0.4m.

Ly-986. Gandon III sommet NK a 1 **4720 \pm 140**
2770 BC
Arca senelis, alt +2m.

Ly-987. Gandon III base NK e 5 **5590 \pm 140**
3640 BC
Arca senelis, alt +0.7m.

Ly-984. Gandon III sommet NK a 1 **3410 \pm 130**
1460 BC
Tymponotous sp; alt ca +2m.

Ly-985. Gandon II base NK C4 **5650 \pm 150**
3700 BC
Arca senelis alt +1.2m.

General Comment (PE): from 3 pairs of results, date of base is ca 5500 BP and corresponds to maximal Nouakchottian transgression (Elouard, 1968); see also T-404: 5570 ± 120 , and Ly-350: 5510 ± 120 BP from Nouakchott (R, 1975, v 17, p 15). 3 pairs of dates for top decrease toward NW as expected, marking beginning of regression, seems earlier than expected.

Khant de Saint-Louis series, Sénégal

Arca senelis, from a kitchen midden, a sand dune and a marine terrace overlain by another kitchen midden in Le Marigot de Khant, 15km E of Saint-Louis, Sénégal ($16^{\circ} 8' N$, $16^{\circ} 27' W$). Coll 1971 and

subm 1974 by P Elouard. Le Marigot de Khant formed a deep lagoon, open to the sea.

Ly-988. Saint-Louis SL 10 **5340 ± 120**
3390 BC
Shells from kitchen midden overlying marine terrace.

Ly-989. Saint-Louis SL 11 **5410 ± 120**
3460 BC
Shells from marine terrace.

Ly-990. Saint-Louis SL 13 **5650 ± 140**
3700 BC
Shells from kitchen midden overlying dune.

General Comment (PE): 3 results indicate that terrace and kitchen middens are Nouakchottian. Small difference between Ly-990 (a little older) and 2 other dates shows that fishermen settlement followed sea-level regression; comparable dates for human occupation were previously found in regions more open to the sea, eg, at Rao terrace, T-463: 5470 ± 110 BP (Elouard et al, 1966).

II. ARCHAEOLOGIC SAMPLES

A. Bronze to Historic periods

Ly-870. Tumulus de Mijoux, La Faucille, Ain **Modern**
 $\delta^{14}\text{C} = +0.25\% \pm 1.40$

Wood from floor in an Iron age tumulus at Mijoux near, La Faucille, Ain (46° 4' N, 6° 0' E). Coll and subm 1973 by M Labarrère, Gex. *Comment (ML)*: date proves that tumulus was used recently as hunting shelter or look-out post.

Ly-905. Saint-Jacut de la Mer, Côtes du Nord **365 ± 130**
AD 1505

Human skull from a common grave in an old cemetery near Saint-Jacut de la Mer, Côtes du Nord (48° 36' N, 2° 12' W). Coll 1970 by M Thebault and subm 1973 by J C Ménès, Bernin, Isère. Expected age: from 5th century AD to time of French Revolution (Lemasson, 1912). *Comment (JCM)*: grave must be from cemetery of Abbey of Saint-Jacut, whose site was unknown till now.

Ly-871. Clairière de Girieux, Proveysieux, Isère **575 ± 125**
AD 1375

Charcoal from hearth 45cm deep, assoc with supposed Chalcolithic industry in an open air site at Girieux quarry near Proveysieux Isère (45° 15' N, 5° 40' E). Coll 1972 and subm 1973 by M Malenfant, Grenoble. *Comment (MM)*: date proves hearth is not contemporary with industry. Either it was dug into archaeological layers or industry comes from elsewhere.

Ly-898. Soyons, Ardèche **1510 ± 220**
AD 440

Human bones from 4m depth in excavation for a road at S Soyons, Ardèche (44° 53' N, 4° 5' E). Coll 1973 by R Martin, Valence, and subm by P Elouard. From 2m under a Gallo-Roman layer; expected age: 2500 to 1000 BC. *Comment*: date does not agree with expected age, indicates either a landslide of Gallo-Roman deposits or a deep inhumation.

Ly-899. Nécropole de St Just-Lyon Rhône **1770 ± 120**
AD 180

Human bones from Gallo-Roman sarcophagus from cemetery around foundations of several Paleochristian to Middle age churches in Les Macchabés St, near Saint-Just, Lyon, Rhône (45° 46' N, 4° 50' E). Coll and subm 1972 by J F Reynaud, Univ Lyon II. *Comment* (JFR): considering statistical range, sarcophagus was not reused in Carolingian time ca AD 800 as presumed).

Grigny series, Rhône

Wood from handles of metallic objects dredged from Rhône R at Grigny, Rhône (45° 36' N, 4° 47' E). Coll 1970 and subm 1971 by G Chapotat, Centre recherche Archéol, Vienne, Isère.

Ly-954. Grigny RH 43 **2160 ± 160**
210 BC

Fragment of *Abies* from bargeman's iron boot hook, attributed to La Tène period or younger.

Ly-953. Grigny RH 15 **2200 ± 320**
250 BC

Fragment of *Buxus* or *Cornus* from a bronze staff attributed to Bronze age, but this type of staff may also be younger.

Ly-952. Grigny RH 12 **3070 ± 110**
1120 BC

Fragment of *Fraxinus* from a bronze staff "à oeillet en aillérons médians" attributed to Bronze age (Chapotat, 1971).

General Comment (GC): Ly-952 indicates beginning of Late Bronze or end of Middle Bronze age, as normal for this type of staff; Ly-953 is 500 yr too young for Bronze age but may indicate that staff was used later; Ly-954 proves this type of boot hook, still used during the last century, remained unchanged for 2000 yr.

Ly-881. Mehatze, Unité B, Itassou, Pyrénées Atlantiques **2380 ± 130**
430 BC

Charcoal from clayey sediments from an incineration cist in Mehatze necropolis near Itassou, Pays Basque, Pyrénées Atlantiques (43° 18' N, 1° 25' W). Coll and subm 1973 by C Chauchat, Inst Quaternaire, Bordeaux. No industry has been found in these graves; their attribution to 1st Iron age depends on architectural comparisons. *Comment* (CC):

seems to confirm attribution to 1st Iron age; sample comes from last built part of site.

**2400 ± 160
450 BC**

Ly-904. Lezoux, Puy de Dôme

Human bones from a Gallo-Roman necropolis at Lezoux, Puy de Dôme (45° 49' N, 3° 22' E). Coll by H Vertet and subm 1973 by M Dumontet, Dir Antiquités historiques, Clermont Ferrand. Site includes 2 cemeteries: from Protohistoric period (some centuries BC), the other from the Roman period (1st to 4th centuries AD). Bones were expected from younger graves cutting through both cemeteries. *Comment*: despite submitter's opinion and archaeological evidence, bones probably come from Protohistoric period, or at latest, beginning of Roman.

Vendenheim series, Bas Rhin

Charcoal from 2 graves in Vendenheim site, Bas Rhin (48° 40' N, 7° 42' E). Coll and subm 1973 by A Thevenin, Dir antiquités préhistoriques, Strasbourg.

**2370 ± 100
420 BC**

Ly-867. Vendenheim n° 2

Samples from a grave 1.80m deep, assoc with La Tène or Bronze industry. Coll 1973 by J Sainty. *Comment* (AT): date indicates La Tène period.

**4870 ± 110
2920 BC**

Ly-866. Vendenheim n° 1

Sample from a grave 1.50m deep with industry of Lingolsheim group type (between Michelsberg and Poinçonné types). Coll 1973 by F Wendling. *Comment* (AT): date a little older than expected but feasible. Nearest ¹⁴C result in region is from Level X at La Baume de Gonvillars, Haute Saône, assoc with industry of Rössen-Michelsberg type, Gif-466: 5000 ± 250 (R, 1970, v 12, p 429) which, as normal, is a little older.

**Ly-880. Grotte de la Balme,
Sollières-Sardières, Savoie**

**2450 ± 110
500 BC**

Charcoal from hearths in La Balme Grotto at Sollières-Sardières, Savoie (45° 16' N, 6° 48' E). Coll and subm 1973 by A Bocquet, Inst Dolomieu, Grenoble. Hearths were a few cm from late Bronze II ceramics (ca 900 BC) and included some Early Bronze or Chalcolithic pottery. *Comment* (AB): too young for Late Bronze II, even with 3σ statistical range, so date indicates subsequent use of site that contaminated Protohistoric hearth.

**2870 ± 100
920 BC**

Ly-872. Les Champs vieux 72 Z/3 Haute-Loire

Charcoal assoc with carbonaceous earth from Les Champs-Vieux site near Solognac sur Loire (44° 58' N, 3° 42' E). Coll 1972 by R Liabeuf and subm 1973 by M Philibert, Le Puy. Samples were in group at level of Late Neolithic industry, comparable to one previously measured at

Le Rond du Lévrier site, Salette, Hauteloire; Ly-194: 3370 ± 210 BP (R, 1971, v 13, p 59). *Comment* (MP): much younger than expected; probably proves charcoal came from overlying Late Bronze occupation level and fell through very aerated upper layer (Philibert & Moser, 1974.) Such contamination by charcoal from overlying layers is frequent in shelters in regions with basaltic formations, see eg, upper layers in Longe-traye site, Hauteloire (R, 1975, v 17, p 22).

B. Neolithic and Mesolithic periods

3910 ± 100

Ly-895. Tumulus “Dolmen” des Grèzes, Souillac, Lot 1960 BC

Human bones from main room of dry-stone dolmen at “Les Grèzes”, near Souillac, Lot (44° 55' N, 1° 26' E). Coll and subm 1973 by J P Girault, Cugnaux, Haute Garonne. Dolmen is a round dry stone tumulus containing a rectangular room, which continues without narrowing up to tumulus inner edge with only large stone to separate room and corridor. This monument cannot be compared to any other. Bones are assoc with arrowheads and pearls and grave is presumed Chalcolithic. *Comment* (JPG): date agrees perfectly with industry.

4150 ± 180

Ly-896. Champs sur Yonne, Yonne

2200 BC

Human bones from open-air sepulture 1m deep at Champs sur Yonne, Yonne (47° 44' N, 3° 36' E). Coll 1965 and subm 1973 by F Poplin; assoc with attractive campaniform vase. *Comment* (FP): date conforms to Chalcolithic attribution.

Les Baigneurs series Charavines, Isère

Samples from 2 levels and several places in coastal submerged sta, Les Baigneurs, in Paladru Lake at Charavines, Isère (45° 25' N, 5° 30' E). Coll and subm by A Bocquet.

4190 ± 150

Ly-792. Les Baigneurs, (Cha 3) Pirogue A

2240 BC

Wood from a monoxyl barge lake mud at level of upper archeologic layer. Coll and subm 1972. *Comment* (AB): this style of barge remained unchanged for several millennia. Result indicates barge is contemporary with coastal sta.

4540 ± 120

Ly-908. Les Baigneurs (Cha 6), Pilotis n° 131

2590 BC

Fragment of pile, supposedly from last occupation of site. Coll 1973.

**Ly-793. Les Baigneurs (Cha 2),
Pilotis triangle I-7**

4440 ± 230

2490 BC

Fragment of pile, supposedly from 1st occupation of site. Coll 1972.

4230 ± 130

Ly-907. Les Baigneurs (Cha 5), Pilotis n° 127

2280 BC

Fragment of pile, supposedly from 1st occupation of site. Coll 1973. May be contemporaneous with Cha 4: Ly-906.

Ly-794. Les Baigneurs (Cha 1), Couche B 4 **4360 ± 130**
2410 BC
Charcoal from lowest layer. Coll 1972.

Ly-909. Les Baigneurs (Cha 7), Couche B 1 **9940 ± 130**
7990 BC
Weathered twigs and bark called "lacustrine dung" from upper Layer B 1, in which was embedded a flint dagger with a handle in form of discoidal pommel.

Ly-906. Les Baigneurs (Cha 4), Couche B 3 **4100 ± 120**
2150 BC
Charcoal from lower Layer B 3.

General Comment (AB): all results are statistically very close and suggest occupation ca 2300 to 2400 bc, closely agreeing with other results from Late Neolithic or Chalcolithic coastal sta, as: Ly-688: 4600 ± 120 from lake Aiguebelette, Savoie, or Ly-851: 4070 ± 140 from lake Clairvaux, Jura, which are a little younger (R, 1975, v 17, p 19). But it remains impossible to distinguish typologically which layer had 2 or more different occupations. On the other hand ¹⁴C ages might be slightly modified by true age of tree trunks when used in construction (Ly-908, -799, eg), and samples were not necessarily in outer part of piles. Ly-909 is much too old (at least 5500 yr); result is aberrant and unexplained.

Ly-980. La Balme les Grottes, Isère **5270 ± 140**
3320 BC

Small human bones from an ossuary in Locus III, upper gallery, La Balme grotto, La Balme-les-Grottes, Isère (45° 51' N, 5° 19' E). Coll 1969 by J Reymond, and subm 1974 by A Bocquet. Sample assoc with Late Neolithic industry. *Comment (AB):* date is a little older than expected and suggests Middle Neolithic, agreeing with a potsherd of Chassean tradition from neighboring loc. Common ossuaries are generally from Late Neolithic time.

Les Tumulus de Bougon series, Deux-Sèvres

Human bones from 2 funerary rooms in Megalithic necropolis, "Les Tumulus", near Bougon, Deux-Sèvres (46° 21' N, 0° 11' W). Coll and subm 1973 by J P Mohen, Mus Antiquités Natl Saint-Germain en Laye. These 2 dolmens were protected by 2 different tumuli belonging to a set of tumuli and dolmens used or reused for at least 1500 yr during Neolithic period. Same types of Megalithic monuments are also found in Brittany, W France (Mohen, 1973).

Ly-968. Bougon, Tumulus F, n° 3 **4470 ± 230**
2520 BC

Bones from Tumulus F probably built during Chassean period but reused afterward; artifacts of "Vienne-Charente" type (Late Neolithic) were id.

Ly-967. Bougon, Tumulus F, n° 2**4790 ± 220****2840 BC**

Bones from same tumulus as Ly-968. This "Angoumoisian type" dolmen looks like La Saussaie tumulus, Charente Maritime, but it was first used by a Chassean population who decorated support vessel in Bougon style.

Ly-966. Bougon, Tumulus E, n° 1**5800 ± 230****3850 BC**

Bones from Tumulus E, older than Tumulus F, including artifacts of "Groupe des Cous" Type; may be Early Neolithic. Although less imposing, this monument may be compared to Barnenez Cairn at Plouezoch, Finistère, for which there are 4 Gif dates ca 5600 BP (R, 1971, v 13, p 215).

General Comment (JPM): 3 dates agree well with archaeological interpretation of site, Ly-968, a little younger than 967 may indicate reoccupation of site after Chassean period; Ly-966 is 1 of oldest dates obtained for such a monument and may be compared to Gif-165: 5800 ± 300 from Le Guegnoc I and to Sa-95: 5840 ± 300 from Kercado; both sites in W Brittany (R, 1966, v 8, p 76). Ly-967 corresponds to 1st occupation time of funerary room and perhaps to building of monuments.

Ly-864. Périgneux, J XII-XIII, Loire**5140 ± 140****3190 BC**

Charcoal from Layer 4 of a Chassean hearth to S of the Violette near Périgneux, Loire (45° 26' N, 4° 9' E). Coll 1965 by J P Thévenot and subm 1972 by J Combiér, *Dir Antiquités préhistoriques, Romanèche, Saône et Loire*. *Comment* (JC): similar to S France Chassean and may be a little older than Norman Chassean. Agrees with many other results on Chassean civilization and indicates penetration into Massif Central earlier than supposed (Combiér, 1962).

Ly-970. Aubigny au Bac, Nord**5570 ± 250****3620 BC**

Human bones from sepulture assoc with Campaniform industry at Aubigny au Bac, Nord (50° 15' N, 3° 9' E). Coll 1972 and subm 1973 by P Demolon, Mus Chartreuse, Douai. *Comment* (PD): sepulture was dug into ground but covered by a polishing stone and contained a Campaniform vessel (Demolon *et al*, 1975). Waller's sepulture seems nearly contemporaneous, ca 1800 BC, but date is inexplicably much older, although no trace of 2 occupation periods was found.

Moulligna series, Bidart, Pyrénées Atlantiques

Peat assoc with charcoal coll at lower and upper part of archaeological layer with flints and burnt gravels, attributed to Asturian. Neolithic was expected (Oldfield, 1960) at La Moulligna near Bidart, Pyrénées Atlantiques (43° 25' N, 1° 49' W). Coll and subm 1973 by C Chauchat.

- 5760 ± 150**
3810 BC
- Ly-882. Mouligna n° I sommet**
From top of layer.
- 5550 ± 150**
3600 BC
- Ly-883. Mouligna n° 2, base**
From base of layer.
- General Comment (CC):* previous date gave a more recent age: Q-314: 5100 ± 130 (R, 1960, v 2, p 70), but wood used for dating was not clearly assoc with industry, which might be a little older as confirmed by present results. Stratigraphic inversion is only statistic and average of both results is: Ly-882/883: 5650 ± 100 (3700 bc). Attribution of Austrian civilization to Early or Middle Neolithic period is confirmed.
- 5940 ± 140**
3990 BC
- Ly-865. Reichstett, Fosse 43, Bas-Rhin**
Fossil pitch mixed with earth from Grave 43 in loess at Reichstett, Bas-Rhin (48° 38' N, 7° 45' E). Coll 1972 and subm 1973 by A Thevenin. Assoc with Neolithic "Rubanné" industry. *Comment (AT):* date agrees perfectly with expected age, may be compared to Ly-335: 5490 ± 140 BP (R, 1973, v 15, p 143) from attributed "Rubanné récent" level at Gondensans les Montby site, Doubs.
- 7000 ± 130**
5050 BC
- Ly-868. Abri Cornille, Couche 6**
Charcoal from earth in Layer 6 at L'Abri Cornille near Istres, Bouches du Rhône (43° 39' N, 5° 0' E). Coll 1969 and subm 1972 by M Escalon de Fonton, Marseille. Assoc with Montadian industry (Epipaleolithic) and with pollens and sediments attributed to Dryas III. Humic fraction of charcoal was previously measured: Ly-413, 8100 ± 130 BP (R, 1973, v 15, p 527). *Comment (MEF):* date is obviously too young for this industry and proves that hearth was polluted by over-exposure to open air (Escalon de Fonton, 1966).
- 8490 ± 170**
6540 BC
- Ly-863. Les Charmes 65, Sermoyer, Ain**
Charred nuts from Layer 7Y in Mesolithic Sauveterrian site at Les Charmes near Sermoyer, Ain (46° 29' N, 4° 58' E). Coll 1965 by J P Thévenot and subm 1972 by J Combier. *Comment (JC):* in statistical range of Gif-1597: 8150 ± 190 BP (R, 1974, v 16, p 37) and perfectly agrees with oldest dates of Tardenoisian industry, eg. at Montbani, Aisne, Gif-356, or at Coincy en Tardenois, Aisne, Gif-1266 (R, 1972, v 14, p 290). Contemporaneous with Sauveterrian layers in Rouffignac site, Dordogne: 3 GrN dates (R, 1972, v 14, p 59) and probably older than Sauveterrian layers in Montclus site, Gard: 4 Ly dates ca 7800 BP (R, 1971, v 13, p 62).

C. Paleolithic periods

Ly-958. La Baume Loire 11 n° 2, Haute-Loire **10,200 ± 950**
8250 BC

Bits of charcoal from hearth assoc with flints of Late Upper Paleolithic industry in basaltic Rock Shelter II at La Baume Loire near Solignac, Haute-Loire (44° 56' N, 3° 54' E). Coll and subm 1973 by A Cremillieux, Le Monastier sur Gazeille. *Comment* (AC): despite large statistical range due to scarcity of material, date confirms Upper Paleolithic occupation of site. True age may be older since pollution occurred in site from upper layer, shown by previous date on same layer: Ly-452, 3950 ± 120 (R, 1973, v 15, p 147).

Grotte Jean Pierre 2 series, Saint Thibaud de Couz, Savoie

Samples from the only archaeological layer of Jean Pierre 2 grotto, Saint Thibaud de Couz, Savoie (45° 40' N, 5° 50' E). Coll 1969 and subm 1973 by P Bintz, Inst Dolomieu, Grenoble.

Ly-925. Os de la grotte Jean-Pierre 2 **12,400 ± 240**
10,450 BC
 $\delta^{13}C = -17.7\%$

Bones.

Ly-926. Charbon de la Grotte Jean-Pierre 2 **13,280 ± 290**
11,330 BC

Charcoal.

General Comment (BP): previous dates on charcoal from same site: Ly-828, 12,470 ± 200 and Ly-390, 13,300 ± 280 (R, 1975, v 17, p 25). Disparity of results was ascribed either to pollution or to maximal statistic fluctuation. New results confirm 900-yr range. As archaeological layer is fairly thick, disparity of ^{14}C dates may only be explained by compaction into 1 layer of several occupations, which can be distinguished in neighboring grotto, Jean-Pierre 1.

Ly-894. Grotte du Crest, Viry, Saône et Loire **12,850 ± 240**
10,900 BC

Bone splinters from little Magdalenian site in Le Crest Grotto near Viry, Saône et Loire (46° 27' N, 4° 0' E). Coll 1958 by R Horiot (1965) and subm 1973 by R Desbrosse, Blanzay. *Comment* (RD): approaching Ly-393: 12,500 ± 240 BP from Magdalenian Layer of Solutré site, typology being comparable (Combier, 1955). Date should correspond to Bölling period but microfauna indicate very cold, steppe-like climate (Combier, 1959). However ^{14}C dates of climatic phases of the Late Würm, before Alleröd, in Middle East France are neither well established (Evin, 1974) nor very numerous (Desbrosse and Girard, 1974).

Gare de Couze series, Lalinde, Dordogne

Bones from 2 layers of Magdalenian site La Gare de Couze near Lalinde, Dordogne (44° 49' N, 0° 44' E). Coll 1957 by F Borde and subm 1974 by F Delpech, Lab Géol Quaternaire, Univ Bordeaux I. Industries

assoc with bones of antelope Saïga whose existence in SE France seems short-lived and localized (Fitte & Sonnevile Borde, 1962).

Ly-976. La gare de Couze, Couche C **11,750 ± 310**
9800 BC
Assoc Industry: Magdalenian VI. Expected age: 10,000 BC.

Ly-975. La gare de Couze, Couche H **12,430 ± 320**
10,480 BC

Assoc limited industry: Magdalenian V or VI, similar age expected.

General Comment (FD): both values are in stratigraphic order and in general date range for Magdalenian V or VI; see La Madeleine and Duruthy sites below. Ly-391: 10,900 ± 230 BP (R, 1970, v 12, p 554) comes from an upper layer assoc with Magdalenian industry.

La Madeleine series, Tursac, Dordogne

Samples from several layers in La Madeleine site at Tursac, Dordogne (44° 58' N, 1° 02' E). Coll 1970-71 and subm 1973 (except Ly-234) by J M Bouvier, Lab Géol Quaternaire, Univ Bordeaux I (Bouvier, 1973).

Ly-919. La Madeleine n° 19 **12,640 ± 260**
10,690 BC
 $\delta^{13}C = -19.2\text{‰}$

Bones from Layer F, Level 7. Assoc with industry from beginning of Magdalenian VI.

Ly-920. La Madeleine n° 21 **12,750 ± 240**
10,800 BC
 $\delta^{13}C = -19.3\text{‰}$

Bones from Layer G, Level 9. Assoc with industry from end of Magdalenian V.

Ly-921. La Madeleine n° 25 **13,070 ± 190**
11,120 BC
 $\delta^{13}C = -19.5\text{‰}$

Bones from Layer I, Level 13. Assoc with industry from beginning of Magdalenian V.

Ly-922. La Madeleine n° 26 **13,440 ± 300**
11,490 BC
 $\delta^{13}C = -20.1\text{‰}$

Bones from Layer J, Level 14. Assoc with industry from end of Magdalenian IV.

Ly-234. La Madeleine n° 20 to 24 and 10 **Modern**
 $\delta^{14}C = +0.7\text{‰}$
± 2.4

2 bits of charcoal from 2 places in Level 9. Assoc with Late Magdalenian V. Coll and subm 1968. *Comment*: $\delta^{14}C$ value suggests 1 charcoal piece is old and the other is very modern. Result indicates difficulty of

dating small samples and importance of removing spurious material.
General Comment (JMB): La Madeleine is the eponymous site of Magdalenian civilization, with 19 levels embedding industry from Stages IV-VI of Magdalenian tradition. The 1st dates are of passages between IV to V, and V to VI stages, which are in stratigraphic succession and suggest a short Magdalenian V stage and long VI stage. Other dates will be necessary for Stage IV. Results are comparable to those for Magdalenian industry at Duruthy site, Landes (see below), with identical dates for end of Magdalenian IV.

Duruthy series, Sorde-L'Abbaye, Landes

Bones from several layers in Duruthy grotto near Sorde-L'Abbaye, Landes, (43° 31' N, 1° 10' W). Coll 1972 and subm 1973 by R Arambourou, Inst Quaternaire, Univ Bordeaux I.

Ly-858. Duruthy, Couche 3, sommet **11,150 ± 220**
9200 BC
 From top of layer including Magdalenian VI industry.

Ly-859. Duruthy, Couche 4, sommet **13,510 ± 220**
11,560 BC
 From top of layer including Magdalenian IV industry.

Ly-860. Duruthy, Couche 4, base **13,840 ± 210**
11,890 BC
 From base of layer including Magdalenian IV.

Ly-861. Duruthy, Couche 5 **14,180 ± 200**
12,230 BC
 From several levels in upper part of layer including Magdalenian III.

General Comment (RA): dates are in expected range and compare to La Madeleine results (see above). With no date from lowest layer of Magdalenian VI, estimated length of industry, probably long is impossible, Magdalenian IV duration may be longer than dates show due to possible erosion of lowest part of layer, as evident in upper part of Magdalenian III layer. Thermoluminescence dates were made on samples from Layers 3 and 4 by Lab Cristallographie et Physique du Cristal, Univ Bordeaux I (Schvoerer *et al*, 1974) with the following results: BOR-6: 11,290 BP for Layer 3 (Ly-858), and BOR-7: 14,500 BP for Layer 4 (Ly-859-860) with ca 10% range. Both dating methods correspond.

Ly-977. Fongaban, Couche III, Saint-Emilien, Gironde **14,300 ± 680**
12,350 BC

Bones from Layer III in Le Vallon de Fongaban site, at Bergat near Saint-Emilion Gironde (44° 53' N, 0° 10' W). Coll 1970 by J P Rigaud and subm 1974 by F Delpech. Assoc with industry typologically attributed to Late Magdalenian and with mainly bisons, and also horses and saïgas. Presumed from Würm IV with expected age ca 12,000 BP (Rigaud *et al*, 1970). *Comment (JPR)*: date is older than expected for Magda-

lenian IV even accounting for large statistical range. Either pollution occurred or artifact used for archaeological attribution appeared earlier than supposed.

Le Flageolet II series, Bezenac, Dordogne

Bones from several layers in Le Flageolet II rock shelter (44° 49' N, 1° 6' E). Coll 1971 and subm 1973 by J P Rigaud, Inst Quaternaire, Bordeaux I.

Ly-916. Le Flageolet II, n° 1	12,870 ± 390 10,920 BC $\delta^{13}C = -19.5\text{‰}$
Ly-917. Le Flageolet II, n° 2	14,110 ± 690 12,160 BC $\delta^{13}C = -20.5\text{‰}$
Ly-918. Le Flageolet II, n° 3	15,250 ± 320 13,300 BC $\delta^{13}C = -18.8\text{‰}$

General Comment (JPR): assoc industry attributed to Late Magdalenian period, based on typologic character (Rigaud, 1970). Ly-916 is in range of usual dates for period, but Ly-917 and especially 918 are out of range. Either dates are too old for unknown reason, or special type of industry appeared earlier than supposed.

Ly-978. Combe-Cullier, Lacave, Lot

Bones from Layer IX in Combe Cullier site near Lacave, Lot (44° 50' N, 1° 34' E). Coll 1971 by J F Flies and subm 1974 by F Delpech. Assoc with Magdalenian industry and with reindeers, chamois, and saïga (Lorblanchet, 1969). *Comment (FD):* date indicates time of E-ward extension of antelope saïga. Comparable to Magdalenian III layer of Saint-Eulalie grotto at Espagnac, Lot, previously dated: Gif-2194, 15,200 ± 300 BP (R, 1974, v 16, p 26).

Laugerie Hautes series, Les Eyzies, Dordogne

Bones from several Magdalenian layers in Laugerie-Haute site near Les Eyzies, Dordogne (44° 58' N, 0° 57' E). Coll 1958 by F Bordes (1958) and subm 1974 by F Delpech. As in other sites, industry embedded in layers assoc with bones of antelope saïga.

Ly-974. Laugerie Haute Est, Magdalénian III	13,970 ± 480 12,020 BC
Bones from several layers in main geologic secs assoc with Magdalenian III industry. Presumed climatic phase: Würm IV.	
Ly-973. Laugerie Haute Est, Magdalénian II	17,040 ± 440 15,090 BC
Bones from several layers not stratigraphically joining main geologic secs assoc with Magdalenian II industry.	

Ly-972. Laugerie-Haute Est, Magdalénian 0 **18,260 ± 360**
16,310 BC

Bones from 2 layers in main geologic sec assoc with Magdalenian 0 industry and presumably beginning of Würm IV.

General Comment (FB & FD): Ly-974 and -972 agree with expected age and, in general, possible date range for Magdalenian III and 0 industries. But Ly-973 seems too near -972, because of presence of Magdalenian I layer between these layers. This connection between dated bones and Magdalenian II industry seems doubtful or a large statistical fluctuation of at least 2σ must be supposed between true ^{14}C age and obtained value.

La Salpêtrière series

Bones from 10 layers in 4 geol secs in La Salpêtrière site near Remoulins Gard ($43^{\circ} 55' \text{ N}$, $4^{\circ} 35' \text{ E}$). Coll 1964 and subm 1973 by M Escalon de Fonton. The 4 secs were excavation sectors left intact by numerous archaeologists and correlations between secs were made with the industries found. Site shows longest stratigraphy in SE France (Escalon de Fonton, 1965). All bones contained normal collagen (ca 2%) except oldest .3%.

Ly-937. La Salpêtrière, Grand Témoin **10,680 ± 300**
Bayol, Couche 6 **8730 BC**

Assoc industry: Upper Salpêtrian (Magdalenien V). Expected age: ca 13,000 BP.

Ly-938. La Salpêtrière, Grand Témoin **11,080 ± 250**
Bayol, Couche 7-14 **9050 BC**

Assoc industry: Middle Salpêtrian (Middle Magdalenian). Expected age: ca 14,000 BP.

Ly-939. La Salpêtrière, Centre du **18,880 ± 300**
Porche, Couche 6 **16,930 BC**

Assoc industry: Middle Salpêtrian (Middle Magdalenian). Expected age: ca 14,000 BP.

Ly-940. La Salpêtrière, Grand Témoin **20,200 ± 660**
Bayol, Couche 24 **18,250 BC**

Assoc industry: Middle Solutréan. Expected age: ca 20,000 BP.

Ly-941. La Salpêtrière, Petit Témoin **17,900 ± 690**
Bayol, Couche V₂ **15,950 BC**

Assoc industry: Early Solutréan. Expected age: ca 21,000 BP.

Ly-942. La Salpêtrière, Centre, Couche 30 A **20,630 ± 770**
18,680 BC

Assoc industry: Late Aurignacian. Expected age: 22,000 BP.

Ly-943. La Salpêtrière, Centre, Couche 30 E **21,760 ± 490**
19,810 BC

Assoc industry: Late Middle Aurignacian. Expected age: 23,000 BP.

Ly-944. La Salpêtrière, Centre, Couche 30 M **27,530 ± 2600**
25,580 BC

Very little organic matter available. Assoc industry: Middle Aurignacian. Expected age: 23,000 BP.

Ly-945. La Salpêtrière, Centre, Couche 30-0 **20,860 ± 460**
18,910 BC

Assoc industry: Gravettian. Expected age: 24,500 BP.

Ly-946. La Salpêtrière, Centre, Couche 32 C **21,380 ± 760**
19,430 BC

Assoc industry: Early Aurignacian. Expected age: ca 31,000 BP.

General Comment (ME de F): all dates from Salpêtrian layers do not agree with expected ages and are either younger (Ly-937-938) or older (Ly-939). Likewise, Early Solutrean date should be ca 20,000 BP, according to layer correlations. Such a value (Ly-940) is normal for Middle Solutrean: see eg, Oullins grotto, Ardèche, Ly-799: 19,710 ± 400 BP (R, 1975, v 17, p 28). The 3 dates ca 21,000 BP for Late and Middle Aurignacian are 1st results for this industry, correlated with Perigordian IV to VI stages in the Dordogne (Laville, 1975) with ¹⁴C dates ca 23,000 BP. Inversion of values between Ly-944 and -946 with respect to industries remains unexplained but is confirmed by organic matter. La Salpêtrière site yields unsatisfactory dates despite good bony material.

Ly-981. Grotte de Conives, Thonay, Indre **32,000 ± 900**
30,050 BC

Bones from Conives grotto near Thonay, Indre (46° 37' N, 1° 29' E). Coll and subm 1974 by J Allain, Antiquités préhistoriques, Bourges. Bones are not assoc with industry in site but human settlements occurred in rock shelters nearby. Site was hyenas' den with *Megaceros* bone, supposedly contemporary with neighboring human habitats. *Comment* (JA): date indicates period corresponding to Middle Paleolithic industries, whereas industries from human habitats are Magdalenian; thus neighboring human and animal remains are not contemporaneous.

La Grande Roche series, Quincay, Vienne

Carbonaceous earth from layer, "black ensemble", Sample no 4L(I) 22 En, in Châtelperroian site La Grande Roche, near Quincay, Vienne (46° 36' N, 0° 15' E). Coll 1970 and subm 1973 by F Levêque, Dir Antiquités préhist, Poitiers.

Ly-790. Quincay 4L (I) 22 En Reliquat **11,910 ± 200**
9960 BC

Ly-791. Quincay 4L (I) 22 En Extra **20,300 ± 500**
18,350 BC

General Comment (FL): humic fraction date is older than insoluble fraction, but both values do not fit with age of Châtelperronian industry (beginning of Upper Paleolithic) eg, in Le Renne grotto at Arcy sur Cure, Yonne, GrN-1742: $33,860 \pm 50$ BP (R, 1963, v 5, p 116). Probably earth samples contained numerous thin rootlets that pretreatment did not eliminate. Other measurements on samples from same layer will be made later.

Gigny sur Suran series, Jura

Bones from 3 layers in La Balme grotto site near Gigny sur Sura, Jura (46° 27' N, 5° 27' E). Subm 1973 by M Vuilleme, Lons le Saunier, Jura.

Ly-789. Gigny sur Suran, Niveau VIII, n° 2 **28,500 ± 1400**
26,550 BC

From same layer as Ly-566: $29,500 \pm 1400$ (R, 1973, v 15, p 521). Coll 1970. *Comment* (MV): date confirms previous measurement (average: Ly-566/789: $28,900 \pm \begin{matrix} 1200 \\ 800 \end{matrix}$) showing that Middle Paleolithic industries may have lasted longer in Jura region when Early Aurignacian or Perigordian industries appeared in other regions. Bird fauna indicate a cold climate (Mourer-Chauviré, 1975).

Ly-971. Gigny sur Suran, Niveau XV, n° 1 **≥32,300**
Assoc with typical Mousterian "enriched in denticules". Coll 1972.

Ly-804. Gigny sur Suran, Niveau XX, n° 2 **≥31,500**
Assoc with typical Mousterian "rich in racloirs". Coll 1971.

General Comment (MB): small amount of organic matter in bones reduces dating limit and only Ly-789 gives a finite date marking end of Mousterian occupation. The other dates are only minimum. Other measurements on larger samples will be made later.

III. HYDROGEOLOGIC SAMPLES

Ly-818. Eau de Tinogasta, Argentina **88.2 ± 1.5% modern**
 $\delta^{13}C = -11.31 \pm 0.04\%$

Water from aquifer system near Tinogasta, Argentina (28° 0' S, 67° 40' W). Coll and subm 1973 by J Molinari, Centre d'Etudes Nucléaires Grenoble. Treatment on sampling place was made according to process recommendations of IAEA, Vienna.

Eau de la Mine de Razès series, Haute-Vienne

Samples from 2 layers in Razès uranium mine, Haute-Vienne (46° 2' N, 1° 20' E). Coll 1971 by Centre d'Energie Atomique and subm 1971 by Y Vuillaume, Bur recherches Geol Min, Orléans. Mine is dug in gneiss and slightly mineralized water from layer percolates probably

vertically from surface. No treatment was made on ground and CO₂ used for counting was directly evolved by HCl in lab.

Ly-516. Razès galerie profonde **19.5 ± 1.7‰ modern**
 $\delta^{13}\text{C} = -13.35 \pm 0.05\text{‰}$

From -225m.

Ly-517. Razès, galerie branche nord **53.8 ± 2.2‰ modern**
 $\delta^{13}\text{C} = -15.34 \pm 0.05\text{‰}$

From -180m.

Ly-518. Razès, galeries branche sud **61.9 ± 3.3‰ modern**
 $\delta^{13}\text{C} = -14.10 \pm 0.05\text{‰}$

From -180m.

General Comment: contrary to presumed values, ¹⁴C contents show that percolating water in mine layers is fairly old, especially at -225m, suggesting a large aquifer in gneiss.

Aïn Beni Mathar series, Morocco

Water from several wells in Aïn Beni Mathar aquifer basin, S Oujda, E Morocco. Coll by M Dupuy, Dir Hydrogeol Maroc, and subm 1972 by Y Vuillaume. Ground water is in an aquifer of fractured dolomitic calcareous rocks, with large flows to springs or artesian wells. The isotopic study was made to choose between several hypotheses for water origin and to detect an eventual exhaustion of the water reserves.

Sample	Loc	N Lat	W Long	$\delta^{13}\text{C} \text{‰}$ ±0.05	¹⁴ C ‰ modern
Ly-634. Janvier	23-25	33° 44'	2° 20'	-13.13	8.7 ± 0.9
Ly-635. Février	27-18 B	34° 0'	2° 1'	-12.80	28.5 ± 0.8
Ly-636. Mars 2	54-18	34° 0'	2° 14'	-11.18	6.0 ± 0.7
Ly-637. Avril	55-18	34° 5'	2° 13'	-12.54	4.9 ± 0.6
Ly-638. Mai	24-25	33° 47'	1° 54'	-11.48	3.4 ± 0.6
Ly-639. Juin	25-25	33° 21'	2° 16'	-15.69	47.7 ± 0.9
Ly-640. Juillet	61-18	34° 7'	2° 8'	-12.73	2.8 ± 1.7
Ly-641. Août	5-25	33° 18'	2° 0'	-13.65	8.5 ± 0.7
Ly-642. Septembre	68-18	34° 2'	2° 4'	-12.61	6.0 ± 0.6
Ly-643. Octobre	59-18	34° 7'	2° 7'	-13.01	12.2 ± 0.7
Ly-644. Novembre	55-18	34° 5'	2° 13'	- 7.03	3.5 ± 0.7
Ly-645. Décembre	61-18	34° 7'	2° 8'	- 5.77	3.2 ± 0.4

General Comment (YV): $\delta^{13}\text{C}$ values show no isotopic exchange between aquifer and water. High ¹⁴C content assoc with ³H measurable content suggest a recent water drift in sampling points 27/18B and 25/25. All radiocarbon values and other isotopic results (¹³C, ¹⁸O, and ³H) indicate a double supply for aquifer: one is autochtone at outcropping of aquifer formation, the other is allochtone for all ground water and comes from

High and Middle Atlas Mts. Values also confirm that flow depends on deep structure of geol beds and especially on their discontinuity (Vuillaume, 1972).

Miocene limestone of Cyrenaic series, Libya

Water from an aquifer system in Karstic Miocene limestone of Cyrenaic, N Libya. Coll during a program of studies (GEFLI) and subm by Bur Recherches Géol Min, Orléans. Most ground water is confined with natural outlets along Mediterranean sea coast (Castany *et al*, 1974).

Sample	Date	N Lat	E Long	$\delta^{13}\text{C} \text{‰}$ ± 0.05	$^{14}\text{C} \text{‰}$ modern
Ly-568. Salantah	12/7/71	32° 34'	21° 38'	- 6.97	35.5 ± 1.0
Ly-569. Fitayah N° 7		32° 43'	22° 32'	-10.61	2.5 ± 0.6
Ly-570. Fitayah N° 4		32° 46'	22° 40'	- 6.90	18.7 ± 0.7
Ly-571. Al Abyar N° 2	12/17/72	32° 13'	20° 34'	- 5.92	4.0 ± 0.6
Ly-572. Al Haniyah	12/6/71	32° 50'	21° 26'	- 9.04	62.2 ± 1.0
Ly-573. Marawah	12/8/71	32° 33'	21° 20'	- 6.79	9.7 ± 0.7
Ly-574. Miltaniyah	1/22/72	32° 17'	20° 42'	- 0.99	4.6 ± 0.9
Ly-575. Sadi Rahumah	1/15/72	32° 33'	20° 52'	- 0.36	37.8 ± 0.8
Ly-576. GEFLI C9	1/21/72	32° 9'	20° 32'	- 6.05	11.9 ± 0.7
Ly-601. Barradah	3/29/72	32° 53'	22° 0'	- 28.0	94.3 ± 1.5
Ly-602. GEFLI C13	3/24/72	31° 38'	20° 16'	- 0.92	≤ 2.3
Ly-603. Al Labraq	3/28/72	32° 46'	20° 50'	-12.49	112.3 ± 1.5
Ly-604. Blue Lagoon	3/14/72	32° 12'	20° 8'	- 8.25	38.6 ± 2.1
Ly-605. Dabuffiyah	3/30/72	32° 47'	22° 6'	- 9.68	62.2 ± 1.2
Ly-606. Baninah N° 3	2/12/72	32° 7'	20° 16'	- 7.04	17.4 ± 0.6
Ly-607. GEFLI C12	2/13/72	31° 43'	20° 15'	- 3.06	5.1 ± 2.0
Ly-608. Darnah S2	4/1/72	32° 42'	22° 30'	- 7.32	61.2 ± 2.1
Ly-609. GEFLI C7	2/9/72	31° 43'	20° 13'	- 1.55	12.6 ± 0.8
Ly-629. Al Marj N° 10	8/14/72	32° 27'	20° 46'	- 8.06	43.2 ± 1.1
Ly-665. GEFLI C1	6/26/72	32° 10'	20° 20'	- 4.24	12.0 ± 0.6
Ly-666. GEFLI C2	6/25/72	32° 20'	20° 46'	- 4.20	4.6 ± 0.6
Ly-667. GEFLI C3	6/29/72	32° 23'	20° 22'	- 5.06	21.4 ± 0.6
Ly-668. GEFLI C5	7/31/72	32° 16'	20° 22'	- 4.53	26.6 ± 0.7
Ly-669. GEFLI C10	7/1/72	32° 47'	20° 30'	- 1.90	3.3 ± 0.4
Ly-670. GEFLI C14	6/25/72	32° 41'	22° 36'	- 3.81	27.6 ± 0.8

General Comment: assoc with ^3H , low values of ^{14}C content indicate mixing between recent and old waters. Some very low values of ^{14}C content assoc with $\delta^{13}\text{C}$ near 0‰ P D B also suggest an isotopic exchange between calcareous aquifer and water. The geographic distribution of radiocarbon data translates general trend of water flow in aquifer: ^{14}C values toward NE and low value for confined ground water, especially in SW region.

**Ly-271. Forage de Pernes les Fontaine,
Vaucluse**

3.5 ± 0.5% modern

$\delta^{13}C = -3.32 \pm 0.04\text{‰}$

Water from very deep ground water coll by boring near Pernes les Fontaines, Vaucluse (43° 59' N, 5° 3' E). Coll 1969 by A Boudin, and subm 1970 by H Paloc, Bur Recherches Géol Min, Montpellier. Sample fully treated in lab. *Comment:* water is presumed fossil but low ^{14}C activity and presence of some tritium units indicate pollution by surface water possibly via tubing, despite artesian character of ground water at site.

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