

LYON NATURAL RADIOCARBON MEASUREMENTS VIII

J EVIN, G MARIEN, and C PACHIAUDI

Laboratoire de radiocarbone, Centre de Datation et d'Analyses
isotopiques, Université Claude-Bernard de LYON
43 boulevard du 11 Novembre 1918, 69621 Villeurbanne FRANCE

INTRODUCTION

This list includes most of the measurements made in 1977 and 1978 using the two Packard liquid scintillation spectrometers described in Lyon VII (R, 1978, v 20, p 19). The backgrounds of both spectrometers decreased by about 30% with new photomultipliers, giving 1.9 ± 0.1 cpm and 2.4 ± 0.2 cpm, respectively, for 3ml C_6H_6 (depending on counting vessels). Proportional detectors are only used for very small samples. Counting procedures are described in the text. Dilution ratios indicate the amount of sample versus the total quantity of C_6H_6 or CO_2 introduced in the detectors. No change was made either in chemical treatment or in the calculation method (half-life: 5570 ± 0 , one standard deviation, standard ^{13}C correction only for bones).

ACKNOWLEDGMENTS

We thank Joëlle Maréchal and Gérard Drevon for their sample preparation and routine operation. We are indebted to L. David and P. Elouard of the Dept of Geology for administrative and financial support, and we are grateful to the staff of the Nuclear Physics Institute for help and technical assistance.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Samples from peat bogs of low altitudes

Ly-1669. Marais de Lavours, Vongnes, Ain **Modern**
 $\delta^{14}C = +18.6\% \pm 1.6\%$

Plant debris from alluvial sediments of Le Séran R at Les Rosières in Le Marais peat bog, near Vongnes, Ain ($45^{\circ} 49' N$, $5^{\circ} 39' E$). Coll and subm 1975 by R Vilain, Geol Dept, Univ Lyon. *Comment* (RV): indicates that sample deposited by recent fluctuation of Le Séran R, and is unrelated to filling of Lavours peat bog.

Ly-1044. Marais de Saint-Gond, Morains, Marne **1530 $\pm$ 120**

Sediment rich in organic matter from boring in sediments of upper course of Petit Morin R, near Morains, Marne ($48^{\circ} 48' N$, $3^{\circ} 59' E$). Coll and subm by F Megnien, Bur recherches Geol Min, Brie-Comte-Robert. Peat thickness established in E termination of Saint-Gond peat bog which was formed by capture of upper course of Petit Morin R by Somme Soude R. *Comment* (FM): approximately indicates when occurred, but further studies are necessary

Aigues-Mortes series, Gard

Sediments, mainly organic debris, deposited by branches of Rhône R in W part of its delta, near Aigues-Mortes, Gard. Coll by A L'Homer and subm by A Marcé, Bur recherches Geol Min, Orléans La Source.

Ly-1041. Rempart LU2, Aigues-Mortes 1980 ± 130

Pure powdered plant remains coll at 0.4m depth between 2 ancient offshore bars (see Le Grau du Roi series, below) just outside Medieval walls of Aigues-Mortes city (43° 35' N, 4° 12' E). Coll and subm 1975.

Ly-1264. Le Canet, Aigues-Mortes 1720 ± 130

Sandy powdered plant remains coll at 0.6m depth on side of ancient lagoon, in connection with Lairon pond. Vegetals were deposited by an ancient lateral channel of Paccaïs Rhône R at Mas du Canet (43° 33' N, 4° 14' E). Coll and subm 1976.

General Comment (AL): both dates agree and are max for closing of fluvial drift system near Aigues-Mortes.

Ly-1040. Marais de Fourchon, Arles, Bouches du Rhône 5850 ± 240

Peaty sediment rich in organic matter from 8.5m depth at base of SA 1 or SA 3 boring in Fourchon peat bog near Arles, Bouches du Rhône (43° 40' N, 4° 38' E). Coll 1975 by A L'Homer and subm 1975 by A Marcé. Pollen diagram studied by H Triat, Lab Bot Hist, Univ Aix-Marseille, 2/3 diluted sample. *Comment* (AL and HT): formation of Fourchon peat bog occurred behind offshore bar formed during period of stable sea level. At this level, pollen diagram indicates development of *Fagus* forest, which, according to botanic data in region (Triat-Laval, 1978), has been attributed to the Atlantic period. Date agrees with Ly-1038, below, and with unpub result from 9.1m depth at same site: MC-1165, 6580 ± 100 BP.

Marais de Meyranne series, Raphèle lès Arles, Bouches du Rhône

Peat from 3 levels of SA 4 boring in Meyranne peat bog, near Raphèle lès Arles, Bouches du Rhône (43° 39' N, 4° 43' E). Coll 1975 by A L'Homer and subm 1975 by A Marcé. Pollen diagram studied by H Triat.

Ly-1037. Marais de Meyranne, 2 2930 ± 270

From 2m depth, 1/6 diluted sample.

Ly-1038. Marais de Meyranne, 4.3 5010 ± 310

From 4.3m depth, 1/2 diluted sample.

Ly-1039. Marais de Meyranne, 6 8010 ± 400

From 6.0m depth, 1/6 diluted sample.

General Comment (AL & HT): like Fourchon and Fos peat bogs, Meyranne peat bog grew behind offshore bar during same period of stable

sea level. Pollen diagram shows beginning of climatic improvement phase at level of Ly-1039, above stratigraphic lacuna. Ly-1038 is just before increase of *Fagus* curve that remains constant until deforestation by humans, a little after Ly-1037 at level of which *Abies* disappears, (Triat-Laval, 1978).

Les Courtins series, Muron, Charente Maritime

Peat from 2 levels of 658/3/501 boring in *Scrobicularia* clays "Bri", of Rochefort peat bog at Les Courtins, near Muron, Charente Maritime (46° 2' N, 0° 49' W). Coll 1975 by B Bourgueil, Bur recherche Geol Min, Poitiers, and subm 1975 by A Marcé.

Ly-1042. Les Courtins, 14m **8380 ± 250**

From 14.03m to 14.05m depth, 2/3 diluted sample.

Ly-1043. Les Courtins, 16m **8140 ± 330**

From 16.07m to 16.10m depth, 1/3 diluted sample.

General Comment (BB): considering counting error, both dates are similar, indicating rapid sedimentation and confirming expected Holocene age.

Canal de la Fure series, Charavines, Isère

Peat from top and base of peaty layer, 1m thick, submerged at 1.3m in Fure channel, artificial overflow of Paladru lake at Charavines, Isère (45° 25' N, 5° 31' E). Coll and subm 1978 by M Girard and A Bocquet, Inst Dolomieu, Grenoble.

Ly-1663. Canal de la Fure, Sommet **1210 ± 130**

From top of peat layer, underlying lacustrine chalk layer.

Ly-1664. Canal de la Fure, Base **4780 ± 150**

From base of peat layer, overlying another lacustrine chalk layer.

General Comment (AB): Late Neolithic settlement on lowest lacustrine chalk layer in neighboring Les Baigneurs bay gave numerous pub dates from 4440 to 4100 BP (R, 1976, v 18, p 73). Between both dates lake level probably rose slowly to allow growth of homogeneous peat layer without clay and chalk. Waters rose high enough to involve chalk layer overlying present submerged Medieval (12th century) settlement.

Le Moulin de Sienne series, Ebréon, Charente

Peat from 2 40m neighbouring excavations in Aigre peat bog at Le Moulin de Sienne near Ebréon, Charente (45° 57' N, 0° 01' E). Coll and subm 1976 by Y Guillien, Bourg la Reine. Peat interstratified in calcareous tufa rich in organic matter and called "Bouchot".

Ly-1620. Moulin de Sienne II **4800 ± 150**

From 2m depth in excavation near side of peat bog.

Ly-1619. Moulin de Siarne I 5350 ± 170

From 6m depth in excavation near middle of peat bog.

General Comment (YG): as peaty layer in Excavation II dips towards Excavation I and both dates are in 2σ statistical margins, peat may be only one layer which occurred during Atlantic period. This indicates quick growth for 6m thickness of "Bouchot".

Le Parc Borély series, Marseille, Bouches du Rhône

Peat from 2 levels of boring in town park Borély in Le Prado quarter, at Marseille, Bouches du Rhône (43° 16' N, 5° 22' E). Coll 1973 and subm 1977 by H Triat.

Ly-1466. Parc Borély, 395cm 3370 ± 140**Ly-1467. Parc Borély, 590cm 6380 ± 140**

General Comment (HT): both dates agree with expected ages. Pollen diagram indicates disappearance of *Tilia*, *Ulmus*, and *Quercus pubescens*. This demonstrates rapidity and amount of deforestation in Marseille region where 1st clearing of woods by humans occurred during Neolithic period at Ly-1467 level (Triat-Laval, 1978).

Marais des Grands Paluds series, Fos sur Mer, Bouches du Rhône

Peaty sediments from 3 close borings in N part of Les Grands Paluds peat bog, near Fos sur Mer, Bouches du Rhône (43° 28' N, 4° 52' E). Coll and subm 1977 by H Triat-Laval.

Ly-1493. Les Grands Paluds de Fos, 130 to 135cm, No. 1 2240 ± 140

Peat coll from 130 to 135cm depth by plastic tubing drill; pollen diagram indicates late increase of *Fagus* in Sub-Atlantic period.

Ly-1494. Les Grands Paluds de Fos, 130 to 135cm, No. 2 2260 ± 150

Peat from same level as Ly-1493 but coll by Smith's drill.

Ly-1495. Les Grands Paluds de Fos, 140cm 3000 ± 130

Clay, rich in organic matter, coll by plastic tubing drill at 140cm depth.

Ly-1496. Les Grands Paluds de Fos, 184 to 189cm 4450 ± 300

Peat, little evolved from 184 to 189cm depth, coll by sovietic drill. 1/5 diluted sample. Pollen diagram indicates beginning of continuous curve of *Fagus* in Sub-Boreal period.

General Comment (HT): Ly-1493 and -1494, from same level, coll to test 2 boring systems in very wet peat bog where peaty sediment remains fluid. As expected, similarity of both results excludes mixture contamination of samples. Pollen diagram indicates beginning of Sub-Boreal period at level of Ly-1496, which then agrees with generally proposed chronol-

ogy for beginning of this climatic phase. Hiatus occurred in sedimentation between Ly-1493/1494 and Ly-1495 at about limit of Sub-Boreal and Sub-Atlantic periods. Previously pub value, Ly-364: 5600 ± 150 (R, 1973, v 15, p 136) from 4.1m depth in S part of peat bog, at Le Pont des Clapets, fits with present series and corresponds to end of Atlantic (Triat-Laval, 1978).

Les Paluds series, Courthézon, Vaucluse

Peat from 2 levels of boring with Smith's drill in Les Paluds peat bog, near Courthézon, Vaucluse ($44^{\circ} 5' N$, $4^{\circ} 53' E$). Coll 1975 and subm 1977 by H Triat to complete and confirm 5 previously pub dates (R, 1978, v 20, p 20).

Ly-1465. Les Paluds de Courthézon, 260 to 265cm 4250 $\pm$ 250

Peat from 260 to 265cm depth where pollen diagram indicates beginning of *Fagus* extension, 1/2 diluted sample. *Comment* (HT): date a little younger than generally accepted (4700 BP) age of this pollen event in N Europe.

Ly-1582. Les Paluds de Courthézon, 480 to 500cm 11,570 $\pm$ 200

Peat from 480 to 500cm depth, underlying level dated by Ly-1136: $11,530 \pm 230$, 470 to 475cm deep. *Comment* (HT): confirms previous result; indicates either complex evolution of vegetation during Alleröd period or rejuvenation of all samples from base of boring, due to local edaphic conditions.

General Comment (HT): 2 present results and previous series show vegetation history since Tardiglacial period. Extension of *Pinus* forest from Alleröd (Ly-1582/1136) or earlier (contamination) to Pre-Boreal (Ly-1263) is interrupted by phase of more steppe-like vegetation during Late Dryas. Short extension of *Corylus* may be seen at Boreal period (Ly-1262). First appearances of *Abies*, after those of *Quercus ilex* occurred in Atlantic period (Ly-1135) and increase of *Fagus* mark beginning Sub-Boreal (Ly-1465). Human influence may be detected as soon as Neolithic time.

Les Autures series, L'Isle sur la Sorgue, Vaucluse

Peat from 3 levels of boring in ancient Les Autures peat bog, near L'Isle sur la Sorgue, Vaucluse ($43^{\circ} 56' N$, $5^{\circ} 03' E$). Coll 1977 and subm by H Triat-Laval.

Ly-1563. Les Autures, 129 to 132 cm 5620 $\pm$ 360

From 129 to 132cm depth, 1/3 diluted sample. Pollen diagram indicates beginning of *Fagus* curve. *Comment* (HT): seems to be a little too old with respect to Ly-1465, above, for same botanic event but agrees with previously pub date, Ly-911: 4450 ± 150 (R, 1976, v 18, p 62) at nearby site.

Ly-1564. Les Autures, 149 to 151cm 6020 $\pm$ 230

From 149 to 151cm depth, 9/10 diluted sample. *Comment* (HT): just before level, pollen diagram has continuous curve of *Abies* consistent with prosperity of fir forests in South Alps as, for instance, shown by Col des Lauzes and Lac Long Inférieur series (R, 1978, v 20, p 27-29; de Beaulieu, 1977). After level, *Abies* curve reflects regional fir forest.

Ly-1565. Les Autures, 303 to 307cm 7610 $\pm$ 190

From 303 to 307cm depth, assumed from Atlantic period. *Comment* (HT): agrees with Ly-910: 6880 $\pm$ 180 (R, 1976, v 18, p 62) from L'Isle sur la Sorgue, neighboring site, and may mark beginning of Atlantic period, with small frequency of *Quercus pubescens* but without *Quercus ilex* and *Abies* pollen

Barbegal series, Arles, Bouches du Rhône

Samples from several levels of boring made by sovietic drill in Barbegal peat bog, near Arles, Bouches du Rhône (43° 41' N, 4° 42' E). Coll and subm 1976 by H Triat-Laval.

Ly-1460. Barbegal 80-85 3670 $\pm$ 140

Peat from 80 to 85cm depth. Pollen diagram indicates decrease of *Betula* and *Quercus pubescens* and increase of *Fagus* and *Quercus ilex*.

Ly-1461. Barbegal 120 5140 $\pm$ 130

Peat from 120cm depth. Pollen diagram indicates beginning of continuous curve of *Abies* which should correspond to Atlantic A period.

Ly-1462. Barbegal 160 5160 $\pm$ 230

Peat from 160cm depth, 2/3 diluted sample. Pollen diagram indicates beginning of *Fagus* curve which could correspond to beginning of Atlantic A period.

Ly-1463. Barbegal 240 6860 $\pm$ 340

Peaty clay from 240cm depth, at base of boring, 1/3 diluted sample. At overlying depth, 235cm, *Quercus ilex* pollens could imply pre-Atlantic date for lowest levels of site (Triat-Laval, 1978).

General Comment (HT): Ly-1460 proves early human influence by clearing of woods which favored *Fagus* extension. Time proximity of Ly-1461 and -1462, despite 40cm distance, shows very rapid filling. Ly-1463 seems too young for hypothesis of pre-Atlantic sediment at base of Barbegal peat bog.

Marais des Baux series, Mouriès, Bouches du Rhône

Organic sediments from several levels of borings coll by Smith's drill in middle of Les Beaux dried peat bog, near Mouriès, Bouches du Rhône (43° 41' N, 4° 48' E). Coll 1976 and subm 1977 by H Triat-Laval.

Ly-1504. Les Baux 70-75 3370 ± 190

Dark gray marl from 70 to 75cm depth. Just below curve of *Quercus ilex* and *Fagus* begins, while *Pinus* falls sharply. *Comment* (HT): same pollen event and date in Barbegal site: Ly-1460, above.

Ly-1505. Les Baux 85-90 3100 ± 290

Clear gray marl from 85 to 90cm depth, 2/3 diluted sample. Pollen diagram shows beginning of *Fagus* curve. *Comment* (HT): younger than expected for *Fagus* appearance with respect to Ly-1040 at Le Fourchon and Ly-1563 at Les Autures peat bogs, above.

Ly-1506. Les Baux 120-125 5180 ± 390

Very clear gray marl with small organic content, 1/5 diluted sample, from 120 to 125cm depth. Beginning of *Abies* curve in pollen diagram. *Comment* (HT): shows more recent age for *Abies* appearance than in Courthézon site: Ly-1135, 7350 ± 170 (R, 1978, v 20, p 20).

Ly-1507. Les Baux 155-160 7260 ± 1140

Chalky marl with very poor organic content, 1/15 very diluted sample, from 155 to 160cm depth. *Comment* (HT): too young, as pollen diagram defines end of pre-Boreal period.

Ly-1464. Les Baux 245-255 8130 ± 750

White clay with some organic debris, 1/10 very diluted sample, from 245 to 255cm depth. *Comment* (HT): too young, as pollen diagram indicates pre-Boreal period.

Ly-1508. Les Baux 280-285 9750 ± 960

Sandy gray clay with very low organic content, 1/15 very diluted sample. Pollen diagram shows an increase of *Pinus* probably during pre-Boreal period. *Comment* (HT): contrary to 2 previous results, and considering large counting error, date agrees with Ly-1558 from Beauchamp-Panières site, below.

General Comment (HT): all results from this site seem too young except those from samples with normal organic content. Discrepancies may be due to clayey nature of sediments or to another unknown reason, specific to sampling site (Triat-Laval, 1978).

Beauchamp-Panières series, Saint-Rémy de Provence, Bouches du Rhône

Samples from several levels in borings coll by Smith's drill in Beauchamp-Panières ancient peat bog, near Saint-Rémy de Provence, Bouches du Rhône (43° 32' N, 4° 53' E). Coll and subm 1977 by H Triat.

Ly-1554. Beauchamp-Panières, 85-90 8320 ± 510

Gray marl with low organic content, 1/3 diluted sample. From 85 to 90cm depth. Pollen data corresponding to beginning of Atlantic period. *Comment* (HT): date is younger than expected and disagrees with results below as well as with pollen data.

Ly-1555. Beauchamp-Panières, 95-100 6770 ± 450

Gray marl with low organic content, 1/5 diluted sample, from 95 to 100cm depth. Just before *Abies* appearance that corresponds to Atlantic A period. *Comment* (HT): younger than expected by Ly-1135: 7350 ± 170 for pollen event in Courthézon site (R, 1978, v 20, p 20), but agrees with Ly-910: 6880 ± 180 (R, 1976, v 18, p 62) from L'Isle sur la Sorgue site.

Ly-1556. Beauchamp-Panières, 120-125 8210 ± 700

Gray marl with few plant remains, 1/10 very diluted sample, from 120 to 125cm depth. Pollen diagram indicates extension of *Quercus pubescens* forest. *Comment* (HT): agrees with expected age and Ly-1262: 8480 ± 200 from Les Paluds de Courthézon and Ly-1019: 7880 ± 200 for Mollèges sites (R, 1978, v 20, p 20).

Ly-1557. Beauchamp-Panières, 136-140 8390 ± 210

Peat from 136 to 140cm depth. A high but short extension of *Corylus* occurs at level attributed to Boreal period. *Comment* (HT): confirms attribution and also agrees with Ly-1262 (see above).

Ly-1558. Beauchamp-Panières, 143-146 10,140 ± 220

Peaty marl from 143 to 146cm depth, just before a sedimentation hiatus. *Comment* (HT): may attribute max *Pinus* forest in beginning of Pre-Boreal period.

Ly-1559. Beauchamp-Panières, 220-225 11,320 ± 1060

Sandy clay, very poor in organic matter, 1/10 very diluted sample, from 220 to 225cm depth. Pollen diagram implies end of Alleröd period. *Comment* (HT): despite very large counting error, date agrees with expected period.

Ly-1560. Beauchamp-Panières, 328-332 12,740 ± 480

Gray marl from 328 to 332cm depth, 1/2 diluted sample. Pollen diagram shows phase of better climate with presence of *Quercus pubescens* and *Corylus*, which may correspond to Alleröd and Bölling periods as middle Dryas period cannot be seen in any pollen diagram in region.

Ly-1561. Beauchamp-Panières, 395-400 12,580 ± 640

Sandy gray clay with some plant debris from 395 to 400cm depth, 1/3 diluted sample. Pollen data should suggest Early Dryas. *Comment* (HT): date agrees with assumed climatic period only with 2σ statistical margin.

Ly-1562. Beauchamp-Panières, 40-50 12,320 ± 1020

Gray clay with small organic matter content from base of another boring coll by sovietic drill, 1/5 diluted sample. Pollen diagram comparison here makes oldest date of site expected. *Comment* (HT): much too close to Ly-1560 and -1561, date is younger than expected. Thus, most samples from bases of borings yield less reliable results which may be due to small amount of available organic matter.

General Comment (HT): pollen history of site begins with no meso-thermic sp but with a steppe phase which may be contaminated by younger carbon. Subsequent increase of *Quercus pubescens*, *Alnus*, and *Corylus* pollen initiated a long phase (Ly-1559 and -1560) of *Pinus* forest of which max occurred during Boreal period. Late Dryas (Ly-1558) is very well marked by decrease of arboreal pollen. Extension of *Quercus* forest 1st due to *Q. pubescens* (Ly-1556) sp then to *Q. ilex* at Atlantic period where human influence becomes apparent. *Abies* appears at Atlantic period (Ly-1555) followed by *Fagus* at beginning of Sub-Boreal (Triat-Laval, 1978).

B. Samples from peat bogs of high altitudes

Dar Fatma series, Aïn Draham, Tunisia

Peat from 2 levels of core coll by Coûteaux' drill in Dar Fatma peat bog at 910m alt, near Aïn Draham, Tunisia (36° 46' N, 8° 42' E). Coll 1977 by A Pons and subm 1978 by A Pons and M Reille, Lab Bot Hist and Palynol, Univ Marseille.

Ly-1627. Dar Fatma, Sommet

Modern
 $\delta^{14}\text{C} = +20.0\% \pm 3.0$

Ly-1650. Dar Fatma, 63 to 71cm

700 ± 110

General Comment (MR): pollen diagram shows last great deforestation just before Ly-1650. As shown in pollen diagram from Moroccan Rif (Reille, 1977) this event is a consequence of Arabian invasion.

Ly-1335. Col de Zad, Azrou, Morocco

1150 ± 120

Peat from 70 to 72.5cm depth of core coll by Coûteaux' drill at alt 2000m at Le Col de Zad, near Azrou, Morocco (33° 00' N, 5° 03' W). Coll 1971 and subm by M Reille. Pollen diagram indicates disappearance of deciduous *Quercus* (Reille, 1976). *Comment* (MR): base of core gave unpub date: Lv-672, 2860 ± 60 and transition between Sub-Boreal and Sub-Atlantic periods cannot be seen in pollen diagram where deciduous *Quercus* should be reliable marker.

Ly-1233. Tizirène, Bab Taza, Morocco

1390 ± 140

Peat with *Cyperaceae* sp from 130 to 140cm of core coll by Coûteaux' drill at alt 1400m in pond at Tizirène, near Bab Taza, Rif, Morocco (35° 01' N, 5° 00' W). Coll 1971 and subm 1976 by M Reille. Should correspond to Sub-Atlantic phase, before olive cultivation which began in Rif region ca 1000 BP. *Comment* (MR): agrees with expected age and approximates date of base of core from a neighboring pond, top of which yielded unpub date: Lv-647, younger than 210 BP (Reille, 1977).

Ly-1459. Oukaïmeden, Marrackech, Morocco

1610 ± 140

Peat from 115 to 120cm depth in core coll at alt 2600m in Agdal of Oukaïmeden, near Marrackech, Morocco (31° 12' N, 7° 51' W). Coll 1971 and subm 1976 by M Reille. Pollen diagram indicates disappearance of *Quercus* at level. *Comment* (MT): consistent with unpub result from

150cm depth in core, Lv-693: 2680 ± 50 BP, which marks end of Sub-Boreal. As in Col de Zad site, above, transition from Sub-Boreal to Sub-Atlantic periods is not botanically characterized. Disappearance of deciduous *Quercus* is probably due to dry tendency during Sub-Atlantic period and may be used as marker for region.

Pélléautier series, Haute Alpes

Samples from levels of several cores close to each other in La-Mottequi-Tremble peat bog, near Pélléautier, Hautes Alpes ($44^{\circ} 31' N$, $6^{\circ} 11' E$). Cores I and III were coll by Coûteaux' drill in 1971 and Cores IV, V, and VI by Smith's drill in 1973, 1973 and 1976 respectively. Samples subm and pollen diagrams studied by J L de Beaulieu as part of general study of South Alps late and postglacial vegetation. All other Lyon radiocarbon results were pub previously (R, 1978, v 20, p 22-30). Site lies at alt 975m on side of Céüse mt ca 400m above large glacial valley of Durance R. Because of its very open position in landscape, site may well reflect vegetational history of region (de Beaulieu, 1977), and studies on coll cores are still in process. Often due to scarcity of organic matter in lowest levels, difficulties encountered in countings sometimes involved large counting errors and control measurements. Numbers indicate depths in cores and climatic phases are deduced from pollen diagrams.

Ly-581. Pélléautier I, 70 to 75cm 660 $\pm$ 210

Gray clayey peat with mollusk shells. Disappearance of *Abies* and *Quercus*, appearance of *Juglans* and many non-arboreal pollens. High deforestation probably due to Middle age grazing fields, 5/6 diluted sample.

Ly-797. Pélléautier I, 260cm 4640 $\pm$ 190

Black peat, 20cm above limit of lacustrine chalk, *Abies* predominance, end of Atlantic period.

Ly-582. Pélléautier III, 145 to 150cm 4850 $\pm$ 250

Lacustrine chalk with low organic content giving a 7/12 diluted sample. Pollen diagram demonstrates large hiatus at 39cm depth in boring made on peat bog side. Predominance of *Pinus* Pre-Boreal or Alleröd. *Comment* (JL de B): aberrant result may be due to sampling system or secondary disturbance in levels.

Ly-1211. Pélléautier IV, 175 to 180cm 6430 $\pm$ 190

Peat, predominance of *Abies*. Atlantic period.

Ly-1212. Pélléautier IV, 185 to 195cm 7600 $\pm$ 230

Peat, *Pinus* predominance, *Quercus* presence and beginning of continuous curve of *Abies*; end of Boreal period.

Ly-1213. Pélléautier IV, 305 to 315cm 9090 $\pm$ 230

Peat from 1st peaty level above lacustrine chalk, *Pinus* predominance on mesothermic sp, Pre-Boreal.

Ly-1214. Pélleautier IV, 465 to 475cm 11,000 ± 460

White chalk with little organic content involved counting in proportional detectors even after 1/2 dilution of sample. Only *Pinus* with some *Betula* pollen; Alleröd or Bölling phase.

Ly-1215. Pélleautier IV, 504 to 513cm 11,750 ± 500

Same as Ly-1214 for dating material, pollen date and counting procedure but without dilution.

Ly-1216. Pélleautier IV, 540 to 550cm 13,210 ± 410

Gray marl with higher content of carbon precluding dilution before measurement in small counters. Short shift of *Pinus* pollen percentage due to somewhat larger quantity of *Betula* pollens. End of continuous curve of *Juniperus*. Max of *Betula* is presumed during Bölling period.

Ly-1218. Pélleautier V, 565 to 574cm 14,320 ± 680

Marl with small organic content involving 3/4 diluted sample and measurement in proportional detectors. Predominance of *Juniperus* with *Betula* and *Pinus* presence; early Dryas.

Ly-1217. Pélleautier V, 587 to 595cm 10,990 ± 660

Same dating material and counting procedure with 4/7 dilution. Before *Juniperus* max. Large amount of *Pinus* pollen, Early Dryas. *Comment* (JL de B): aberrant result for unknown reason.

Ly-1775. Pélleautier VI, 415 to 422cm 12,810 ± 280

Peaty clear marl with many shells. Beginning of *Pinus* forest extension corresponding to large *Betula* decrease and end of *Juniperus* continuous curve; beginning of Bölling-Alleröd period.

Ly-1776. Pélleautier VI, 462 to 470cm 13,200 ± 550

Gray marl with plant debris and shells, 1/2 diluted sample, min of *Pinus*, max of *Juniperus*, just before expansion of *Betula*; before or during beginning of Bölling-Alleröd period.

Ly-1342. Pélleautier VI, 545 to 555cm 15,300 ± 320

Marl rich in organic debris but poor in pollen. Predominance of *Juniperus*. *Comment* (JL de B): does not fit with all other results for unknown reason.

Ly-1794. Pélleautier VI, 605 to 615cm 14,560 ± 420

Peaty marl with organic debris and shells, beginning of first *Juniperus* max; before Bölling. Same pollen proportion in Core V at Ly-1218 level, 4/5 diluted sample.

Ly-1795. Pélleautier VI, 620 to 625cm 15,090 ± 430

Peaty marl, just before beginning of 1st *Juniperus* max, 3/5 diluted sample.

Ly-1468. Pélleautier VI, 625 to 635cm 14,770 ± 300

Same material and pollen event as Ly-1795.

+ 1900
Ly-1796. Pélleautier VI, 690 to 708cm 23,730
 – 1500

Clay very poor in organic matter, 4/30 very diluted sample and long counting time. Pollen diagram shows some changes in composition of steppe-like vegetation together with reduced percentage of long distance pollen (*Pinus*). Down to the base of core, at 780cm depth, sediment and pollen composition remain similar.

General Comment (JL de B): on 18 results, only Ly-582 and -1217 are not consistent for unknown reasons. All other dates give continuous chronology of site vegetation that fits very well with generally accepted absolute chronology of assumed climatic phases. Dates also agree with most values from neighboring sites, such as Siguret (de Beaulieu, 1977), Saint-Léger, Le Forest and Les Lauzes series (R, 1978, v 20, p 24-27) where last max of *Juniperus*, 1st max of *Pinus*, and appearance of *Abies*, are contemporaneous. Oldest dates are more interesting as they establish, for 1st time, an absolute chronology within Early Dryas period during steppe-like and steppe-bush phases. Nevertheless, Ly-1796 needs confirmation with further measurements on largest samples.

C. Bone samples from fill of grottos

Ly-1292. Aven du Nonoss, Entremont le Vieux, Savoie 4210 ± 160

Bones (*Bovidae*) from base of Le Nonoss "aven", near Entremont le Vieux, Savoie (45° 27' N, 5° 54' E). Coll 1975 by M Ulysse and subm 1975 by M Philippe, Hist Nat Mus Lyon. *Comment* (MP): much younger than expected but may fit with fauna.

Causse du Gramat series, Lot

Bones from various fauna from fillings of several "avens", holes or grottos scattered on karstified calcareous plateau. Causse de Gramat, between valleys of Dordogne and Lot R, Lot dept. Samples were coll during survey of paleontol sites to complete previous pub series (R, 1975, v 17, p 13) by M Philippe.

**Ly-1578. Igues de Bramarie, Diaclase supérieure,
 Caniac du Causse 1900 ± 600**

Bones (*Equidae*) found close to entrance of Igues de Barrière aven, near Caniac du Causse, Lot (44° 39' N, 1° 37' E), 1/10 very diluted sample. Coll 1975 and subm 1976.

**Ly-1577. Igues de Bramarie, Conduite forcée,
 Caniac du Causse 2880 ± 630**

Bones (*Bovidae*) from 40m depth at base of Igues de Bramarie aven, near Caniac du Causse, Lot (44° 39' N, 1° 37' E), 1/6 very diluted sample. Coll 1975 and subm 1976.

Ly-1367. Igues du Pepin, Caniac du Causse 5350 ± 380

Bones from various fauna from 25 to 35m depth between aven-shafts 2 and 3 of Le Pépin aven, near Caniac du Causse, Lot (44° 38' N, 1° 40' E), 1/3 diluted sample. Coll 1971 and subm 1976. *Comment* (MP): as some sp of fauna are obviously Würmian, such as reindeer, date proves mixture of ancient and recent bones in sites.

Ly-1576. Igues de Barrière, Miers 19,940 ± 800

Bones (*Bovidae*) from 40m depth at base of Igues de Barrière aven, near Miers, Lot (44° 53' N, 1° 42' E), 2/3 diluted sample. Coll 1972 and subm 1976.

+ 2000

Ly-1294. Perte de Bramarie, Caniac du Causse, Lot 31,500
– 1600

Bones (*Elephas*) from 50m depth at base of Perte de Bramarie aven, near Caniac du Causse, Lot (44° 39' N, 1° 37' E). Coll 1974 and subm 1975.

General Comment (MP): as shown by dilution ratios, organic contents of bones is variable and, here, inversely proportional to absolute age. Loss of organic carbon in bones depends mainly on burial since more recent bones, such as those from Igues de Bramarie, were found overlying karstic fill and were submitted to meteoric water leachings. Bones underlying or in karstic fill are generally packed in waterproof clay. Contrary to previously pub series, ages are time scattered and Ly-1294 is as old as most samples from Le Causse de Martel sites: Ly-1225, below, and Causse de Martel series, below and R, 1976, v 18, p 66-67 (Evin *et al*, 1980).

Causse de Martel series, Lot and Corrèze

Bones from various sp from fills of several aven, holes or grottos scattered on karstified calcareous plateau Causse de Martel, between Brive bassin and Dordogne R valley. Coll during paleontol excavation (Ly-1225) or during survey of paleontol sites.

Ly-1293. Grange Cournille, Saint-Cernin de Larche, Corrèze
Modern
 $\delta^{14}\text{C} = -1.5\% \pm 1.6$

Bones (*Bovidae*, *Equidae*) filled Grange Cournille grotto, near Saint-Cernin de Larche, Corrèze (45° 6' N, 1° 25' E). Coll 1974 and subm 1975.

Ly-1574. Grotte Linoire, Turenne, Corrèze 1420 ± 220

Bones of small sp from wastes of excavation in Linoire grotto, near Turenne, Corrèze (45° 03' N, 1° 35' E), 1/2 diluted sample. Coll 1974 and subm 1975.

+ 1300

Ly-1575. Pech de l'Ajasse, Gignac, Lot 16,200
– 1500

Bones (*Rangifer tatandus* & micro fauna) from base of Le Pech de l'Ajasse aven, near Gignac, Lot (44° 58' N, 1° 29' E), 1/10 very diluted

sample. Coll 1974 and subm 1975. *Comment* (MP): despite thick concretions on bones and large statistical margins, date is youngest for Würmian sites of Causse de Martel plateau and is, then, contemporaneous with many samples from Causse de Gramat plateau, above and R, 1975, v 17, p 13.

+ 1400

Ly-1225. Siréjol, Couche très profonde, 30,100
Gignac, Lot - 1700

Bones (*Bovidae*) from lowest filling layer of Siréjol grotto, near Gignac, Lot, (44° 59' N, 1° 29' E). Coll 1975 and subm 1976. *Comment* (MP): perfectly confirms 2 previous measurements (Ly-614 and -767), of which average is $30,100 \pm 1100$, from upper layers of site fill which is then homogeneous in time (R, 1976, v 18, p 67). Three dates may be compared to results from Jaurens site (R, 1976, v 18, p 66; Evin *et al.*, 1980).

General Comment (MP): as in series above, amount of organic content seems independent of absolute age of bones, and is more correlated with burial process.

Ly-1177. Locus 3 de la Falaise, Vergisson, Saône et
Loire 28,680 ± 660

Bones of various sp (*Bovidae*, *Equidae*, *Rodentia*, *Hyaenidae*) from fill of fissure, called Locus 3, in calcareous cliff of Vergisson, Saône et Loire (46° 18' N, 4° 42' E). Coll 1974 and subm 1977 by M Philippe. Two neighboring fissures, Locus 1 and 2, are prehistoric sites in which were found *Homo neandertalensis* remains. *Comment* (MP): no systematic excavation was made to establish contemporaneity between dated fauna and Mousterian industry or human fossils.

La Sartanette series, Remoulins, Gard

Bones from 3 levels in deepest room, called "Couloir des Trépassés" of La Sartanette grotto, near Remoulins, Gard (43° 56' N, 4° 32' E) (Bonnet *et al.*, 1946) Coll 1941 by A Bonnet and J du Cailar, preserved in Nîmes Mus and subm 1974 by A Bonnet, Nîmes. Because of low organic content all samples were measured in small detectors after dilutions.

Ly-1589. La Sartanette Couche Z 4720 ± 110

Human bones from Layer Z overlying stalagmitic Floor T, assoc with ceramic industry attributed to Early Bronze age. *Comment* (AB): too old for assumed assoc industry but makes sepulture contemporaneous with other Late Neolithic sepultures of same type with trepanned human skulls. In another part of grotto were found somewhat younger ages for a Late Neolithic industry of Chalcolithic-Ferrières type (Bonnet *et al.*, 1973).

Ly-1590. La Sartanette, Couche T 21,900 ± 1500

Bones (*Capra ibex*) embedded in stalagmitic cover assumed from Layer T to be from Late Würm period, 3/4 diluted sample. *Comment* (AB): indicates end of Würm III, climatic phase of which cold climate

is compatible with stalagmitic formation. Within statistics it may be contemporary with Ly-1591, below, from underlying Level P.

Ly-1591. La Sartanette, Couche P $22,700 \pm 1700$

Bones (*Ursus spealeus*) from Layer P, underlying stalagmitic Floor T, 3/4 diluted sample. *Comment* (AB): fauna (*Ursus spelaeus*) found in European grottos from Rumania to Spain were generally assumed from Würm I or Würm II glacial periods, such as in Prélétang grotto: Ly-167: older than 32,000 BP (R, 1971, v 13, p 45). Present results indicate Würm III agrees with similar fauna at Arlay, Jura: Ly-498/499: $25,720 \pm 700$ (R, 1973, v 15, p 520).

Ly-1597. Gouffre d'Abdala, Bagnères de Bigorre, Hautes Pyrénées $\geq 29,200$

Bones from clay fill of fissure presently filled in deep gallery of Abdala gulf, near Bagnères de Bigorre, Hautes Pyrénées. ($43^{\circ} 05' N$, $0^{\circ} 09' E$). Coll 1967 and subm 1976 by A Clot, Bordères sur Echez. Assoc fauna contains a large bovine (maybe bison), a deer and a large hamster, found only once before in Middle Paleolithic site at Fontchevade, Charente. *Comment* (AC): as expected, date suggests Würm II is min so that fauna may be contemporaneous with Fontchevade site.

D. Samples from fluvial sediments

Ly-1100. Damerey, Saône et Loire 1930 ± 300

Small amount of bones from 2.5m depth in drainage ditch in La Saône R alluvium at Damerey Saône et Loire ($46^{\circ} 51' N$, $4^{\circ} 58' E$). Coll 1975 by R Fleury, Bur recherches Geol Min, Orléans, and subm 1975 by A Marcé; 1/10 very diluted sample. *Comment* (RF): younger than expected considering burial depth of bones that may have been deposited during exceptional flood of La Saône R.

Ly-1553. Source 1, Bagnols les Bains, Lozère 1490 ± 130

Wood from frame of ancient catchment of thermal waters at well called "Source 1" at Bagnols les Bains, Lozère ($44^{\circ} 30' N$, $3^{\circ} 37' E$). Coll 1977 by J J Risler, Bur recherches Geol Min Clermont-Ferrand and subm 1977 by A Marcé. Coll to determine age of 1st use of site. *Comment* (JJR): as expected, shows that catchment was 1st made during Roman time and may have been restored at end of this period.

Ly-1552. Bois de Laives, Laives, Saône et Loire 3500 ± 110

Wood from gravel quarry Le Bois de Laives, near Laives, Saône et Loire ($46^{\circ} 30' N$, $4^{\circ} 49' E$). Coll 1977 by R Fleury, and subm 1977 by A Marcé. Comes from same level as a previously dated wood: Ly-461: 5380 ± 380 (R, 1973, v 15, p 136). Level lies between fine and coarse alluvium of La Grosne R. *Comment* (RF): agrees with previous date and gives approx value to accumulation rate of vegetal horizons and alluvium in La Saône R, tributary of which is La Grosne R.

Barrage des Beaumes series, Saint-André d'Embrun Hautes Alpes

Wood from several morainic layers lying on left bank of Durance R, discovered in exploratory pit made to study dam settlement at Les Beaumes near Saint-André d'Embrun, Hautes Alpes (44° 24' N, 6° 31' E). Coll and subm 1977 by M Giafferi, Geol Dept, Electricité de France, Paris.

Ly-1584. Les Beaumes 1 **3080 ± 140**

Wood from 4.6m depth.

Ly-1585. Les Beaumes 2 **2860 ± 230**

Wood from 4.6m depth, 5/6 diluted sample.

Ly-1586. Les Beaumes 3 **2920 ± 110**

Wood from 5.6m depth.

General Comment (MG): three dates statistically yield same age and indicate rapid deposition.

Ly-1609. La Ratissou, Sablons, Isère **2880 ± 130**

Fragment of oak trunk found at 5m depth on left bank of Rhône R in main channel at Ratissou, near Sablons, Isère (45° 20' N, 4° 46' E). Coll and subm 1976 by G Chapotat, Centre recherches archeol Vienne. *Comment* (GC): dates youngest alluvium of Rhône R in site where Salaise series, below dates lowest terraces.

Villa San Maria, series, Chieti, Abruzzi, Italia

Wood from 2 levels of boring at Villa San Maria, near Chieti, Abruzzi, Italy (41° 57' N, 14° 22' E). Coll by M Spilotro and subm 1974 by G S Tazioli, Inst Geol Appl Geotech, Univ Bari.

Ly-1011. Villa San Maria A **3990 ± 120**

From 5.5m depth

Ly-1012. Villa San Maria B **5240 ± 120**

From 12.5m depth.

General Comment (GST): dates landslide phenomena that embedded woods in fluvio-lacustrine formation.

Nuovo Porto di Gioiatauro, Reggio di Calabria, Calabria, Italia

Lignite from 2 neighboring borings at Nuovo Porto di Gioiatauro, near Reggio di Calabria, Calabria, Italy (38° 28' N, 15° 55' E). Coll 1977 by A Guerichio and G Melidoro and subm 1977 by G Melidoro, Ist Geotech, Univ Bari.

Ly-1665. Nuovo Porto di Gioiatauro L **3870 ± 430**

Small amount of material from 42m depth in boring L, 1/5 diluted sample.

Ly-1666. Nuovo Porto di Gioiatauro H 4000 ± 160

From 30m depth in Boring H.

General Comment (GM): as expected, both dates yield similar Holocene age to fluvial formation in which they were embedded and show rapid sedimentation rate.

Les Vollaires series, Lazer, Hautes Alpes

Lignite from 3 levels of fluvio-lacustrine formation, outcropping on side of Le Clapier small R at Les Vollaires, near Lazer, Hautes Alpes (44° 21' N, 5° 47' E). Coll and subm by G Monjuvent, Inst Dolomieu, Grenoble. Stratigraphic series is 10m thick and has 14 layers of which 9 are lignite and 3 tufa. Pollen diagram studied by J L de Beaulieu.

Ly-1329. Les Vollaires 14 5680 ± 160

From upper layer.

Ly-1327. Les Vollaires 5 6870 ± 180

From layer in middle of tufa in central part of series.

Ly-1328. Les Vollaires 1 12,250 ± 430

From lowest layer with organic matter, 5/6 diluted sample.

General Comment (GM and JL de B): pollen diagram indicates Atlantic period for tufa embedding Ly-1627, agreeing perfectly with date. Despite their scarcity, pollen from lowest layer implies more temperate climate than generally assumed for late glacial climatic phase indicated by Ly-1328. As expected, all values attribute Late Würm or Holocene age for lowest level of glacier of Saint-Genis Mt. Date between Ly-1328 and -1327 was previously obtained in similar series made nearby in Les Barbiers small R valley, near Lazer: Ly-555: 9250 ± 190 (R, 1973, v 15, p 516). Both series assoc with slimes overlying lowest terrace of Le Buech R.

Ly-1704. La Borde, Joze, Puy de Dôme 7020 ± 180

Tree trunk interstratified in pebble formation that constitutes lowest terrace of Allier R at La Borde, near Joze, Puy de Dôme (45° 51' N, 3° 18' E) (Daugas *et al*, 1978). Coll and subm 1978 by J P Daugas, Dir Ant Préhist, Auvergne Clermont-Ferrand and J P Raynal, Inst Quat Univ, Bordeaux. *Comment* (JP and JPR): peat layer was previously found near site and dated: Sa-103: 13,500 ± 450 (R, 1965, v 7, p 241). Depth of this last sample was 14m; it was at about same relative alt above present channel of Allier R, as Ly-1704. Thus comparison of both dates supports hypothesis of Holocene tectonic up or down motions which involved recent filling and deepening phases in E part of Grande Limagne plain.

Chonas series, La Terrasse, Isère

Wood from several levels of Isère R alluvia in sand-pit at Chonas, near La Terrasse, Isère (45° 23' N, 5° 55' E). Coll 1975 by C Hanns, Inst Geog, Univ Tübingen, and F Serre and C Goeury, Lab Bot et Palynol, Univ Aix-Marseille; subm 1977 by F Serre.

Ly-1648. Chonas G II 1 1040 ± 150

Indeterminable wood with diffuse pores, from pit base, 11.5 and 8.5m below ground surface.

Ly-1649. Chonas G II 4 4970 ± 170

Fragment of *Quercus pubescens* trunk from an unknown level in pit.

Ly-1647. Chonas G II 3 11,520 ± 260

Wood (cf *Pinus sylvestris*) from same level as Ly-1648.

General Comment (FS): Ly-1647 supports unpub Heidelberg lab result: $11,850 \pm 100$ from same pit. Other results from neighboring pits also agree (Hannss, 1977). Ly-1648 shows disturbance due to quarrying, Ly-1649 fits with all other values in surrounding sites.

Ly-1319. Graffen Weiher, Engenthal, Bas Rhin 10,580 ± 270

Peaty sand from 5.2 to 5.3m depth of boring in peat bog at Graffen Weiher, near Engenthal, Bas Rhin (48° 38' N, 7° 18' E). Coll 1976 by M Menillet, Bur recherches Geol Min, Orléans, and subm 1976 by A Marcé. Pollen diagram studied by G Farjanel, Bur recherches Geol Orléans. *Comment* (GF): pollen diagram at level indicates large extension of *Betula*, decrease of *Pinus*, and may correspond to Late Dryas period as implied by date.

Aéroport Nice-Côte d'Azur series, Nice, Alpes Maritimes

Samples from 3 levels of Core S Q 613 coll by boring in Le Var R alluvia in planned extension zone of Nice-Côte d'Azur airport, near Nice, Alpes Maritimes (43° 39' N, 7° 12' E). Coll by Exploration Soc and subm by A Marcé.

Ly-1517. Nice Côte d'Azur, SQ 613, 32.7m 6750 ± 410

Small bit of charcoal from 32.7m depth, 8/30 very diluted sample.

Ly-1518. Nice Côte d'Azur, SQ 613, 67.6m 11,460 ± 520

Black clay from 67.6m depth, 1/3 diluted sample.

Ly-1519. Nice Côte d'Azur, SQ 613, 69.5m 12,760 ± 710

Black clay with some charcoal bits from 69.5m depth, 1/5 diluted sample.

General Comment (AM): despite large counting error dates make it possible to estimate rapidity of recent Var R alluviation.

Salaise sur Sanne series, Isère

Bones from alluvium of 2 terraces of Rhône R near Salaise sur Sanne, Isère. Coll 1976 by G Mabilon, Le Péage de Roussillon and subm by G Chapotat.

Ly-1689. Les Blaches, Salaise sur Sanne 14,110 ± 620

Equus femur and indeterminable humerus from ca 15 to 18m depth in Champagne terrace at Les Blaches N quarry (45° 21' N, 4° 47' E); 1/3 diluted sample.

Ly-1690. Le Stade, Salaise sur Sanne 20,370 ± 460

Fragment of *Elephas primigenius* humerus from 17m depth in Saint-Rambert d'Albon terrace at Le Stade quarry (45° 21' N, 4° 47' E).

General Comment (GC): Ly-1690 confirms -360: 18,800 ± 490 (R, 1973, v 15, p 138) from same terrace 5km upstream and assumed Late Würmian age of Saint-Rambert d'Albon terrace (David *et al*, 1972). Ly-1689 is youngest date obtained for Rhône terrace system (Chapotat *et al*, 1980).

+ 5000

Ly-1587. Le Pont de Mirabeau, Saint-Paul lès Durance, Bouches du Rhône 26,550 – 3000

Small charcoal bits found scattered in lithochrome colluvium interstratified in loess on left bank of Durance R at Pont de Mirabeau, near Saint-Paul lès Durance, Bouches du Rhône (43° 41' N, 5° 30' E). Coll and subm 1974 by P Ambert, Inst Geog, Univ Aix en Provence; 1/2 diluted sample, measurement in proportional counters. *Comment* (PA): despite large counting error, date comparable with 2 previously pub results from similar stratigraphic series at Vautubière in same region: Ly-769: 31,900 ⁺¹⁹⁰⁰ _{–1500} (R, 1975, v 17, p 9) and Ly-1002: 30,100 ⁺³⁴⁰⁰ _{–2600} (R, 1976, v 18, p 69). This agreement between 3 values makes questionable currently accepted chronology of slope deposits, which has been attributed to late interglacial in Provence (Ambert *et al*, 1974).

L'Amourette series, Mens, Isère

Woods from several level of series of torrential sediments at l'Amourette, near Mens, Isère (44° 48' N, 5° 43' E). Coll and subm 1975 by M Archambault, Inst Etudes Ligériennes, Univ Orléans. Because very old ages of samples were expected, pyrophosphate treatment was lengthened to remove contamination.

Ly-1033. L'Amourette 2 ≥36,600

From 42m depth in W part of series. Counting of only 3ml benzene.

+ 1780

Ly-1184. L'Amourette 6 43,000 – 1460

From 9m depth: counting of 10ml benzene.

+ 1860

Ly-1322. L'Amourette 5 43,800 – 1520

From 11m depth: counting of 10ml benzene.

+ 2060

Ly-1321. L'Amourette 3 45,500 – 1320

From 36m depth: counting of 10ml benzene prepared from CO₂ obtained by combustion of pyrolyzation gas.

Ly-1320. L'Amourette 3b **≥46,000**

Same as Ly-1321 but 10ml benzene from sample combustion after pyrolyzation.

General Comment (MA): compatible with pub Le Villard series (R, 1978, v 20, p 33). Should attribute Würm II age to sampled series which should be then contemporaneous with max advance of Isère glacier which formed Le Triève lake. Like Villard series, however pollen analysis indicates temperature climate which is somehow surprising during Würm II period.

Ly-1551. Forêt de Chaux, Falletans, Jura **>30,000**

Peaty lignite from 7.6m depth in boring in superficial formations of Chaux forest, near Falletans, Jura (47° 03' N, 5° 44' E). Coll 1976 by Y Kerien, Bur recherches Geol Min, Lyon, and subm 1976 by A Marcé. *Comment* (YK): as lignite horizon overlies several different formations, it might be assumed, with lack of fauna or pollen data, either very recent or coming from the Pliocene-Pleistocene limit, like other similar formations in region. Date rather supports the last hypothesis.

*E. Samples from various continental sediments***Chavannes series, La Thuile, Aosta, Italia**

Woods found in rocks falls at alt ca 1900m in Chavannes small R valley, near La Thuile, Aoste, Italy (45° 44' N, 6° 54' E). Coll 1975 by A Cerutti and subm 1976 by R Vivian, Inst Geog, Grenoble. Woods were uprooted by rock fall from Ciavaretta mt slope at ca alt 2100m. At present, very large trees cannot grow at high alts in valley. Growth period of dated trees is assumed to be before Little Glacial age, cold climatic phase that began approx in the 16th century and shifted timber line down.

Ly-1617. Chavannes 1 **170 ± 130**

Fragment of *Larix*.

Ly-1618. Chavannes 2 **450 ± 140**

Fragment of *Pinus*.

General Comment (RV): Ly-1618 agrees with hypothesis as it probably grew ca AD 1500. Ly-1617 is much younger than expected and should correspond to uplift of timber line after Little Glacial age, an hypothesis which remains very questionable.

Ly-1655. Glacier du Chardon, La Bérarde, Savoie **560 ± 120**

Fragments of tree trunk from sediments lying on Le Chardon glacier at alt 2500m at La Bérarde, near Saint-Christophe en Oisans, Savoie (44° 54' N, 6° 18' E). Coll 1976 by R Lambert and subm 1977 by R Vivian. Wood probably comes from rock falls of lateral moraine that was covered by forest before Little Glacial age. *Comment* (RV): date is ca AD 1390, ie, before beginning of last cold climatic phase. Agrees with Ly-

1618, above, and with previous measurement of another wood from front of same glacier: Ly-280: 750 ± 130 (R, 1973, v 15, p 135; Vivian, 1975).

Ly-1219. Les Eymards, Lans en Vercors, Isère 860 ± 130

Charcoal from assumed fossil soil at 150cm depth at Les Eymards near Lans en Vercors, Isère ($45^{\circ} 6' N$, $5^{\circ} 34' E$). Coll and subm 1974 by G Monjuvent. *Comment* (GM): disagrees with expected age. Despite fossil aspect and depth, soil is recent and was probably covered by superficial slope deposits.

Ly-1656. Corbassière, Fionnay, Valais, Suisse 4080 ± 150

Fragment of tree trunk from channel of Corbassière, torrent at alt 2150m, 150m downstream of tongue of Corbassière glacier, near Fionnay, Valais, Switzerland ($46^{\circ} 02' N$, $7^{\circ} 18' E$). Coll 1976 by M Willaud, Soc Forces motrices Mauvoisin, Sion, and subm by R Vivian. *Comment* (RV): although nothing is known of growth place of tree, as it was found in torrent alluvium, date aligns it with other dated tree trunks from neighboring glacier Ferpècle, such as Ly-685: 3360 ± 230 or Ly-683: 5340 ± 250 (R, 1975, v 17, p 7-8; Bezingue, 1974).

Ly-1060. Saint-Bauzile, Ardèche $>40,540$

Lignitic debris from diatomitic layer outcropping in quarry near Saint-Bauzile, Ardèche ($44^{\circ} 40' N$, $4^{\circ} 40' E$). Coll and subm 1975 by P Délétie, Geol Dept Electricité de France, Paris. Layer assoc with recent basaltic flows, 1978 K/ar dating of which gave ca 4.1 MA, and confirmed no radiocarbon activity of sample.

F. Samples from marine and lagoonal sediments

Ly-1265. Marais de la Fosse, Saint-Gilles du Gard 3820 ± 140

Shells (*Cardium edule*) picked up on surface of La Fosse coastal peat bog, near Saint-Gilles du Gard, Gard ($43^{\circ} 37' N$, $4^{\circ} 14' E$). Coll 1976 by F Bazile, Vauvert, and A L'Homer and subm 1976 by A Marcé. *Comment* (FB and AL): dates closing of presently filled lagoon in Rhône R delta and fits with 2 other results from another lagoon in delta, MC-1161: 4190 ± 70 and MC-1162: 4160 ± 100 (Bazile, 1976).

Ly-1159. Le Relais, Fos sur Mer, Bouches du Rhône 5890 ± 200

Large shells coll on offshore bar at alt $-1.5m$ at pumping sta Le Relais near Fos sur Mer, Bouches du Rhône ($43^{\circ} 28' N$, $4^{\circ} 49' E$). Coll 1976 by A L'Homer and subm 1976 by A Marcé. *Comment* (AL): as in W part of Le Rhône R delta a contemporaneous offshore bar (see, Ly-1514, below) is at alt $+1.5m$; difference between both dates shows importance of subsidence movement that occurs in central part of Rhône R delta.

Le Grau du Roi series, Hérault and Gard

Marine shells from offshore bars, approx parallel to present coast in W part of Le Rhône R delta. Coll 1977 by A L'Homer and subm 1977 by A Marcé.

Ly-1514. Le Grau du Roi 25647, Aigues-Mortes, Gard **5460 ± 160**

From youngest offshore bar, 1km W Aigues-Mortes, Gard (43° 45' N, 4° 10' E).

Ly-1512. Le Grau du Roi 25645, Le Grand Travers, Hérault **6080 ± 170**

From youngest offshore bar, between Maugio pond and sea, at Le Grand Travers (43° 44' N, 4° 03' E).

Ly-1513. Le Grau du Roi 25646, Bergerie de Haute Plage, Hérault **6660 ± 170**

From intermediate offshore bar, at La Bergerie de Haute Plage, near La Grande Motte, Hérault (43° 45' N, 4° 05' E).

Ly-1511. Le Grau du Roi 25644, Le Petit Travers, Hérault **7050 ± 190**

From oldest offshore bar between Maugio pond and sea, at Le Petit Travers, Hérault (43° 43' N, 4° 02' E).

General Comment (AL): all results agree with series of MC lab dates on shells from other sampling points on same bars between Maguelonne and Aigues-Mortes (Bazile, 1974). Both series elucidate emerging sequence of recent ages of parallel bars according to proximity to present sea coast, *ie*, land advancement in that part of Rhône delta.

Ile des Madeleines series, Sénégal

Marine shells from 2 places on small island Les Madeleines, W Dakar, Sénégal (14° 34' N, 17° 29' W). Coll and subm 1978 by P Elouard, Geol Dept, Univ Lyon.

Ly-1671. Plage de l'Ile des Madeleines **Modern**
 $\delta^{14}\text{C} = +0.5\% \pm 1.5$

Shells (*Patella safiana*) from beach at alt +2m. *Comment* (PE): proves that shells are recent storm sediments and are not sediments of assumed raised beach.

Ly-1670. Sommet de l'Ile des Madeleines **1130 ± 130**

Shells (*Thais haemastoma*) from kitchen midden at top of island. *Comment* (PE): confirms human occupation of island at same period in which kitchen midden of Le Fadiout or Le Salaun region was built (see, eg, Bangaléré series: R, 1975, v 17, p 13).

Rao and Gandon series, Sénégal

Shells (*Arca senelis*) from marine terraces near Rao (15° 56' N, 16° 26' W) and Gandon (15° 57' N, 16° 26' W) villages, near Saint-Louis,

Sénégal. Coll 1973 by J Monteillet, Saint-Louis, and subm 1978 by P Elouard. Measurements made to complete previously pub results (R, 1976, v 18, p 69; Monteillet, 1974).

Ly-1344. Rao R I A **4220 ± 160**

Ly-1347. Rao R I E **4580 ± 520**

4/30 very diluted sample because of accidental loss of most of the sample.

Ly-1346. Gandon G I C **5200 ± 210**

2/3 diluted sample.

Ly-1345. Gandon G I A **5670 ± 240**

1/2 diluted sample.

General Comment (PE): Ly-1344 and -1345 come from level that marks small transgressive oscillation during general regression following max of Nouakchottian transgression. They both confirm Ly-982: 4670 ± 120 and Ly-986: 4720 ± 140 . Ly-1345 and -1346 mark max of Nouakchottian transgression and agree with previous dates for same event on same site Ly-983: 5250 ± 120 , Ly-985: 5650 ± 150 and Ly-987: 5590 ± 140 and on numerous sites of W African coast (Elouard, 1968).

Côte de l'Angola series, Angola

Shells from marine terraces, lying behind present shore and attributed to Nouakchottian transgression, ca 6000 BP, because of alt and fauna. Coll 1974 by P Giresse and M Kouyoummtzakis, Univ Brazzaville, Congo, and subm 1975 by P Elouard.

Ly-1271. Estrada de Catumbela G K AN 1/47b **28,600** **+ 1300**
- 1140

Shells (*Arca senclis*) from 7 to 10m alt on Catumbela rd side (12° 28' S, 13° 35' E).

Ly-1273. Baia de Azal G K AN 2/57 **29,300** **+ 1700**
- 1400

Shells (*Arca senclis*, *Typonatinus fuscatus*), from 10 to 12m alt on Azal beach (12° 38' S, 13° 15' E).

Ly-1272. Estrada da Baia des Pipas G K AN 2/40 **≥31,400**

Shells (*Cardium rigens*) from 15m alt on Pipas beach rd (15° 07' S, 12° 12' E).

General Comment (PE): series does not confirm expected Holocene age and indicates that terraces were probably formed during Inchirian transgression, ca 30,000 BP (Elouard & Faure, 1967).

II. ARCHAEOLOGIC SAMPLES

A. Historic and Protohistoric periods

Ly-1581. Saint-Cyr sur Rhône, Rhône **820 ± 100**

Skull from Grave 2 of an ancient cemetery, Saint-Cyr sur Rhône (45° 31' N, 4° 50' E); coll and subm 1976 by G Chapotat. No assoc industry was found in grave which was dug in loess and surrounded by stones. *Comment* (GC): any age was expected; date shows that cemetery was used during Middle Age.

Ly-1626. Le Pusmin, Sarzeau, Morbihan **1250 ± 150**

Fragment of a wooden beam from stud-work of ground level of Medieval house at Le Pusmin, near Sarzeau, Morbihan (47° 31' N, 2° 48' W). Coll and subm 1977 by P Gévin, Dept Geol, Univ Lyon. 9/10 diluted sample. *Comment* (PG): 1st story of house has large windows and is precisely dated by inscription on beam from AD 1568. Ly-1626 shows that lowest part of house with windows was built during Early Middle Age, agreeing with architectural style of popular houses from this period.

Ly-1667. Cimetière des Chouennes, Brens, Ain **1340 ± 240**

Human bones from ancient cemetery, "Burgonde", constituted of sepultures with small flag-stones at Les Chouennes, near Brens, Ain (45° 42' N, 5° 41' E). Coll and subm 1977 by R Vilain; Dept Geol, Univ Lyon. Bones lay in sandy sediment exposed to leaching by meteoric waters. Organic matter was badly preserved and samples were too diluted to be counted in small proportional detectors. *Comment* (RV): date, ca 4th to 6th century, agrees with expected range of dates for such "Burgonde" cemetery.

Ly-1580. Sainte-Blandine, Vienne, Isère **1720 ± 110**

Human skull from ca 2m depth in alluvia at foot of Sainte-Blandine hill at Vienne, Isère (45° 31' N, 4° 53' E). Coll 1972 by M Eynaud and subm 1976 by G Chapotat, Centre Recherches Archeol, Vienne. *Comment* (GC): as bones were found near La Tène III site, expected age was 50 BC. Date rather indicates end of Roman period, during which boundary of Roman town was very close to sampling site.

Ly-1410. Grigny RH 83, Rhône **2250 ± 120**

Fragment of wooden (*Pinus picea*) handle of iron object, presumably a ploughshare, dredged from Rhône R at Grigny, Rhône (45° 36' N, 4° 47' E). Coll 1972 and subm 1977 by G Chapotat. *Comment* (GC): agrees with other measurements from similar wooden handles of metal objects from same site (R, 1976, v 18, p 71) ranging from Middle Bronze to La Tène III periods (Chapotat *et al*, 1978).

Agay and Bataignerseries, Var and Alpes Maritimes series

Human bones found on sea bottom, very close to 2 wrecks submerged near Mediterranean seashore. Artifacts assoc with wrecks date

from ca AD 950 (Arnaud *et al*, 1978). Subm 1977 by G and S Arnaud, Paleo-anthropology Lab, Draguignan.

Ly-1469. Agay, Var 1790 $\pm$ 110

From -50m alt, in Agay bay, near Agay, Var (43° 26' N, 6° 51' E). Coll 1968 by A Visquis.

Ly-1471. Bataigner B, Cannes, Alpes Maritimes 1390 $\pm$ 300

From -54m alt, 500m E Sainte-Marguerite I. in Napoule bay near Cannes, Alpes Maritimes (43° 31' N, 7° 01' E). Coll 1974 by J P Joncheray; 5/6 diluted sample.

Ly-1472. Bataigner C, Cannes, Alpes Maritimes 1350 $\pm$ 150

From another skeleton from same location as Ly-1471.

General Comment (GA & SA): younger than expected by artifacts assoc with wrecks. Relationship between skeletons and ships is not well established, as many shipwrecks occurred in region for 2 millennia.

Ly-1625. Le Parc, Yzeron, Rhône 1700 $\pm$ 200

Charcoal fragment from shallow ashy layer in meadow at Le Parc, near Yzeron, Rhône (45° 43' N, 4° 36' E). Coll and subm 1977 by L Jeancolas, Tassin. 1/3 diluted sample. Site is shallow circular mound presumably starting point of Roman aqueduct supplying "Lugdunum", Roman city of Lyon. *Comment*: despite uncertainty, date confirms hypothesis of aqueduct origin.

Ly-1657. Saré Diouldé, IFAN 123, Koussanar, Sénégal 430 $\pm$ 130

Charcoal from 0.5m depth under top of stoney funeral tumulus at Saré Diouldé Koussanar Dist, Sénégal (14° 7' N, 13° 50' W). Coll 1977 by G Thilmans and subm 1977 by C Descamps, Inst Fondamental Afrique Noire, Dakar. This Megalithic Senegambian monument included ca 20 burials with only a few potsherds. *Comment* (CD): Senegambian megaliths are found in 3 regions. Date proves that those from E region are much younger than those from central (Tiekene Boussoura, Ly-1343, below) or W (Sine Ngayène, Dak-201: 867 $\pm$ 117; R, 1977, v 19, p 161) regions.

Ly-1343. Tiekene-Boussoura, IFAN 109, Koupentoum, Sénégal 1160 $\pm$ 220

Powder of black potsherds from 1m depth in Megalithic Circle 4 of Tiekene-Boussoura site, Koupentoum Dist, Sénégal (14° 00' N, 14° 35' W). Coll 1975 by G Thilmans and subm 1976 by C Descamps (Thilmans & Descamps, 1975). 1.2kg of potsherds were powdered and burned to get 2/3 diluted sample. *Comment* (CD): agrees with other results from similar monuments at Kodian site: Dak-41: 1356 $\pm$ 126; Dak-54: 1212 $\pm$ 125; at Wassu site, Dak-2: 1200 $\pm$ 110 (Thilmans & Descamps, 1974).

Koumbi Saleh series, Timbedra, Mauritania

Charcoal from several different places in Koumbi Saleh archaeol site, 55km NE Timbedra, Mauritania (15° 46' N, 7° 59' W). Site is prob-

ably one of former capitals of ancient empire of Ghana (7th to 19th centuries). Site was excavated several times since 1913. Samples come from last excavation period (1975, 1976). Excavations were directed by S Robert, Inst Mauritanien recherches Sci, Nouakchott, helped by A Cross, French Center of French Embassy, Libreville; and S Berthier, Hist Dept, Univ Lyon II. SB I and SB II refs indicate samples from 2 neighboring excavations in 1975 and 1976 by S Berthier in SE part of town, near an old mosque. S Robert excavated here in 1975 and 1976 and got samples with SR II and SR III refs. Occupation of Koumbi Saleh site seems to have been continuous for at least 7 centuries, from about end of 7th century to 15th century. Stratigraphy of site could be divided in 3 important periods, each comprising 2 to 4 levels. Period of Levels I a/b may correspond to ancient pre-urban or to 1st urban occupation from 7th to 9th centuries; period of Levels II a/b corresponds to 1st important city from beginning of 9th to 12th centuries; period of Levels III a/b/c/d correspond to most recent occupation with recently well-preserved walls and house from 12th to 15th centuries.

Ly-1525. Koumbi Saleh SB I 56	440 ± 180
From 335cm depth, Level III/c; 1/2 diluted sample.	
Ly-1524. SB I 48	550 ± 230
From 350cm depth, Level III/c; 1/5 diluted sample.	
Ly-1526. SB I 73	860 ± 210
From 410cm depth, Level III/b; 1/3 diluted sample.	
Ly-1520. SB I 95	590 ± 120
From 465cm depth, Level III/a.	
Ly-1521. SB II 15	230 ± 120
From 255/260cm depth, Level III/d.	
Ly-1341. SB II 46	1000 ± 150
From 395/400cm, Level III/b; 1/2 diluted sample.	
Ly-1523. SR II 39	500 ± 110
From 340/350cm depth, Level III/c.	
Ly-1522. SR II 40	500 ± 120
From 340/350cm depth, Level III/c.	
Ly-1610. SR II 41a	1400 ± 160
From 350cm depth, Level III/c; 5/6 diluted sample.	
Ly-1792. SR II 41b	1280 ± 150
From 350cm depth, Level III/c.	
Repeat of previous sample. Average of both 1340 ± 100.	
Ly-1612. SR III 163	940 ± 120
From 290cm depth, Level III b/c.	

Ly-1615. SR III 177 **980 ± 130**

From 340cm depth, Level III/b.

Ly-1613. SR III 165 **1210 ± 140**

From 360cm depth, Level III a/b.

Ly-1614. SR III 170 **540 ± 120**

From 355/360cm depth, Level III/b.

Ly-1616. SR III 196 **1290 ± 130**

From 620/650cm depth, Level I/c-II/a.

Ly-1611. SR III 152 **870 ± 120**

From 630cm depth, Level Ib/II/a.

General Comment (SR): most results from excavation SB I, SB II and SR III (except Ly-1521, -1610, -1792) seem to connect hypothetical stratigraphy (Berthier, 1978) and previous measurements: Dak-156: 981 ± 114 and Dak-157: 1122 ± 125 from Level Ia in 1972 excavation by A Cros and S Robert (R, 1977, v 19, p 162). Two results appear older than previously imagined: Ly-1526 and -1341. Ly-1792 check does not confirm eventual inversion between Ly-1611 and -1610 which was believed would explain discrepancy of both results. From excavation SR III only Ly-1611 and -1614 seem to conform obviously to other investigations. The other 4 dates seem too old without precise importance of divergence, particularly between Ly-1612 and -1615, for unknown reason (D Robert & S Robert, 1979).

Kandiama series, Velingara, Sénégal

Charcoal from several places in Kandiama site, Velingara Dist, Sénégal (13° 10' N, 13° 51' W). Coll and subm by J Girard, Univ Lyon. This enigmatic site is system of shallow intersecting galleries, filled by secondary lateritic sediments.

Ly-1312. Kandiama 2 **Modern**

$\delta^{14}\text{C} = -1.7\% \pm 2.1$

From base of gallery alpha. 5/6 diluted sample. Coll and subm 1976.

Ly-1313. Kandiama 3 **Modern**

$\delta^{14}\text{C} = -2.0\% \pm 1.7$

From inside filling of gallery alpha. Coll and subm 1976.

Ly-1156. Kandiama 1 **1540 ± 180**

From gallery 5m deep. 1/2 diluted sample. Coll and subm 1975.

Ly-1780. Kandiama C **490 ± 160**

From base of filling of C gallery. Coll and subm 1978

Ly-1781. Kandiama C' **1050 ± 170**

From base of inside filling of C' Gallery. Coll and subm 1978.

Ly-1782. Kandiana C'' 1310 ± 380

From base or inside filling of C'' gallery. 1/4 diluted sample counted in proportional detector. Coll and subm 1978.

General Comment (JG): Ly-1312, -1313, and -1780 prove that secondary materials entered galleries before and after excavations. Ly-1781, -1782, and -1156 agree with expected age, as oral tradition since 11th century mentions gallery habitation in region.

Ly-1604. Santourin, Billième, Savoie 2240 ± 260

Small bits of charcoal from 4 places in archeol layer with poor ceramic industry. At 1.7m depth near Megalithic monument (Lagier-Bruno, 1973), called "La Pierre de Santourin" at Santourin, near Billième, Savoie (45° 48' N, 5° 23' E). Coll 1975 and 1976 by L Lagier-Bruno, Yenne. *Comment* (LLB): indicates La Tène period and supports attribution of layer to temporary settlement of sheep-fold on site, which is, thus, independent of Megalithic monument.

Ly-1573. Vallée des Reines, Luxor, Egypt 2490 ± 250

Fragment of human mummy from ancient excavation in Les Reines valley near Luxor, Egypt (25° 41' N, 32° 28' E). Coll 1976 and subm 1977 by R Laurent, Villeurbanne. *Comment* (RL): despite poor preservation conditions and unscientific collection procedures, date proves mummy is authentic and may come from Late Empire epoch.

Dikili Tash series, Krinides, Kavala, Greece

Charcoal from several levels of Dikili Tash site, near Krinides, Kavala province, Greece (41° 00' N, 24° 40' E). Coll and subm by J Deshayes, Univ Paris I.

Ly-1306. Dikili Tash C 75-2 2870 ± 370

From Soil 2 in Boring B'C'. Coll and subm 1975; assoc with Late Bronze industry. Expected age: 1500 bc. Very, 8/30, diluted sample.

Ly-1063. Dikili Tash C 74-6 3430 ± 120

From 1.5m depth under remains of fallen Late Bronze wall. Coll and subm 1974. Expected age: ca 1500 bc.

Ly-1304. Dikili Tash C 75-6 2370 ± 230

From Soil 3 in Boring A'B'. Coll and subm 1975; assoc with industry attributed to end of Troie I culture. Expected age: ca 2500 bc; 2/3 diluted sample.

Ly-1305. Dikili Tash C 75-7 5030 ± 160

From Soil 3 in Boring P 24. Coll and subm 1975, assoc with industries attributed to end of Troie I culture. Expected age: ca 2500 bc.

Ly-1061. Dikili Tash C 74-1 6480 ± 270

From soil at 1m depth. Coll and subm 1974. Assoc with industry of "Baden" culture. Expected age: ca 3000 bc; 1/3 diluted sample.

Ly-1602. Dikili Tash C 74-2 3700 ± 230

From same soil as Ly-1061. Coll and subm 1975; 1/3 diluted sample. Measurement in proportional detector.

Ly-1064. Dikili Tash C 74-7 6040 ± 120

From ditch at 1.75m depth. Coll and subm 1974; assoc with some Chalcolithic potsherds. Expected age: 3500 BC or Expected age if from the beginning of Late Bronze level :3000 BC.

Ly-1062. Dikili Tash C 74-5 6100 ± 200

From soil at 1.85m depth. Coll and subm 1974, assoc with end of Chalcolithic industry. Expected age may agree with 2 unpub Gif dates: Gif-1425: 5750 ± 140 and Gif-1738: 5600 ± 150. 2/3 diluted sample.

General Comment (JD): most results do not fit expected ages, especially Ly-1304 and -1602, which are much too young. Ly-1061 is much too old and does not agree with strat order, for unknown reason. Ly-1063 shows that Level 2 of site belongs to Late Bronze period, as confirmed by further excavations. Even taking into account its large statistical margin, Ly-1306 inexplicably remains younger than Ly-1063. Ly-1305 is a little older than 6 unpub Pennsylvania lab results: P-917-923: 2300 to 2450 BC. Ly-1064 demonstrates that the ditch is Chalcolithic and is a little older than previous results and Ly-1062.

Pirak series, Baluchistan, Pakistan

Charcoal from several levels of tell, 9m high, at Pirak, near Sibi, Baluchistan, Pakistan (29° 30' N, 67° 54' E). Coll by French Archaeol Mission of Indus; subm 1978 by J F Jarrige, Guimet Mus Paris (Jarrige & Enault, 1976).

Ly-1644. Pirak 5 1800 ± 170

From Layer 3 at 1.5m depth, Sq 3-O, Loc 88. Coll 1974. Assoc with mixed industry from Bronze and Iron ages Expected age: ca 900 BC.

Ly-1643. Pirak 4 2970 ± 140

From Layer 8 at 2.5m depth, Sq 4-L, Loc 84. Coll 1974. Assoc with industry from beginning of Iron age. Expected age: ca 1000 BC.

Ly-1642. Pirak 3 3150 ± 150

From Layer 34 at 6m depth, Sq 3-I. Coll 1971. Assoc with industry from end of Bronze age. Expected age: ca 1400 BC.

Ly-1641. Pirak 2 4080 ± 290

Form Layer 39N at 8m depth and 1m above present plain level, Sq 3-I. Coll 1973. Assoc with Bronze age industry. Expected age: ca 1450 BC. 1/2 diluted sample.

Ly-1640. Pirak 1 3410 ± 140

From Layer 40 at 9m depth and at present plain level, Sq 3-I, Loc 73. Coll 1973. Assoc with Bronze age industry. Expected age: ca 1550 BC.

General Comment (JFJ): Ly-1644 is much younger than expected which may be due to contamination by recent roots or deep burrow holes in upper levels of tell. Ly-1641 is too old either because of statistical variation, or, more probably, because of intrusion of ashes from older occupation level, presently almost completely eroded. Three other results agree with expected values.

Ly-1409. La Madeleine des Albis, Penne, Tarn 890 ± 180

Charcoal from a hearth at 0.25m depth in large room of La Madeleine grotto near Penne, Tarn (44° 05' N, 1° 43' E). Coll 1976 by H Bessac and subm by J Lautier, Albi. Assoc with mixed industries from several epochs of Bronze age period. *Comment* (JL): proves that sediment probably was redeposited in Middle age, as confirmed later by discovery of potsherds from AD era, in site border.

Ly-1566. Hohlandsberg 76 L II, Wintzenheim, Haut-Rhin 3290 ± 150

Charcoal from soil at 0.8m depth in alt habitat at Hohlandsberg, near Wintzenheim, Haut-Rhin (48° 02' N, 7° 11' E). Coll and subm 1976 by S Plouin, Ingersheim. Industries found at site are attributed to Late Bronze II and III periods, but exact assoc of sample with either of these periods is uncertain. *Comment* (SP): dates occupation soil from early period: Late Bronze II agrees closely with Gsy-85: 3215 ± 150 (R, 1966, v 8, p 132) from another Late Bronze II site at Cronenbourg, Bas-Rhin. However, both dates are a little older than expected according to generally accepted chronology of Bronze age in region.

Ouroux series, Ouroux sur Saône, Saône et Loire

Samples from homogeneous archaeol level which is fire destroyed dwelling of riverside site of Ouroux, near Ouroux-sur-Saône, Saône et Loire (46° 43' N, 4° 56' N). As site is presently submerged in La Saône R, sample was coll 1973 by dredging and subm by L Bonnamour, Denon Mus, Châlon sur Saône. Late Bronze IIIb industry gives expected date ca 750 BC (Bonnamour, 1974).

Ly-1025. Ouroux, 38/52 3110 ± 110
Charred wood, from beam; subm 1974.

Ly-1570. Ouroux 1 2720 ± 150
Charcoal from twigs; subm 1976.

Ly-1571. Ouroux 2 2710 ± 130
Charred twigs; subm 1976.

General Comment (LB): very old date of Ly-1025 is probably due to age of beam when used for dwelling construction. Dates from twigs agree perfectly with expected age.

*B. Neolithic period***Ly-1624. La Côte de Bar, Saint-Mihiel, Meuse 3770 ± 230**

Charcoal from upper level of Boring M2 in Shaft 2 at 1 end of Neolithic flint mine at La Côte de Bar, near Saint-Mihiel, Meuse (48° 48' N, 5° 31' E). Coll 1976 by V Blouet and subm 1977 by C Guillaume, Dir Antiquités Préhist, Lorraine, Metz. Assoc with a Neolithic industry (may be Seine-Oise-Marne), 9/10 diluted sample *Comment* (CG): at other end of mine, 2 structures were previously dated: Ny-285: 4170 ± 70 (R, 1974, v 16, p 122) and MC-573: 4060 ± 50 (unpub). Three dates, even with their maximal statistical margins, prove that mining lasted for only a short time (Guillaume, 1974).

Le Trou des Fées series, Bayonville sur Mad, Meurthe et Moselle

Charcoal from 1 level in Neolithic sepulchral grotto Le Trou des Fées, near Bayonville sur Mad, Meurthe et Moselle (49° 01' N, 5° 58' E). Coll by V Blouet and subm 1977 by C Guillaume.

Ly-1622. Bayonville sur Mad, 1/76 4170 ± 200

From Pit X2. Coll 1976; 3/5 diluted sample.

Ly-1623. Bayonville sur Mad, 1/77 4280 ± 150

From Hearth 3, in W gallery. Coll 1977.

General Comment (CG): both dates are very close to each other and agree with expected age for this type of Late Neolithic monument. In nearby Noveant sur Moselle site, 2 sepultures assoc with same industry were dated by Nancy at 4520 ± 70 (unpub) for Sepulture 2 and Ny-297: 4140 ± 70 for Sepulture 1 (Guillaume, 1978).

Conjux series, Savoie

Wood from several levels of lake margin site, discovered in boring lake sediments in N part of Le Bourget lake, at Conjux, Savoie (45° 47' N, 5° 49' E). Coll 1975 by R Castel, Aix les Bains, and subm 1975 by R Laurent, Villeurbanne. Boring showed 2 intact superimposed occupation levels, in sta to S and separated from formerly excavated lake margin site.

Ly-1326. Conjux 4 2870 ± 140

Fragment of pile from house of upper level at 0.6m depth.

Ly-1325. Conjux 3 3820 ± 140

Fragment of pile from house of lower level at 1.5m depth.

Ly-1324. Conjux 2 3970 ± 140

Fragment of tree branches from partition between 2 piles of house of lower level at 1.9m depth.

Ly-1323. Conjux 1 3970 ± 140

Fragment of wooden joist sustaining floor of house of lower level at 1.9m depth.

General Comment (RL): agrees with expected ages, indicating that upper level is contemporaneous with Late Bronze neighboring coastal sta of Chatillon, near Chindrieux, in same N part of Le Bourget lake, eg, Ly-18: 2730 ± 160 (R, 1969, v 11, p 114). Three other results are very close to each other and make lower level contemporaneous with Chalcolithic coastal sta lying in S part of lake at Meymart and dated by Ly-190: 4060 ± 120 (R, 1975, v 17, p 57).

La Jonquière series, Foissac, Aveyron

Samples from several places in La Jonquière grotto, near Foissac, Aveyron ($44^{\circ} 30' N$, $2^{\circ} 01' E$). Subm 1975 by J Clottes, Dir Antiquités préhist Midi-Pyrénées, Foix (Clottes, 1976).

Ly-1221. La Jonquière, habitation 3950 $\pm$ 130

Charcoal from surface sediment near Late Chalcolithic habitation. Coll 1972 by M Lorblanchet and L Genot.

Ly-1592. La Jonquière, Squelette 4050 $\pm$ 600

Bits of charcoal underlying human skeleton without assoc industry but assumed contemporaneous with Chalcolithic habitation. Coll 1975 by P Soleihavoup; 1/4 diluted sample measured in proportional detector.

Ly-1593. La Jonquière, couches colonnes 3930 $\pm$ 410

Charcoal from zone between sepulture and habitation. Coll 1975 by P Soleihavoup; 2/5 diluted sample.

General Comment (JC): despite large statistical margins due to scarcity of material, dates are very close. They show that all archaeol remains in grotto are contemporaneous and from same epoch as the one dated Chalcolithic site in Quercy region: Les Grèzes tumulus near Souillac, Lot: Ly-895: 3910 ± 100 (R, 1976, v 18, p 73).

Le Fournet series, Montmaur, Drôme

Samples from several levels in Neolithic sepulchral grotto Le Fournet, near Montmaur, Drôme ($44^{\circ} 41' N$, $5^{\circ} 20' E$). Coll 1966 by A Hérítier and subm by A Cogoluènes Geol Dept Univ Lyon (Anthony, 1914).

Ly-1733. Le Fournet 4 3950 $\pm$ 180

Splinters of human bones from several sqs at base of grotto; subm 1978.

Ly-1178. Le Fournet 1 4140 $\pm$ 190

Human tibia from Sq 1/2 at base of grotto. Subm 1975; 2/3 diluted sample.

Ly-1302. Le Fournet 2 4570 $\pm$ 140

Charcoal from Sq 10 at middle of grotto. Subm 1975.

Ly-1407. Le Fournet 3 4720 $\pm$ 200

Human tibia from Sq 14 in lowest layer at base of grotto. Subm 1976. 4/30 very diluted sample but very long measurement.

General Comment (AC): series shows sepulchral grotto were used for 2 periods: one period ca 4600 BP may be contemporaneous with Chassean habitation found in grotto nearby, the other period ca 4000 BP during Chalcolithic, assumed from industry assoc with bones. Anthropologic study seems to confirm 2 different populations (Cogoluënhes, 1979).

Ly-1659. Les Sarrasins, 68, Seyssinet-Pariset, Isère 4630 ± 290

Charcoal from hearth in Layer 10, Sq B-1, in Les Serrasins grotto, near Seyssinet-Pariset, Isère (45° 10' N, 5° 41' E). Coll 1976 and subm 1977 by A Bocquet Dolomieu Inst, Grenoble. Assoc with Late Neolithic ceramic industry. Pollen diagram indicates major deforestation caused by human activity. *Comment* (AB): confirms Late Neolithic attribution to industry and its contemporaneity with lake margin site of Conjux (above). Three dates from younger layer in site were previously pub (R, 1971, v 13, p 55; R, 1973, v 15, p 52).

Ly-1588. La Roche Dumas, Arsac en Velay, Haute-Loire 5120 ± 320

Bits of charcoal from Level 3b in La Roche Dumas site, near Arsac en Velay, Haute-Loire (44° 59' N, 3° 56' E). Coll and subm 1974 by A Crémillieux, Le Monastier sur Gazeille. Assoc crude industry which may be attributed to Chassean culture with respect to another more characteristic industry occurring nearby. 1/2 diluted sample counted in proportional detectors. *Comment* (AC): sample confirms Middle Neolithic attribution and is similar to Ly-1549, below, from neighboring Le Chambon site (Cremillieux, 1974).

Ly-1549. Le Chambon, Goudet, Haute-Loire 5160 ± 250

Charcoal from 0.6m depth in base of Chassean hut of Le Chambon site, near Goudet, Haute-Loire (44° 50' N, 3° 55' E). Coll and subm 1976 by A Crémillieux. 2/5 diluted sample counted in proportional detectors. *Comment* (AC): together with Ly-1588, above, dates Chassean of Velay region, despite isolated geog position, from about same epoch as other Chassean industries of France.

Le Camp de César series, La Grotte, Cher

Samples from 2 levels of Le Camp de César site, near La Grotte, Cher (46° 42' N, 2° 31' E). Subm 1977 by J Allain, Dir Antiquités préhist Centre, Bourges. Site is prehistoric camp of barred spur type, isolated from plateau by front rampart, excavation of which proved was continuously occupied from Chassean period (Ly-1515) to Christian era. During beginning of Iron age, rampart was around whole spur as shown by Boring 16 (Ly-1516).

Ly-1516. Camp de César, Sondage 16 1850 ± 200

Charcoal from 1.8m depth in burned layer at base of circular Iron age rampart. Coll 1968 by J Allain. 5/6 diluted sample. *Comment* (JA): date is ca 600 yr too young; sample polluted by roots.

Ly-1515. Camps de César, fosse 5000 $\pm$ 170

Bones from ditch underlying front rampart and belonging to oldest outworks system. Assoc with pure Chassean industry of Bourgogne type. Coll 1974 by M Vannier, Saint-Amand-Montrond. *Comment* (JA): fits in expected chronologic margins of Les Ponts site (Eure et Loir): Gif: 2774: 4550 ± 130 , Gif-2772: 4790 ± 130 and Gif-2773: 4860 ± 130 (Haricot, 1978).

Ly-1350. Buderfeld, Uckange, Moselle 2100 $\pm$ 150

Charcoal from 1.2m depth in Ditch C of Danubian Rubané-récent site Buderfeld near Uckange, Moselle ($49^{\circ} 17' N$, $6^{\circ} 08' E$). Coll 1975 by V Blouet and subm 1976 by C Guillaume. Site is row of ditches with lineal Rubané-Récent industry of rough or decorated potsherds (Lepape, 1970). *Comment* (CG): by comparison of German sites with similar industry, expected age was ca 4000 bc. Date is much younger and may be explained by fact that sampling was made only some days after opening of ditch, and may have been contaminated.

Bougon series, Deux-Sèvres

Human bones from lowest archaeol level of funerary room of Neolithic Megalithic necropolis of Bougon (Deux-Sèvres) ($46^{\circ} 21' N$, $0^{\circ} 11' W$). Coll and subm 1977 by J P Mohen, Mus Antiquités Nath, Saint-Germain en Laye. Funerary room is round dolmen with stony corridor buried in cairn and assoc with Tumulus F (Mohen, 1973).

Ly-1699. Bougon, Tumulus FO, Sud 5480 $\pm$ 170

Fragment of several bones from S part of room.

Ly-1700. Bougon, Tumulus FO, Nord 5830 $\pm$ 140

Femur from N part of room.

General Comment (JPM): 3 results were previously obtained from site which was occupied for 1500 yr, divided in 4 phases (R, 1976, v 18, p 74-75): Phase I, the oldest, has not been precisely dated, Phase II occurred in Tumulus E (Ly-966: 5800 ± 230) which fits with Ly-1700 from Tumulus F, while Ly-1699 should mark end of this phase. Phase III corresponds to Chassean industry dated in Tumulus F2 by Ly-967: 4790 ± 200 and lately, during Phase IV, monument was reused by Charente-Vienne people also dated in Tumulus F2 by Ly-968: 4470 ± 230 (Mohen, 1977).

Schamli series, Reichtett, Bas-Rhin

Charcoal from 3 ditches of open-air Neolithic site Schamli near Reichtett, Bas-Rhin ($48^{\circ} 38' N$, $7^{\circ} 45' E$). Coll 1976 by J Sainty and subm 1976 by A Thevenin, Dir Antiquités préhist Alsace, Strasbourg.

Ly-1567. Reichtett, Fosse 146 5930 $\pm$ 250

From ditch containing industry of Michelsberg style, assumed younger than neighboring Vendenheim site: Ly-866: 4870 ± 110 (R, 1976, v 18, p 72) assoc with pottery of Lingolsheim group. 1/3 diluted sample.

Ly-1568. Reichtett, Fosse 107 6420 ± 230

From ditch containing industry of Rubané Récent style, assumed younger than Rubané Ancien level in site. Previously dated using fossil pitch: Ly-865: 5940 ± 140 (R, 1976, v 18, p 76). 2/3 diluted sample.

Ly-1569. Reichtett, Fosse 75 6870 ± 260

From ditch with same industry as Ly-1568. 1/2 diluted sample.

General Comment (AT): large statistical errors are due to scarcity of carbon available after basic dissolution which solubilized most of sample. Despite this, dates are very consistent with each other but do not fit with expected ages. Discrepancy may be explained by long continuous occupation of site where many ditches were dug in loess to make house walls in wattle (Thevenin *et al*, 1977), so that ditches might have been used several times and industries of different ages might be mixed.

Ly-1621. Schwindratzeim, Bas-Rhin 6230 ± 300

Charcoal from ditch in open air habitation site at Le Village near Schwindratzeim, Bas-Rhin (48° 45' N, 7° 36' E). Coll 1975 by F Wendling and subm 1977 by A Thevenin. Assoc with Rubané Récent industry. Strong dilution in basic treatment involving 1/3 diluted sample. *Comment* (AT): despite large statistical margin, date should confirm assumed age of Rubané Récent industry. Contrary to Reichtett site, only 1 occupation period occurred in site (Thévenin, 1976).

*C. Mesolithic and Epipaleolithic periods***Ly-1668. Sous Balme, Culoz, Ain 8640 ± 380**

Human bones assoc with Sauveterrian industry, from sepulture dug in thick ashy layer containing same industry in W part, called "Abri", of Sous Balme site, at Culoz, Ain (45° 5' N, 5° 47' E). Coll 1959 and subm 1977 by R Vilain, Dept Geol, Univ Lyon; 2/5 diluted sample *Comment* (RV): in statistical range of Ly-286: 9150 ± 160 (R, 1973, v 15, p 142) from charcoal of ashy layer. Date proves that sepulture marks end of rockshelter occupation.

La Borie del Rey series, Blanquefort, Lot et Garonne

Bones from 2 levels in La Borie del Rey grotto, near Blanquefort, Lot et Garonne (44° 36' N, 0° 58' E). Coll 1973, subm 1977 by J M Le Tensorer, Inst Géodynamique, Univ Bordeaux. Site was formerly excavated by L Coulonges (1963).

Ly-1402. La Borie del Rey, Couche 3 9870 ± 320

From Layer 3 (= Coulonges' Layer 4) assoc with Epi-Azilian industry with microliths, called "Epilaborian". Sedimentologic analyses indicate cool followed by temperate climate; 2/3 diluted sample.

Ly-1401. La Borie del Rey, Couche 5 10,350 ± 340

From Layer 5 (= Coulonges' Layer 3) assoc with peculiar Azilian industry, called "Laborian". Sedimentologic analyses indicate cold and

fairly humid climate suggesting middle of Late Dryas period; 2/3 diluted sample.

General Comment (JM LT): both dates are consistent with each other. They fit in range of dates expected by Late Dryas attribution of levels given by sediment studies and absence of reindeer in assoc fauna (Le Tensorer, 1979).

Chez-Jugie series, Cosnac, Corrèze

Charcoal from several levels and loci in Chez-Jugie rockshelter near Cosnac Corrèze (45° 07' N, 1° 36' E). Coll and subm by G Mazière, Dir Antiquités Préhist Limousin, Limoges and JP Raynal, Inst Quaternaire, Univ Bordeaux. Rockshelter is in sandstone cliff. Erosion has caused loose sand in which small bits of charcoal are scattered. As pH of sediment varies between 4 and 6, bone remains were too small to be used for dating. Charcoal samples were used despite scarcity of material after treatment and risks of contamination by roots, rootlets, and burrows. Assoc industry suggests 2 occupation periods: Sauveterrian in Layer 3 and Azilian in Layer 5 (Mazière, 1978; Mazière & Raynal, 1978).

Ly-1330. Chez-Jugie, I 1890 ± 200

From base of Layer 2, Sq J-III, underlying microlithic industry with Le Martinet trapezoïds. Coll 1975 and subm 1976. Assumed contamination. 1/5 diluted sample.

Ly-1395. Chez-Jugie, V 4540 ± 200

From top of Layer 3, Sq I-IV. Coll 1974 and subm 1977. Assoc with industry, probably redeposited, with Le Martinet trapezoïds. 1/2 diluted sample.

Ly-1600. Chez-Jugie, IV 7010 ± 430

From upper part of Layer 3, Sq H-III, assoc Sauveterrian industry. Coll 1974 and subm 1977. 1/3 diluted sample counted in proportional detectors.

Ly-1396. Chez-Jugie, III 7060 ± 140

From upper part of Layer 3, Sq H-III. Coll 1975 and subm 1977. Assoc with Sauveterrian industry with trapezoïds.

Ly-1652. Chez-Jugie, XV 8080 ± 280

From middle of Layer 3, Sq H-III and H-IV. Coll 1977 and subm 1978. Assoc with Sauveterrian industry with micro-triangles. 23/30 diluted sample.

Ly-1331. Chez-Jugie, II 8040 ± 260

From middle of Layer 3, Sq H-III. Coll 1975 and subm 1976. Assoc with Sauveterrian industry with micro-triangles. 2/3 diluted sample.

Ly-1651. Chez-Jugie, XIV 7650 ± 510

From base of Layer 3, Sq I-IV. Coll 1977 and subm 1978. Assoc with Sauveterrian industry with micro-triangles. 1/2 diluted sample counted in proportional detectors.

Ly-1572. Chez-Jugie, XII 11,840 ± 580

From whole Layer 5, Sq A-III. Coll 1976 and subm 1977. Assoc with Azilian industry. 1/3 diluted sample.

Ly-1601. Chez-Jugie, I & XIII 11,730 ± 530

From base of Layer 5, Sq A-II. Coll 1976 and subm 1977 and 1978. Assoc with Azilian industry. 1/2 diluted sample counted in proportional detectors.

Ly-1802. Chez-Jugie, XVI & XVII 13,000 ± 1,000

From extreme base of Layer 5, Sq J-II and H-III. Coll and subm 1978. Assoc with scarce pré-Azilian industry.

General Comment (GM and JPR): despite difficulties of measurements and risk of contamination, most results are consistent. Ly-1330 and -1395 may show evidence of human caused stratigraphic disturbance and contamination by recent roots. A Mesolithic occupation of site with Le Martinet trapezoïds took place about 7000 BP (Ly-1600 and -1396). Two dates from middle part of Layer 3, Ly-1331 and -1652, attribute satisfactory age, ca 8000 BP, to typical Sauveterrian industry. Ly-1651, a little younger, may correspond to end of Sauveterrian period as excavation revealed basin hearths dug into underlying layers by last Sauveterrian people. Statistical fluctuation or slight contamination may have occurred. Layer 5, with Azilian industry, seems to be from beginning of Alleröd period, according to Ly-1572 and -1601. Statistical margin of Ly-1802 make this result less significant but it does not disagree with other results. Entire series agrees with conclusions deduced from sedimentologic, botanic, and paleontologic studies which attribute Azilian industry to Alleröd climatic phase and Sauveterrian to boundary of Boreal and Atlantic periods (Mazière & Raynal, 1977).

Zatoya series, Abaurrea Alta, Navarra, Spain

Samples from several levels in Zatoya grotto, near Abaurrea Alta, Navarra, Spain (42° 54' N, 1° 15' W). Coll 1976 and subm 1977 by I Barandiaran, Univ Santander. Site has presumably continuous stratigraphy from end of Late Paleolithic to Neolithic periods.

Ly-1397. Zatoya, ZM 31 6320 ± 280

Bones from Level I, Sq 5-Z, 80 to 85cm depth. Assoc with Early and Middle Neolithic industry and presumably of Atlantic period. 1/2 diluted sample.

Ly-1457. Zatoya, ZM 33 8260 ± 550

Charcoal from Level I, Sq 1Z, 120 to 125cm depth. Assoc with Epi-paleolithic industry with geometric microliths. Presumably of beginning Atlantic period. 7/30 very diluted sample.

Ly-1398. Zatoya, ZM 25 **8150 $\pm$ 170**

Charcoal from upper part of Level II, Sq 3A, at 140cm depth. Assoc with Epipaleolithic industry without geometrics. Presumably of Boreal period.

Ly-1599. Zatoya, ZM 27 **11,620 $\pm$ 360**

Small amount of bones from Level II, Sq 3B, 150 to 160cm depth. Assoc with industry of Azilian type with micro-grattoirs. Probably from Boreal or Pre-Boreal periods. 1/3 diluted sample counted for a long time in proportional detector.

Ly-1399. Zatoya, ZM 47 **11,480 $\pm$ 270**

Bones from lower part of Level II, Sq 1Z, 170 to 180cm depth. Assoc with industry of Azilian type in Late Paleolithic tradition. Probably of Pre-Boreal period.

Ly-1458. Zatoya, ZM 29 **$\geq 10,940$**

Bones from Level b³, Sq 15B, 212 to 227cm depth. Assoc with Azilian industry with micro-grattoirs. Presumably of Boreal or Pre-Boreal periods. Min age given, as only 1 count could be made because of laboratory accident. 1/3 diluted sample.

Ly-1400. Zatoya, ZM 34 **11,840 $\pm$ 240**

Bones from same level assoc with same industry in Sq 13B, 209 to 231cm.

General Comment (IB): despite difficulties of measurements for some samples due to scarcity of material, series is coherent and may be divided in 2 parts: 3 1st results conform with expected ages and show that passage from Mesolithic to Neolithic took place at beginning of Atlantic period (Barandiaran, 1977). Four other results are older than expected, as they indicate Alleröd period instead of Pre-Boreal. This should mark long hiatus in sedimentation at Level II and, thus, Azilian industry should be contemporaneous with many other Epipaleolithic industries in S France.

Mallaha series, Eynan, Israel

Small amounts of charcoal from 2 soils in open air site Mallaha, near Houlé lake, Eynan dist, Israel (33° 05' N, 35° 35' E). Subm 1977 by F Valla, French Mission Centre Natl recherches sci, Jerusalem, Israel. Mallaha may be oldest sedentary habitation site presently known. Site consists of bases of circular huts, 5 to 10m diam, in which was found Late Paleolithic, Natufian, industry of Levant region. This industry occurs between Kebarian and prepottery Neolithic A types. Expected ages lies between 11,000 and 12,000 BP; (Lechevallier & Valla, 1974).

Ly-1662. Mallaha, 4012 **11,310 $\pm$ 880**

From soil of House 51. Coll 1975 by M Lechevallier. Marks old occupation phase of site. 1/6 very diluted sample.

Ly-1661. Mallaha, 4040 **11,740 ± 570**

Same origin as previous one. 8/30 diluted sample.

Ly-1660. Mallaha, 4568 **11,590 ± 540**

From soil of House 131. Coll 1976 by F Valla. Marks oldest occupation phase of site. 1/2 diluted sample counted in proportional detectors. *General Comment* (FV): despite large statistical margins, dates are in expected time period. Industries assoc in both soils are from same Early Natufian phase but, as Soil 131 underlies Soil 51, statistical fluctuations apparently inverted 2 soil dates that are very close to each other.

*D. Late and Middle Paleolithic periods***Les Romaines series, Virigin, Ain**

Small bits of charcoal from 3 Magdalenian levels in Les Romaines grotto at Pierre-Châtel, near Virignin, Ain (45° 41' N, 5° 21' E). Coll 1969 and subm 1976 by R Desbrosse, Blanzly (Desbrosse, 1976).

Ly-1594. Les Romaines, Niveau IIa **10,100 ± 350**

From Level IIa, 1/2 diluted sample counted for a long time in proportional detectors.

Ly-1307. Les Romaines, Niveau IIb **10,280 ± 630**

From Level IIb, 7/30 very diluted sample.

Ly-1308. Les Romaines, Niveau III **10,770 ± 410**

From Level III, 1/2 diluted sample.

General Comment (RD): series seems too young for assoc Late Magdalenian industry. Previous measurements were made on bones: Ly-356: 12,980 ± 240 (R, 1973, v 15, p 167) from Level III; on charcoal: Ly-16: 14,380 ± 380 (R, 1969, v 11, p 116) from Level IIa; on gastropod shells: MC-1274: 8230 ± 110 and MC-1275: 12,540 ± 400 from Level IIb and MC-1276: 12,540 ± 230 from Level III (unpub). Discrepancy of dates may be due to downward migration of charcoal or rootlets or to environment and biological effect of terrestrial shells (Evin & Maréchal, 1979).

Ly-1729. Longetraye 6D C1, Freycenet la Cuche, Haute Loire **9360 ± 270**

Charcoal from Layer 1 in Sq 6D of basaltic rockshelter Longetraye, near Freycenet-la-Cuche, Haute-Loire (44° 52' N, 3° 55' E). Coll 1974 and subm 1977 by D Philibert, Univ Lyon. Assoc with Late Magdalenian industry. *Comment* (DP): does not agree with Ly-512: 12,720 ± 750, from Layer 4, Sq 6E in site, assoc with same industry (R, 1973, v 15, p 524) (Elouard *et al*, 1974). Date is too young either because of downward migration of charcoal, frequently occurring in fillings of such basaltic site, or because Layer 1 is transition level between Magdalenian occupation (Ly-512) and subsequent Mesolithic settlement from which several samples were dated: Ly-760: 8590 ± 590 (R, 1975, v 17, p 22).

Ly-1351. Les Coudrays, Etiolles, Essonne 12,000 $\pm$ 220

Fragment of *Elephas primigenius* scapula from 4th occupation level from surface in open-air site Les Coudrays, near Etiolles, Essonne. Coll and subm 1975 by Y Taborin, Univ Paris I. Assoc with Late Magdalenian industry. Climatic phase presumably cold because of frost-fractured flints (Taborin, 1977). *Comment* (YT): in expected range of dates according to Hamburgian character of industry in region.

Ly-1406. Espelugues, Lourdes, Hautes Pyrénées 13,170 $\pm$ 260

Bones from base of S gallery, Loc 1, Espelugues grotto, at Lourdes, Hautes Pyrénées (43° 06' N, 0° 03' W). Coll and subm 1976 by J Omnès, Lourdes. Assoc with some artifacts of Late Magdalenian industry (Omnès, 1977). *Comment* (JO): agrees with attribution of industry to Late phase of Magdalenian. May be compared to Espèche series, below, and to Layer IV in Duruthy site (Magdalenian IV): Ly-859: 13,510 $\pm$ 220, and Ly-860: 13,840 $\pm$ 210 (R, 1976, v 18, p 79).

Le Bois du Cantet series, Espèche, Hautes Pyrénées

Bones from 2 levels of Le Bois du Cantet grotto at Espèche, Hautes Pyrénées (43° 03' N, 0° 08' E). Coll 1964 and 1972 and subm 1976 by A Clot, Bordères-sur-Echez.

Ly-1403. Le Bois du Cantet, Sec II 13,370 $\pm$ 270

Bones coll on stalagmitic floor in Sec II of grotto, assoc with Magdalenian industry.

Ly-1404. Le Bois du Cantet, Sec I 13,060 $\pm$ 430

Bones coll in archaeol layer under stalagmitic floor in Sec I of grotto. Assoc with Late Magdalenian industry. 2/3 diluted sample.

General Comment (AC): both dates agree statistically and should indicate homogeneous occupation of site. Date is compatible with archaeol attribution of industry to Late Magdalenian (Clot & Cantet, 1974). Comparable to Ly-1406, above, and slightly younger than Ly-1405, below, and Caubeta series (R, 1978, v 20, p 48): Ly-1107: 13,910 $\pm$ 230 and Ly-1055: 14,280 $\pm$ 300 with similar assoc industry (Clot & Omnès, 1979).

Ly-1405. La Grande Grotte, Labastide, Hautes Pyrénées 14,260 $\pm$ 440

Bones found on surface grotto filling 400m inside La Grande Grotte, near Labastide, Hautes Pyrénées (43° 08' N, 0° 23' E). Coll and subm 1976 by J Omnès. Formerly excavated grotto on sampling site contained hearths with engraved plates of stone and Magdalenian IV industry (Begouën, 1938). 5/6 diluted sample. *Comment* (JO): agrees with archaeol attribution and with Caubeta series (R, 1978, v 20, p 48, and above) (Clot & Omnès, 1979).

Ly-1628. Paglicci IV-73, Rignano Garganico, Foggia, Italy 13,720 $\pm$ 870

Bones from Level 7c, Sq 35NOP in Paglicci grotto, near Rignano Garganico, Foggia, Italy (41° 39' N, 15° 37' E). Coll 1973 by A Galiberti,

and subm 1976 by P Gambassini, Inst Antropol Paleontol Umana, Univ Siena. Assoc with Epigravettian industry. Expected age: ca 14,000 BP. 1/6 very diluted sample. *Comment* (PG): close to expected age, but ca 1000 yr younger than charcoal sample from same Level: F-65: 14,800 $\pm$ 210 (R, 1977, v 19, p 165). Large statistical margin due to small amount of organic matter preserved in bones may explain difference in apparent age.

Lascaux series, Montignac, Dordogne

Bits of charcoal from 2 locations in gallery called "Diverticule axial" of Lascaux grotto, near Montignac, Dordogne (45° 01' N, 1° 11' E). Subm by Arl Leroi-Gourhan, Mus de l'Homme, Paris.

Ly-1196. Cheval renversé de Lascaux 7510 $\pm$ 650

From upper clay filling of gallery, under painting called "Cheval renversé". Coll 1959 by A Glory and subm 1975. 1/5 diluted sample.

Ly-1197. Faille Méandre de Lascaux 8660 $\pm$ 360

From clayey filling in small fissure in wall at meander of gallery. Coll 1975 by Arl Leroi-Gourhan. 1/2 diluted sample.

General Comment (AL): samples were subm once more to date painting and Early Magdalenian industry with which all clayey filling was assumed contemporaneous. Three results were previously pub for unique human occupation of Lascaux grotto ca 16,800 BP at end of Lascaux interstade (Libby, 1955, p 85; R, 1963, v 5, p 168; R, 1964, v 6, p 247). Present results and new studies (Leroi-Gourhan & Allain, 1979) show that clayey sediments in "diverticule" gallery are probably redeposited. Holocene charcoal has already been found and dated at entrance of grotto: GrN-1182: 8510 $\pm$ 100 and in "Les Gours" passage: GrN-1514: 8300 $\pm$ 75 and GrN-1182: 9070 $\pm$ 90 (De Vries & Waterbolk, 1958). Thus presence of Holocene charcoal in axial gallery demonstrates transport of sediments by water in grotto during Boreal period (Leroi-Gourhan & Evin, 1979).

Terre Sève series, Solutré, Saône et Loire

Bones from several levels in Terre Sève zone of Solutré foot of limestone cliff site, Saône et Loire (46° 18' N, 4° 43' E). Coll and subm 1976 by J Combier, Dir Antiquités Préhist, Rhône-Alpes, Romanèche-Thorins.

Ly-1530. Terre Sève de Solutré, 165-170 13,680 $\pm$ 240

From Sqs I/10-37, 165 to 170cm depth. Assoc with Magdalenian industry.

Ly-1531. Terre Sève de Solutré, 170-175 13,710 $\pm$ 230

From Sqs I/10-37, 170 to 175cm depth. Assoc with Magdalenian industry.

Ly-1532. Terre Sève de Solutré, 180-190 14,360 $\pm$ 280

From Sqs I/10-37-47-57, 180 to 190cm depth. Assoc with Middle Magdalenian industry containing same bone points with geometric decora-

tion found in Arlay site, below. Sediments lying from 175 to 180cm depth are sterile and there is no Magdalenian industry lower than 190cm level.

Ly-1533. Terre Sève de Solutré, Strate supérieure 19,590 ± 280

From Sqs I/11-97 and I/10-7, 240 to 250cm depth. Assoc with a Middle Solutrean industry.

Ly-1534. Terre Sève de Solutré, Strate inférieure 17,310 ± 470

From Sqs I/10-37-47-57, 210 to 250cm depth. Assoc with Middle Solutrean industry.

General Comment (JC): Except for Ly-1534, all dates are consistent with each other and with expected values. Ly-1530 and -1531 places Magdalenian industry before Late Magdalenian level previously dated from another sec of site: Ly-393: $12,580 \pm 250$ (R, 1973, v 15, p 148) and after Ly-1532, which is comparable to 4 results from Magdalenian levels of Arlay site, below. Ly-1533 perfectly agrees with GrN-4442: $19,600 \pm 140$ and GrN-4495: $19,740 \pm 140$ (R, 1967, v 9, p 116) from Level 5 of Laugerie Haute site, Dordogne, which contains same Middle Solutrean industry. Ly-1534, from lowest level of Middle Solutrean level, might be older than Ly-1533; it is however, similar to previous result from level with same industry: Ly-316: $17,150 \pm 300$ (R, 1974, v 14, p 63). This remains unexplained and may be coincidental.

Grotte Grapin series, Arlay, Jura

Bones and reindeer horns from Level C of Grapin grotto, near Arlay, Jura (46° 46' N, 5° 31' E). Coll 1961 by M Vuilleme, Lons le Saunier, and subm 1976 by J Combier. Level corresponds to cold climate with steppic fauna. Assoc peculiar type of Magdalenian industry is not easily correlated with classic Magdalenian of SW France.

Ly-1509. Arlay Niveau C, Bois de Renne, partiel 14,220 ± 560

Small amount of reindeer horn, 1/3 diluted sample.

Ly-1535. Arlay Niveau C, Bois de Renne 14,530 ± 290

Reindeer horn.

Ly-1510. Arlay Niveau C, Os de Renne 14,820 ± 370

Reindeer bones.

Ly-1536. Arlay Niveau C, Os et bois de Renne 14,840 ± 360

Mixing of fragments of bones and horns of reindeer.

General Comment (JC): 2 previous results from same site, Ly-457: $15,320 \pm 370$ and Ly-559: $15,770 \pm 390$ (R, 1973, v 15, p 520) were too old for assoc industry. Sampling of those former measurements is now questionable: it may have been mixing of Magdalenian bones with some bone fragments of carnivore sp from lowest level of site dated twice from ca

25,500 BP (Ly-498 and -499). Both present results remain a little older than expected and than Level D of La Colombière site: Ly-433: $13,390 \pm 300$ (R, 1973, v 15, p 149) but they agree with Ly-1532 from Solutré site, above. The 2 samples (bones and horns) were carefully selected from zone of site where sterile level separates Magdalenian and older non-artifact bearing levels; chosen bone-splinters also had butchery marks (Combier & Vuilleme, 1976).

Laraux series, Lussac les Châteaux, Vienne

Bones from 2 levels in Laraux Rockshelter, near Lussac les Châteaux, Vienne ($46^{\circ} 24' N$, $0^{\circ} 43' E$). Coll 1949 and subm 1978 by L Pradel Chatellerault. Sterile level separates overlying Layer 3 from Layer 5 (Pradel & Cholet, 1950).

Ly-1739. Laraux, Couche 3 21,530 $\pm$ 910

From Layer 3, assoc with Perigordian V_c industry with Noailles and Le Raysse burins. 1/3 diluted sample.

Ly-1740. Laraux, Couche 5 23,510 $\pm$ 640

From Layer 5, assoc with Perigordian V_b industry with truncated artifacts of same type as those from Layer K in La Ferrassie site, Dordogne, where there is also a Late Perigordian industry.

General Comment (LP): age difference between both levels is greater than expected but may be explained by large statistical margin of Ly-1739, which seems a little too young by comparison with dates of Late Perigordian industries in W France, eg, Abri Pataud (R, 1969, v 9, p 113). Date is contemporaneous with Proto-Magdalenian levels of Abri Pataud and Laugerie Haute sites (R, 1963, v 5, p 167). Ly-1740 perfectly agrees with Late Perigordian dates from these 2 sites and fits with 6 other Gif lab results from 22,500 to 24,600 BP from Late Perigordian levels of La Ferrassie site (Delibrias *et al*, 1976, p 1509). Absolute chronology of beginning of Late Paleolithic is not well known even in W part of France and comparisons with similar industries in other regions are questionable. Two similar dates exist, however, from E France sites containing Late Perigordian industries: Ly-309: $24,150 \pm 550$ from Saint-Martin-Sous-Montaigu, and Ly-317: $24,050 \pm 600$ from Solutré (R, 1969, v 13, p 63).

La Baume de Gigny series, Gigny sur Suran, Jura

Bones from 2 upper levels of filling of La Baume site near Gigny sur Suran, Jura ($46^{\circ} 27' N$, $5^{\circ} 27' E$). Coll and subm 1978 by M Vuilleme. Site consists of thick filling in narrow fissure of limestone cliff (Piningre & Vuilleme, 1976).

Ly-1798. La Baume de Gigny, Niveau IV, No. 2 12,370 $\pm$ 460

Bones of small mammals from Upper and Middle part of Level IV from side of walls of rock fissure. Coll 1978, assoc with undiagnostic industry; 1/2 diluted sample. *Comment* (MV): dated to check following

measurement to detect contamination by migration of small bones. Bones were carefully selected and sampled from layer out of contact with underlying Level V.

Ly-1702. La Baume de Gigny, Niveau IV, No. 1 $13,620 \pm 480$

Bones of small mammals from entire Level IV in middle of rock fissure. Coll 1972 and 1973. Fauna is mixture of very cold and forest sp; 2/5 diluted sample.

Ly-1703. La Baume de Gigny, Niveau V $22,430 \pm 500$

Bear and microfauna bones from Level V. Assoc with undiagnostic industry.

General Comment (MV): both results from Level IV are very close to each other and in stratigraphic order. They are older than expected by malaco-fauna which suggest Atlantic period. Instead of Pre-Boreal or Boreal periods which might be assumed by the mixing of mammifera sp, Ly-1798 and -1702 attribute Level IV to Late Würm (Würm IV) and the rather temperate climatic phase could be Bölling. Ly-1703 occurs in expected range of date and confirms that upper part of fissure filling belongs to Late Würm III. Older levels of site (Levels VIII, XV, and XX) corresponding to Early Würm (Würm III or II) were previously dated (R, 1973, v 15, p 521; R, 1976, v 18, p 83).

Ly-1579. Le Trou du Renard, Soyons, Ardèche $\geq 32,100$

Bones from 1.5m depth in Boring 2 of Le Trou du Renard site, near Soyons, Ardèche (44° 54' N, 4° 50' E). Coll and subm 1976 by V Dumazel and A Grève, Soyons. Assoc with Mousterian industry presumed from beginning of Würm III. *Comment* (VD): agrees with expected age as chronology and definition of Würm II/III interstadial is still uncertain. As bedrock lies 1m below sampling level, unlimited ^{14}C result leads to possibility of obtaining older ages by other dating methods.

III. HYDROGEOLOGIC SAMPLES

E Lyon aquifer system series, France

Samples from wells in E Lyon region, coll by J Evin and G Marien to monitor ^{14}C activities of ground waters previously sampled from Spring 1971 to Autumn 1973. Previous results and description of aquifer were pub in Lyon V (R, 1975, v 17, p 29). All present samples were coll Autumn 1977 in "Couloir de Décines" geol unit from sites selected by D Rousselot, Bur recherches Geol Min, Lyon, except Ly-1158 which comes from "Couloir d'Heyrieux" and was suggested by N Mongereau, Dept Geol, Univ Lyon and coll Autumn 1976.

General Comment: all values are same as those obtained 5 yr earlier. They confirm that no change occurred in aquifer system despite extension of industrial zone in E Lyon region and operation of new airport of Satolas. As before, 2 superimposed free ground waters of the aquifer are distinguishable. Values about 70% modern indicate waters from lowest level of aquifer from which Satolas airport is supplied (Ly-1634).

Values about 85% modern indicate upper level of aquifer, while ^{14}C activities higher than 100% modern come from surface rain waters (Evin *et al*, 1979).

Sample no.	Sample	N Lat	E Long	Dilution ratio	$^{14}\text{C}\%$ Modern
Ly-1636.	Puits Troquet, No. 1	45°45'	5°4'	1/2	115.8 $\pm$ 3.2
Ly-1637.	Saugnieu, No. 1	45°43'	5°6'	2/3	109.5 $\pm$ 3.1
Ly-1550.	Ferme de Montchat, No. 1	45°41'	5°5'	1/2	88.7 $\pm$ 2.8
Ly-1638.	Meyzieux ville, No. 1	45°47'	5°0'	2/3	88.1 $\pm$ 2.6
Ly-1639.	Meyzieux zone industrielle, No. 4	45°46'	5°1'	2/3	83.8 $\pm$ 2.6
Ly-1634.	Ferme de Planaise, No. 1	45°43'	5°4'	2/5	84.5 $\pm$ 2.8
Ly-1633.	Satolas Aéroport, No. 3	45°44'	5°2'	1/2	71.8 $\pm$ 2.5
Ly-1635.	Satolas Carrière Perrier, No. 2	45°42'	5°4'	5/6	74.9 $\pm$ 2.2
Ly-1158.	Saint-Pierre de Chandieu, No. 1	45°39'	5°1'	1/3	73.6 $\pm$ 2.9

Az Zawiah series, NW Lybia

Samples from aquifer system around Az Zawiah, NW region of Lybia (32° 52' N, 12° 56' E). Coll 1974 by GERSAR Soc during program of studies called GEFLI and subm 1974 by A Marcé, Bur recherches Geol Min, Orléans. As Miocene limestone of Cyrenaic in NE Lybia (Castany *et al*, 1974), aquifer is confined with natural outlets along Mediterranean sea coast.

Sample no.	Sample	Localization	Dilution ratio	$^{14}\text{C}\%$ Modern
Ly-930.	Wadi Al Hira	RDH1 18/11/73	1	4.5 $\pm$ 0.4
Ly-931.	Wadi R'Mel	DW2 14/02/74	2/3	3.4 $\pm$ 0.5
Ly-932.	Az Zawiah	GZW 15/02/74	1/3	7.8 $\pm$ 1.2
Ly-933.	Az Zawiah	GZW4 26/11/73	1/2	7.8 $\pm$ 0.7
Ly-934.	Az Zawiah	GZW3 7/01/74	2/3	4.7 $\pm$ 0.5
Ly-935.	Az Zawiah	GZW6 —	2/3	2.2 $\pm$ 0.4
Ly-936.	Az Zawiah	GZW5 —	1/2	6.0 $\pm$ 0.7
Ly-947.	Az Zawiah	DW1 longue durée	1/2	10.8 $\pm$ 0.6
Ly-948.	Wadi R'Mel	DW2 13/03/74	1	4.7 $\pm$ 0.4
Ly-949.	Wadi R'Mel	DW5 30/03/74	1	5.2 $\pm$ 0.3
Ly-950.	Wadi R'Mel	DW6 13/04/74	1/2	3.1 $\pm$ 0.5
Ly-951.	Wadi Al Hira	RDM3 23/05/74	1	2.6 $\pm$ 0.3
Ly-992.	Tawarghah	Source 8/07/74	2/3	2.3 $\pm$ 0.7
Ly-993.	Tawarghah	T4 7/07/74	1/3	3.4 $\pm$ 0.7
Ly-994.	Tawarghah	TW1 9/07/74	2/3	1.6 $\pm$ 0.3

General Comment: contrary to Cyrenaic series (R, 1976, v 18, p 85) and despite expected values, results show very low ^{14}C content in entire aquifer, indicating lack of recent feeding in region.

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