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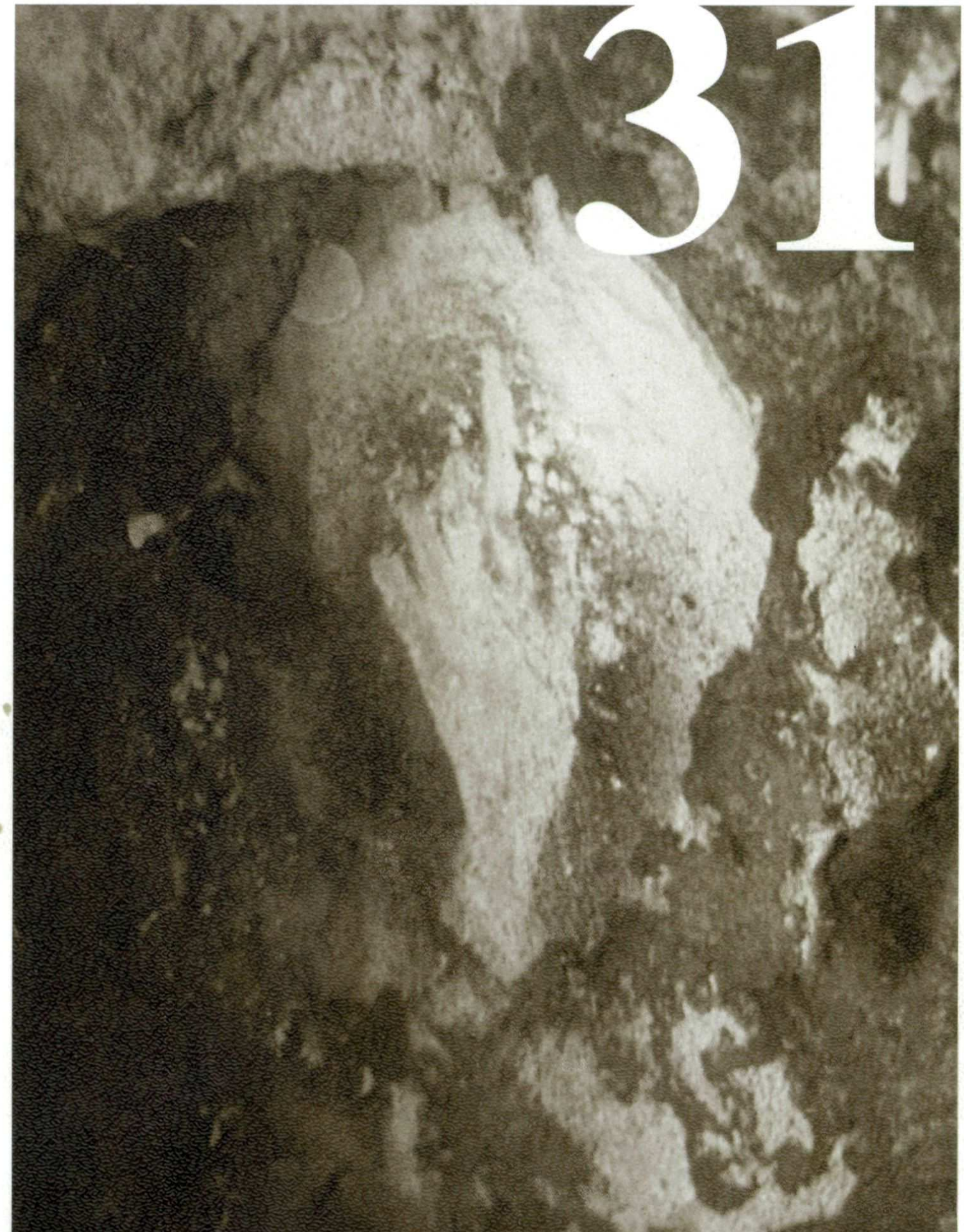

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HUNTERS OF THE GOLDEN AGE

THE MID UPPER PALAEOLITHIC OF EURASIA 30,000 – 20,000 BP

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Paul Pettitt

3 Chronology of the Mid Upper Palaeolithic: the radiocarbon evidence

The objectives of this paper are to present the main problems in radiocarbon dating the period 30-20 kyr bp, and to order in a meaningful way the radiocarbon measurements for the period which were available to the author. From these approaches, both the limitations and potential of Mid Upper Palaeolithic chronology is outlined. Problems relate firstly to the methodological limitations of the technique, whereby the effects of sample contamination on resulting ages are greatly enhanced beyond the Last Glacial Maximum and radiocarbon ages should be recognised as minimum ages, and secondly to archaeological factors such as the context of samples which, for example, may be subject to post-depositional movement. It should be remembered that given the size of errors even at one standard deviation, our chronological resolution of this period is coarse and heterogeneous; we should therefore excercise caution when making temporal comparisons between, for example, the Aurignacian and the Gravettian. Our picture of the chronology of Europe in the period considered is furthermore coloured both by regional research traditions, some of which may place more importance on the use of radiocarbon dates, and by available sample materials, whereby more problematic materials may yield chronological signatures at odds with those obtained by more suitable samples. Such factors may, in worst-case scenarios, produce patterns of dates which, when considered on a regional and inter-regional basis, may be taken to indicate illusory population movements. Finally, a coarse attempt is made to plot the available dates with archaeological associations for this period. Although any such analysis must remain necessarily provisional and the database needs to be improved considerably before such analyses can make a useful contribution to palaeolithic archaeology, the results do at least suggest that radiocarbon dates may have a role to play in examining the palaeodemography of palaeolithic groups.

1. Introduction

Any general discussion of radiocarbon dates for a given archaeological period must inevitably be provisional, as many (probably the majority of) dates have not been published, and others, which are available, are not published systematically and often lack laboratory numbers or detailed information about stratigraphic provenance. It is often impossible to evaluate the reliability of published radiocarbon dates with the information that accompanies them. Given this, and the numerous problems with dating palaeolithic materials, it is very difficult to undertake a general survey of the available data and have anything worthwhile to say about palaeolithic societies at the end.

The first section below discusses the various problems encountered in dating archaeological material beyond the Last Glacial Maximum, noting the limitations of the technique. The next section is a coarse attempt to get to grips with such radiocarbon dates as were available and useable to the author. This should be taken as a representation not only of the chronological distribution of palaeolithic technocomplexes (the traditional use to which radiocarbon dating has been put), but also as a representation of research bias, the numerous factors affecting dating in this period, and, to some extent, the element of chance as to what material was available to the author. The database of sites has been constructed from the Oxford Radiocarbon Accelerator Unit's own computer database, published Groningen and Lyon laboratory dates, and from numerous publications, either given to radiocarbon dates (e.g. *Radiocarbon* journal back to 1970) or to more geographically/topically specific archaeological papers written by palaeolithic specialists. Other dates were kindly supplied directly from palaeolithic archaeologists' own databases. It is not possible to publish here explicitly dates which have not been published elsewhere or those which have been published with insufficient detail as to be of use. The 491 dates amassed in the database are therefore not published here, rather incorporated together in the general analyses below. A final section presents an initial attempt to examine how radiocarbon dates may be informative about demographic patterns between 30 and 20 kyr bp.

2. 30-20 kyr: Problems in radiocarbon dating beyond the Last Glacial Maximum

The problems in radiocarbon dating archaeological sites in the period 30-20 kyr relate to two broad factors: dating methodology and archaeological stratigraphy, and these will be discussed briefly in this section.

Dating any archaeological material beyond the range of INTCAL98 (i.e. *c.* 25 kyr BP) encounters a major problem in the lack of known-age material for which a true date is

Table 1. Mean errors per 2 kyr blocks.

	30-28 kyr	28-26 kyr	26-24 kyr	24-22 kyr	22-20 kyr
Mean error	± 800 yrs	± 600 yrs	± 550 yrs	± 480 yrs	± 485 yrs

known by independent means, and therefore the absence of a reliable, or certainly relatively precise, correction curve (Van Andel 1998. See Pettitt 1999 for a discussion of the problems of accuracy and precision in this time range). As a result, researchers are compelled to work in radiocarbon years, accepting that contamination by more recent material is the main obstacle to reaching true (i.e. accurate) radiocarbon ages (Gowlett and Hedges 1986). In the time period we are concerned with here, 1% contamination at 28 kyr would increase ^{14}C activity by over 30% and reduce the date to less than 20 kyr. Such factors should be taken into account when seeking relatively fine-scale resolution for inter-site comparisons. The important point to bear in mind is that *the great majority of radiocarbon dates over 20 kyr will be underestimates*: it is important to remember that one is dealing in *radiocarbon years* bp.

That Mid Upper Palaeolithic radiocarbon dates are underestimates has been supported by the comparison of ^{14}C dates with other dating methods. Comparing Last Glacial ^{230}Th-^{234}U dates from corals, Bard *et al.* (1993: 197) noted that the radiocarbon ages from corresponding core sections were systematically younger than the U/Th ages. An example within the 30-20 kyr time range concerns the Gravettian levels of La Vigne Brun, France, TL dates for which range from 24-30 kyr with an average of 27 kyr, whereas radiocarbon dates for the same levels averaged around 23 kyr, some 15% lower (Valladas and Valladas 1987: 215).

The time-range under discussion is not a homogeneous period archaeologically and certainly not in terms of radiocarbon methodology. One should remember that problems resulting from contamination and low amounts of surviving collagen are much greater at 30 kyr than at 20 kyr, as the two chronological extremes of the period under discussion are almost two half-lives of radiocarbon apart. A major factor which adds to the heterogeneity of the period is the expression of uncertainty in the convention of radiocarbon errors. As these are a function of the resulting age of a given sample, it follows that the greater the antiquity of a sample, the larger the error. Thus, samples dating closer to 30 kyr will have larger errors than those dating closer to 20 kyr. Table 1 shows the mean error of radiocarbon ages falling into 2 kyr blocks for the entire database used here.

It can be seen that errors on dates falling between 30-28 kyr are typically in the order of ± 800 years, whereas those falling between 22-20 kyr are virtually half of that (this time block in table 1 includes some dates measured two decades ago (or more) and for which errors are relatively large by today's standards. Removing these has the effect of lowering the mean error to about ± 400). It follows that our perceptions of the chronological nature of the Aurignacian and the Solutrean will differ simply as a result of the convention of expressing laboratory error, giving rise to vastly differing error ranges. These are conventionally expressed at the 68% level of confidence; expanding them to the 95% level (which should be used as a convention for any meaningful discussion of chronology) renders the use of radiocarbon dates as a resource in their own right coarse at best. One must therefore be wary of making simple comparisons between population dynamics of sociocultural groups over large distances in time.

Bone is inevitably the main material dated for the European Palaeolithic (85% of the dates used below for which information on sample material was available were from bone/antler/ivory/tooth samples), and the purification of amino acids is much more feasible for the smaller samples required for AMS dating. This may be reflected in the tendency observed in the 1980's for Oxford dates to come out older than those from conventional laboratories, although there is generally good agreement, e.g. as at Abri Pataud and Kraków Spadzista Street (Gowlett and Hedges 1986). A large proportion of radiocarbon dates from Eastern European Plain sites may have been obtained from samples of burnt bone (it was impossible to evaluate the extent to which this is true with the information available), and it should be remembered that surviving amounts of collagen in such samples is low and therefore open to greater effects of contamination. In view of this, many of the resulting ages may be underestimates. In this context, it is interesting to note that the majority of radiocarbon dates for the East European Plain fall after 25 kyr (see below, Table 4). One must therefore exercise caution when comparing such dates with others to infer West-East population movements into this area (Soffer 1986, 1993).

The older the sample submitted for dating, the more background radiation will affect the results, a factor which has notable effects on bone. This is simply because low amounts of collagen (from which the carbon is extracted) will remain in samples from this time period. Because of the low amounts of remaining collagen there has been a tendency to use large samples to obtain a necessary precision, and this has often led to bulk sampling which creates mean dates which are often meaningless, especially in dated sequences consisting of relatively fine stratigraphies. One example of this is the large series of samples from La Ferrassie dated at Gif-Sur-Yvette, which resulted in a wide scatter of dates for each archaeological association (*Radiocarbon* 28(1), 1986). In such circumstances it is impossible to answer archaeological questions as to the nature of site occupation as one cannot rule out the contribution of bulk sampling to the resulting ages. The collection of samples from the edges of a long exposed section at La Ferrassie may also have allowed substantial contamination of samples by modern humic materials (Mellars *et al.* 1987). With the dating of Abri Pataud, one of the most intensively dated sites of this period (discussed in Mellars *et al.* 1987), the Groningen dates were obtained from larger, bulked samples of either burnt or unburnt animal bone, whereas the AMS dates were entirely from amino acids extracted and purified from hydrolysed collagen isolated from individual bones. The agreement between the Groningen and Oxford dates is impressive, with results generally coinciding within one standard deviation for particular samples. Where discrepancies do occur, in some of the perigordian IV, VI and protomagdalenian levels, there is a clear tendency for the AMS dates for certain levels to be slightly older than the corresponding Groningen dates, which may have been due to the greater elimination of contaminants in the Oxford laboratory.

As mentioned above, error ranges on dates in the range 30-20 kyr are ± 400 years or more, and a similar, albeit invisible, error must be borne in mind if one assumes that oscillations in the production of ^{14}C in the radiocarbon reservoir visible in the Holocene also existed in the late Pleistocene. There is no reason to doubt that such fluctuation occurred in the Pleistocene. This could have the effect of eliminating 500 year blocks of time, an error of the same level as that which expresses uncertainty of the radiocarbon measurement itself.

A certain number of radiocarbon dates will lie outside of an expected range/sequence for a particular site, and these often relate to the stratigraphic problems relating to radiocarbon dating palaeolithic materials. Whereas bone samples of great antiquity present problems due to low surviving collagen, the more ideal sample material, charcoal (which is virtually pure carbon) is susceptible to much greater stratigraphic mobility. This vertical movement of sample materials results in residuality or invasivity, a problem which can be encountered in both low and high energy depositional contexts. Contamination by younger, intrusive materials is a major problem. This problem of the mobility of small samples became obvious early on in the life of the Oxford laboratory, where it was noticed that outlying dates in stratigraphic sequences often came from very small samples (Gowlett and Hedges 1986). Dates will be inverted as a result of this, as possibly at Combe Saunière (Geneste in Rigaud 1982), and, one might suggest, for the two outlying dates of 28 and 29 kyr for levels 10 and 9 (on charcoal) in the stratigraphic profile of Molodova V in the Dnestr valley, otherwise consistently dated from 23-10 kyr for levels 10 to 1 (Hoffecker 1988: fig 2). An inversion of dates also occurs at Kraków Spadzista Street C2, where a date obtained on charcoal of 24 kyr is 3-4 kyr older than others obtained on bone and ivory, and is probably due to transport in the sloping solifluction deposits (Kozlowski 1987). In Siberia, Early Upper Palaeolithic materials are redeposited in solifluction deposits dating to 28-25 kyr and to 23 kyr (Larichev *et al.* 1990).

These problems, of course, are not only confined to open sites. One can also observe 'atypical' stratigraphic sections in the cave site of Kent's Cavern, England, where Early Upper Palaeolithic industries containing leaf points have been dated to 28,160 ± 435 (GrN-6201) from a tibia of *Coelodonta antiquitatis* and to 27,730 ± 350 (GrN-6325) from a radius of *Bison*, but to 38,270 +1470/-1240 (GrN-6324) from a radius of *Equus* cf. *przewalskii* from the same stratigraphic spit and grid location (Campbell 1977), which may relate to deposition of each sample in discrete debris flows. Three inverted dates from an as yet unpublished series of Oxford radiocarbon dates from Geissenklösterle, Germany, which fall into the range under discussion, may relate to two residual and one invasive samples (Hahn *pers comm.*).

The sections below present some preliminary results of trying to use the database of 491 radiocarbon dates for the period 30-20 kyr bp which were available to the author. It soon became very apparent in the process of collating this information that the resulting database would be partial and not uniform in nature. This is simply due to the fact that archaeologists do not publish dates according to a convention. Aside from the fact that the database itself is almost definitely an underrepresentation of the actual number of radiocarbon dates with archaeological associations available for this period, there are still numerous problems resulting from varying methods of publishing radiocarbon dates. Most often, the date and error is published with a laboratory number, usually embedded in a text which is site or region specific. The sample material type and $\delta^{13}C$ value obtained are often not published, without which it is impossible to evaluate the integrity of the resulting age. Of the 491 radiocarbon determinations used here, some 150 were listed in various publications without material type, many without a detailed cultural association, and some without laboratory numbers. In view of these problems, one simply has to take the available database on trust, eliminating obvious outliers and problematic results but otherwise treating it as a coarse body of data incorporating numerous errors. This is what has been followed here.

Table 2. Aurignacian radiocarbon dates 30-20 kyr.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
22 (31.4%)	17 (24.2%)	14 (20%)	13 (18.5%)	4 (5.7%)

3. Radiocarbon dates 30-20 kyr

Different countries or regions will have differing traditions of research, and these differences will be reflected to some extent in the radiocarbon database. In this sense, one wonders how much the recognition of the successive cultural traditions of Western Europe for the period concerned (e.g. Fontirobertian, Bayacien, Noaillien, etc. – see papers by Rigaud, this volume and Djindjian, this volume) reflect to some extent the large scale dating projects of major sites such as La Ferrassie and Abri Pataud, whereas the apparently more 'homogeneous' shouldered point traditions to the east reflect a more dispersed state of the database. This regional difference calls to question exactly what we mean by 'centres' of occupation which were often discussed in the workshop, and remind us that 'regions' of palaeolithic Europe were just as much temporal phenomena as spatial. One conclusion of the workshop was that large areas of Europe were empty at stages in the period concerned – Iberia, Italy and elsewhere seem to have been occupied intermittently by humans – a picture of dispersed cultural regions changing over time, which may be reflected in the radiocarbon record. Historicocultural regions are created at many scales, and not only must we question the criteria on which such regions are identified (Boriskovskij 1993) but we must also consider, in the light of the problems raised above, exactly to what scale of historicocultural phenomena radiocarbon dates apply. The question of what radiocarbon dates actually measure will be addressed below, after some examples of dated sites belonging to this period are discussed and a coarse attempt to present the data available to the author has been undertaken.

The French sites of this period that have received relatively intense radiocarbon dating include La Ferrassie, Le Flageolet I and Abri du Facteur (Mellars *et al.* 1987; Rigaud, this volume), but the Abri Pataud is perhaps still the most intensively dated Mid Upper Palaeolithic site, with Groningen and Oxford dates summarised by Mellars and Bricker (1986) and by Mellars *et al.* (1987). The results from the two laboratories were consistent, with only a few outliers, and demonstrated an aurignacian occupation coming to an end by 28 kyr, the perigordian IV occupation extending back to at least 28 kyr, an age of 26-27 kyr for the noaillian layers, a final perigordian occupation extending back to 24-24.5 kyr and protomagdalenian activity at 21-22 kyr. David (1985) supports a mean age of 27 kyr for the Noaillian at Abri Pataud, which he views as an intrusive population movement into the Périgord, interrupting a gradual evolution from Perigordian IV to VI.

Mitoc Malul Galben, Romania, contains deeply stratified Upper Palaeolithic cultural deposits which have been dated extensively by radiocarbon to the 30-20 kyr period. Here, aurignacian occupation seems to have come to an end by 28 kyr, with a substantial occupational hiatus before gravettian occupation commences around 27 kyr. The gravettian occupation ceases with the onset of stadial conditions around 20 kyr. The eastern gravettian sites of Moldavia and the C.I.S. comprise a large proportion of radiocarbon dates from this period, numbering some 76 dates from the Carpathians to the northeastern region of the East European plain (Svezhentsev 1993, and see below).

For the period 30-20 kyr an obvious place to begin a coarse survey of the radiocarbon evidence is to define the available chronological occurrences of the Aurignacian. In view of the problems regarding the stratigraphic mobility of some samples noted above, this is a difficult task in which single dates must be regarded with caution. Table 2 presents radiocarbon dates for aurignacian assemblages which were available to the author in two thousand year time bands within the 30-20 kyr period.

Most of these dates relate to individual assemblages (although many in the 30-23 kyr range relate to the Aurignacian of La Ferrassie), and out of 70 dates, there is a steady decline in numbers over the period, as one might be entitled to expect, with 56% falling before 26 kyr. In view of this, one should be cautious about using the younger dates to infer dates for the terminal Aurignacian, and one should remember the heightened effects of contamination in this time period, which could underestimate dates by several thousand years.

In France, a relatively well understood chronology has been established for the Perigordian V and VI, whereas the Perigordian IV is still poorly defined in chronological terms, although it seems to date between 26-28 kyr (Delporte 1976, but see papers by Rigaud and Djindjian in this volume for alternative cultural groupings/nomenclature) or possibly a little earlier as suggested at Abri Pataud (see above). A large proportion of the radiocarbon dates for Upper Perigordian/ Gravettian assemblages used here comes from the relatively well-dated Eastern Gravettian of Romania and the C.I.S. Table 3 presents these dates, again by two thousand year time bands.

As perigordian/gravettian technocomplexes fall almost entirely within the 30-20 kyr period, they dominate the

Table 3. Perigordian/Gravettian dates 30-20 kyr.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
20 (8.2%)	51 (20.9%)	56 (23%)	62 (25.5%)	54 (22.2%)

Table 4. Solutrean dates 30-20 kyr.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
0	0	0	1	21

Table 5. East European Plain radiocarbon dates.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
5 (6.5%)	8 (10.5%)	13 (17%)	28 (37%)	22 (29%)

sample of available dates as one would expect (of 491 dates, 243 in total have upper perigordian/gravettian associations). These increase in number around 28 kyr after which they are relatively evenly distributed down to 20 kyr. German gravettian dates cluster at 23-24 kyr although they are relatively evenly spread throughout the period, spanning more than 10,000 years (Weniger 1990; Bosinski, this volume). In Moravia, most of the dates for Dolní Věstonice I and II and Pavlov I cluster between 27-25 kyr, generally reflecting repeated settlement of these locations (Svoboda *et al.*, this volume) but pavlovian occupation of this area after 24 kyr is unclear (Svoboda 1990). In northern Central Europe gravettian industries with shouldered points date between 24-23 kyr, with greater evidence for settlement after 24 kyr (Kozlowski 1990). The Italian Gravettian commences around 27 kyr (Mussi, this volume), continuing with the early Epigravettian around the Last Glacial Maximum (Mussi 1990).

Finally, dated Solutrean assemblages are presented in table 4.

As one might expect, no dates for solutrean assemblages date to before 23 kyr (the one date in the 23-22 kyr time block is from the Gruta do Caldeirão (Zilhão *pers comm.*), all others date to after 22 kyr). Solutrean assemblages dating to this period have been found in Portugal, Cantabria and Southern France. One might also include here the Protomagdalenian of Abri Pataud level M2, lens 2, dating to 22,000 ± 600 bp (OxA-162).

Although only a few Upper Palaeolithic sites on the East European Plain have well-preserved, undisturbed archaeological horizons found in clear stratigraphic contexts, a large number of radiocarbon dates exist for the area from the Carpathians, Dnestr basin and Dnepr drainage system to the Mid-Russian Upland and the steppic zone of the plain, with nearly two hundred listed by Svezhentsev (1993). A particularly large series of dates is available for the various Kostenki localities, as well as (for the 30-20 kyr period) Molodova V, Avdeevo, Gagarino, Sungir', and a number of other sites with one or two determinations. These are worth considering in their own right, and table 5 organises the dates presented by Svezhentsev (1993) into two thousand year time bands from 30-20 kyr.

It can be seen that there is a gradual increase in the number of dates through the period, with the majority of dated assemblages (66%) falling after 23 kyr. This is in accord with Soffer (1990) who notes that there is an increase in site density from 26 kyr down to the Late Glacial Maximum in the Central Russian Plain, although the possibility that use of burnt bone samples has affected some of these determinations has been noted above.

Sagaidak I, on the lower reaches of the Bug, was until recently considered to be the oldest Upper Palaeolithic site in the Russian steppe zone, with a radiocarbon date of 21,240 ± 200 (LE-1602A) for an industry which has been described as 'Aurignacoid' (Leonova 1994), but the earliest appearance of, one assumes, modern humans in the region has now been pushed back beyond the concerns of this volume to around 40,000 bp at Kara-Bom in Siberia (Goebel *et al.* 1993). There is however, still a deficiency of well-dated early Upper Palaeolithic sites in Western Siberia, especially in the 30-20 kyr period and only Malaia Syia (33-34 kyr) contains Early Upper Palaeolithic material (Larichev *et al.* 1988), and in the more intensively studied areas of Central and Eastern Siberia much of the material dating to this period is redeposited in solifluction deposits as noted above (Larichev *et al.* 1990). The 'classic' Upper Palaeolithic stage represented by such sites as Mal'ta and Buret' fall towards the end of the period, at 21-20 kyr, although human presence in the area is distributed throughout the 10 kyr under consideration

(Pavlov and Indrelid, this volume).

This brief survey of the radiocarbon dates for Europe at 30-20 kyr bp reinforces the view that occupation of Europe was dispersed and intermittent during this period. The last section aims to follow this a little further as an indication as to where future research might profitably go.

4. Using radiocarbon in the period 30-20 kyr bp

What are radiocarbon dates actually measuring in palaeolithic archaeology, and to what scales of human activity can they be applied? The problems noted above, both in terms of actually obtaining radiocarbon dates for this period and the inherent errors associated with them, will obviously affect the utility of a radiocarbon database for addressing research issues in palaeolithic archaeology. The question still remains, however, whether radiocarbon dates *per se* are of use to palaeolithic archaeology as a resource in their own right. Many aspects of human behaviour that are of concern to palaeolithic archaeologists, such as extinction and demographic shifts are, as Soffer (1993) has called them, 'time-transgressive', that is, they take place as both spatial and temporal phenomena (it seems that the time-transgressive extinction of the Neanderthals was still working through the early part of the period under consideration here – Pettitt 1999). It follows that radiocarbon chronology, in association with spatial data (i.e. the distribution of dated sites) may allow an investigation of such phenomena, and a preliminary investigation along these lines relevant to the period under discussion is presented here.

The size of errors of uncertainty and the heterogeneity of the period naturally restrict the scale at which radiocarbon chronology can be of use. The tables used above present data in 2 kyr time blocks for a reason: given that the range of errors at the 68% level of confidence is between 800 and 400 years, and the possibility that other factors may eliminate 500 year blocks of time, this is assumed to be the finest scale at which radiocarbon dates can be compared in any useful way. A coarser scale would obviously be of little use. A similar method, in which radiocarbon determinations are plotted as totals in one thousand year blocks which overlap by 500 years to smooth out short-term fluctuations is used by Holdaway and Porch (1995), who note cyclical patterns in the number of radiocarbon determinations from *c*. 36 kyr to 10 kyr for Tasmania, which can be correlated to environmental data. A similar method of counting the number of radiocarbon determinations for time blocks was presented for Central Europe by Simán (1990, 1990-1991). Holdaway and Porch's method assumes that radiocarbon determinations are a measure of occupation. They follow Rick's (1987) suggestion that if radiocarbon determinations were obtained randomly from an unbiased archaeological record, the number of radiocarbon determinations will vary with the number of

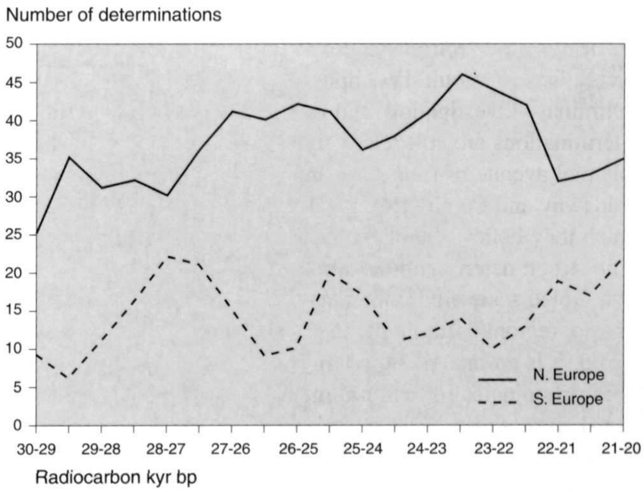

Fig. 1 Moving sum of radiocarbon determinations for southern and northern Europe.

person-years of human existence in a given region. Of course, there are a number of selection biases which have been discussed above, and to a large extent the data will be biased toward sites where a large number of radiocarbon determinations have been obtained without necessarily reflecting more intense occupation, but it is probably fair to assume that the results are at least a very crude measure of regional demographies. The 'moving sum' method advocated by Rick was used here for the Eurasian database covering 30-20 kyr bp. The determinations were divided for comparison into two broad latitudinal regions, that of Southern and Northern Europe. These were divided as follows:

Northern Europe:	United Kingdom, France, Belgium, Germany, Czech Republic, Austria, Poland, Hungary, C.I.S.
Southern Europe:	Gibraltar, Spain, Portugal, Italy, Romania, Croatia, Bulgaria, Greece.

It is obvious that the two latitudinal regions have different patterns of radiocarbon determinations. This supports one of the conclusions of the workshop that behaviour was particularly regionalised in this period (in this context certainly at a gross latitudinal scale), in contrast to the apparent 'uniformity' of the Aurignacian. In view of the apparent patchiness of environmental conditions throughout the period, this is, perhaps, not surprising. What is more interesting, however, is that the two regions appear to covary to some extent; that is, in periods where the number of radiocarbon determinations for Northern Europe decreases, there is a concomitant increase in Southern Europe, and vice versa. These 'oscillations' of radiocarbon determinations seem to vary over relatively similar wavelengths of around 3 kyr between peaks/troughs, despite encompassing minor fluctuations. It should be emphasised that this is only a preliminary investigation, and the absolute numbers of determinations are still relatively low, but it does indicate a potential avenue of future research. It is interesting that Holdaway and Porch (1995: 75) also note 3 kyr wavelengths, which they believe 'strongly suggests that the number of radiocarbon determinations are fluctuating in accordance with global scale environmental changes'. Despite the mosaic, regionalised nature of environmental change in this period, it is an interesting possibility that the pattern of radiocarbon dates for cultural material may relate still to global environmental factors which may be driving human demographic behaviour, but this has to remain largely speculative at present, until the database of available radiocarbon dates increases significantly. Whatever the case, this at least serves to remind us that the natural and cultural regions that were discussed at the workshop are just as much temporal as spatial phenomena.

5. Conclusion

As with the archaeological residues of human groups in operation between 30 and 20 kyr bp, the radiocarbon data form a patchy resource with inbuilt eccentricities and problems, and it is only by appreciating these that the technique may be of use to answer questions of interest to palaeolithic archaeologists. It can, of course, serve to structure the palaeolithic record in time, but the discussion above has sought to isolate exactly what can be done with the *scale* in which this record is organised. This will inevitably be a coarse picture containing inbuilt biases, but it may prove to offer information on human demography and other time-transgressive phenomena. Human behaviour between 30 and 20 kyr bp was scattered and regionally distinct; it was not time-transgressive in any one, uniform way. At a broad level, the available radiocarbon database reflects this, in demonstrating that the number of dated cultural levels does not remain uniform throughout the 10 kyr under consideration, and that two distinct latitudinal regions of Europe have different radiocarbon signatures.

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references

Bard, E., M. Arnold, R.G. Fairbanks, B. Hamelin — 1993 — ^{230}Th-^{234}U and ^{14}C ages obtained by Mass Spectrometry on corals, *Radiocarbon* 35(1), 191-99.

Boriskovskij, P.I. — 1993 — Determining Upper Palaeolithic historicocultural traditions. In: O. Soffer and N.D. Praslov (eds), *From Kostenki to Clovis: Upper Paleolithic Paleo-Indian adaptations,* 143-147, New York: Plenum Press.

Bosinski, G. — this volume — *The period 30,000-20,000 bp in the Rhineland.*

Campbell, J.B. — 1977 — *The Upper Palaeolithic of Britain.* Oxford: Oxford University Press.

David, N. — 1985 — Excavation of the Abri Pataud, Les Eyzies (Dordogne): The Noaillian (Level 4) assemblages and the Noaillian culture in Western Europe, *American School of Prehistoric Research Bulletin* 37, Harvard: Harvard University Press.

Delporte, H. — 1976 — L'organisation du Périgordien Supérieur en France et ses rapports avec le Périgordien d'Europe Central. In: B. Klíma (ed.), *Périgordien et Gravettien en Europe*, U.I.S.P.P. IXe Congres, Brno, Czechoslovakia.

Djindjian, F. — this volume — *The Mid Upper Palaeolithic (30,000 to 20,000 bp) in France.*

Goebel, T., A.P. Derevianko, V.T. Petrin — 1993 — Dating the Middle to Upper Palaeolithic transition at Kara Bom, *Current Anthropology* 34(4), 452-458.

Gowlett, J.A.J., R.E.M. Hedges — 1986 — Lessons of context and contamination in dating the Upper Palaeolithic. In: J.A.J. Gowlett and R.E.M. Hedges (eds), *Archaeological Results From Accelerator Dating*, 63-71, Oxford University Committee for Archaeology monograph 11, Oxford: Oxbow books.

Hoffecker, J.F. — 1988 — Early Upper Palaeolithic sites of the European U.S.S.R. In: J.F. Hoffecker and C.A. Wolf (eds), *The Early Upper Palaeolithic: evidence from Europe and the Near East*, 237-272, Oxford: British Archaeological Reports (Int. Series) 437.

Holdaway, S., N. Porch — 1995 — Cyclical patterns in the Pleistocene human occupation of Southwest Tasmania, *Archaeology in Oceania* 30, 74-82.

Kozlowski, J.K. — 1987 — The Upper Palaeolithic site Krakow-Spadzista Street C2: excavations 1980, *Prace Archeologiczne* 42.

1990 — Northern Central Europe c. 18 000 bp. In: O. Soffer and C. Gamble (eds), *The World at 18 000 BP. Vol. 1. High Latitudes,* 204-227, London: Unwin Hyman.

Larichev, V., U. Khol'ushkin, I. Laricheva — 1988 — The Upper Palaeolithic of Northern Asia: achievements, problems, and perspectives. I: Western Siberia, *Journal of World Prehistory* 2(4), 359-396.

1990 — The Upper Palaeolithic of Northern Asia: achievements, problems, and perspectives. II: Central and Eastern Siberia, *Journal of World Prehistory* 4(3), 347-385.

Leonova, N.B. 1994 The Upper Palaeolithic of the Russian steppe zone, *Journal of World Prehistory* 8(2), 169-210.

Mellars, P.A., H.M. Bricker 1986 Radiocarbon Accelerator Dating in the earlier Upper Palaeolithic. In: J.A.J. Gowlett and R.E.M. Hedges (eds), *Archaeological Results from Accelerator Dating*, 73-80, Oxford University
Committee for Archaeology monograph 11, Oxford: Oxbow books.

Mellars, P.A., H.M. Bricker, J.A.J. Gowlett, R.E.M. Hedges 1987 Radiocarbon Accelerator Dating of French Upper Palaeolithic sites, *Current Anthropology* 28(1), 128-133.

Mussi, M. 1990 Continuity and change in Italy at the Last Glacial Maximum. In: O. Soffer and C. Gamble (eds), *The World at 18 000 BP. Vol. 1. High Latitudes*, 126-147, London: Unwin Hyman.

this volume *Heading south: The gravettian colonisation of Italy.*

Pavlov, P.Yu., S. Indrelid this volume *Human occupation of Northeastern Europe during the period 35,000-18,000 bp.*

Pettitt, P.B. 1999 Disappearing from the world: an archaeological perspective on Neanderthal extinction, *Oxford Journal of Archaeology* 18(3), 217-240.

Rick, J. 1987 Dates as data: an examination of the Peruvian preceramic radiocarbon record, *American Antiquity* 52, 55-73.

Rigaud, J.-Ph. 1982 Circonscription d'Aquitaine, *Gallia Préhistoire* 25, 407-436.

this volume *Human adaptation to the climatic deterioration of the last Pleniglacial in southwestern France (30,000-20,000 bp).*

Simán, K. 1990 Population fluctuation in the Carpathian Basin from 50 to 15 thousand years bp, *Acta Archaeologia Academiae Scientiarum Hungaricae* 42, 13-19.

1990-1991 Some features of populational fluctuations in Europe between 50 to 15 thousand years bp, *Antaeus* 19-20, 11-17.

Soffer, O. 1986 Radiocarbon accelerator dates for Upper Palaeolithic sites in European U.S.S.R. In: J.A.J. Gowlett and R.E.M. Hedges (eds), *Archaeological results from accelerator dating*, 109-115, Oxford University Committee for Archaeology monograph 11, Oxford: Oxbow books.

1990 The Russian Plain at the Last Glacial Maximum. In: O. Soffer and C. Gamble (eds), *The World at 18 000 BP. Vol. 1. High Latitudes*, 228-252, London: Unwin Hyman.

1993 Upper Palaeolithic adaptations in Central and Eastern Europe and man-mammoth interactions. In: O. Soffer and N.D. Praslov (eds), *From Kostenki to Clovis: Upper Palaeolithic Paleo-Indian adaptations*, 31-50, New York: Plenum Press.

Svezhentsev, Y.S. 1993 Radiocarbon chronology for the Upper Palaeolithic sites on the East European Plain. In: O. Soffer and N.D. Praslov (eds), *From Kostenki to Clovis: Upper Palaeolithic Paleo-Indian adaptations*, 23-30, New York: Plenum Press.

Svoboda, J. 1990 Moravia during the Upper Pleniglacial. In: O. Soffer and C. Gamble (eds), *The World at 18 000 BP. Vol. 1. High Latitudes*, 193-203, London: Unwin Hyman.

Svoboda, J., B. Klíma, L. Jarošová, P. Škrdla	this volume	*The Gravettian in Moravia: climate, behaviour and technological complexity.*
Valladas, H., G. Valladas	1987	Thermoluminescence dating of burnt flint and quartz: comparative results, *Archaeometry* 29(2), 214-20.
Van Andel, T.	1998	Middle and Upper Palaeolithic environments and the calibration of C14 dates beyond 10,000 BP, *Antiquity* 72, 26-33.
Weniger, G.C.	1990	Germany at 18 000 bp. In: O. Soffer and C. Gamble (eds), *The World at 18 000 BP. Vol. 1. High Latitudes*, 171-192, London: Unwin Hyman.

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