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Radiocarbon

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EDITORIAL STATEMENT TO CONTRIBUTORS

Since its inception, the basic purpose of Radiocarbon has been the publication of compilations of ^{14}C dates produced by various laboratories. These lists are extremely useful for the dissemination of basic ^{14}C information.

In recent years, Radiocarbon has also been publishing technical and interpretative articles on all aspects of ^{14}C. The editors and readers agree that this expansion is broadening the scope of the Journal. This year, the editors have published the Proceedings of the Tenth International Radiocarbon Conference that was held at Bern and Heidelberg, August 19-26,1979. Volume 22, Nos. 2 and 3, 1980 contained these proceedings. Subscribers receive these issues and the two regular numbers of Volume 22 at the regular subscription price, $60.00 for institutions and $40.00 for individuals. Non-subscribers may order the special publications separately at $60.00. Volume 23, 1981 will return to its usual format of three numbers per volume.

As a result of publishing the proceedings, another section will be added to our regular issues, "Notes and Comments". Authors are invited to extend discussions or raise pertinent questions to the results of scientific investigations that have appeared on our pages. The section will include short, technical notes to relay information concerning innovative sample preparation procedures. Laboratories may also seek assistance in technical aspects of radiocarbon dating.

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The Editors

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* Suggestions to authors of the reports of the United States Geological Survey, 5th ed, Washington, DC, 1958 (Government Printing Office, $1.75).

CONTENTS

WILLARD F LIBBY (1908-1980)

"... chance favors the mind that is prepared." (Pasteur)

Carbon-14, or radiocarbon, was invented before it was known in nature —it was initially produced in a University of California cyclotron as part of a biochemical research project. An abundant source of a long-lived isotope of carbon paved the way to develop the path of carbon in photosynthesis, which led to a 1950 Nobel Prize for Melvin Calvin. Meanwhile, at the University of Chicago, Willard Libby read of the synthesis of the isotope and was able to add two significant observations: a) thermal neutrons in the appropriate energy range existed in the upper atmosphere as the result of cosmic-ray interactions; and b) the atmosphere is 78 percent nitrogen.

A session with his slide-rule indicated an equilibrium concentration of ^{14}C in living material within the detection range of counting equipment then available and an experiment with methane from a Baltimore sewage plant provided the initial material. Here again preparation was the key, for Libby was experimenting with a "screen-wall" counter that increased counter sensitivity for weakly emitting radioisotopes. A few grams of carbon deposited in the counter established the theory and a visit to the University of Chicago Museum of Egyptology provided the test.

Visualize the distress of the Museum Director, guardian of priceless antiquities, being asked to relinquish several grams of irreplaceable wood, so that some crazy chemist could burn it! Needless to say, tens of thousands of radiocarbon dates later, the method confirmed the theory and even the discrepancies continue to stimulate research by physicists, geologists, and archaeologists.

For his seminal role in radiocarbon dating, Willard Libby received the Nobel Prize in Chemistry in 1960. At least seven honorary degrees and numerous awards, prizes, and medals, as well as participation in developmental and advisory committees of the United States Atomic Energy Commission, plus more than 300 published journal articles, reviews, chapters, and books attest to his pre-eminence in the field of nuclear chemistry. More than 100 radiocarbon dating laboratories, thousands of Quaternary investigators, and tens of thousands of radiocarbon dates confirm Willard Libby's legacy.

The editors of RADIOCARBON, together with students of the Quaternary from around the world, join in tribute to the father of radiocarbon dating.

[RADIOCARBON, VOL 22, No. 4, 1980, P 1017-1020]

Radiocarbon

1980

ARCHAEOLOGY AND RADIOCARBON DATING

WILLARD FRANK LIBBY†

University of California at Los Angeles

Paper delivered at the one hundredth anniversary meeting of the Archaeological Institute of America, December, 1979
Boston, Massachusetts

INTRODUCTION

Tonight I have the opportunity to thank my many archaeological collaborators in the early days of radiocarbon dating. The development would not have been possible without their wonderful cooperation. We began, Dr James Arnold and I, with the help of Dr Ernest C Anderson, with the bright hope that we could obtain priceless samples of early dynastic Egypt for checking merely by the asking. Dr Arnold's father was an amateur archaeologist, and he gave us some early hints. Through him we obtained some valuable material from the Metropolitan Museum.

Our very first date was Acacia wood from the tomb of Zoser at Sakkara through the kindness of Ambrose Lansing of the Metropolitan Museum. Dr John Wilson of the Oriental Institute of the University of Chicago, where this research was done, estimated the age to be 4650, whereas we obtained 3979. Correcting for the half-life, 3 percent, we obtain 4100 years, relative to the time of 1950 (BP). So, we see that in the very first sample, had we taken it more seriously, our date was younger than the historical date. This later turned out to be an important matter, for we find that all dates in that span of time must be corrected for an increased cosmic ray intensity presumably due to a weakening of the earth's magnetic field. Mr Arnold put us on to Mr Lansing, and we obtained some material. But we also learned rather quickly that this was not going to be an easy process. We must, in any case, have someone to introduce us. We asked for help from the Archaeological Institute and the American Geological Society who kindly appointed us a most helpful Committee: Frederick Johnson, Chairman, Don Collier, Richard Foster Flint, and Froelich Rainey. Fred, as you know, is an archaeologist along with Froelich Rainey and Don Collier. Dick Flint was a geologist. We rapidly came to the policy of asking this Committee to advise us and to help us procure pertinent samples.

THE COLLABORATION

After the first sample was measured (C-1), Froelich Rainey obtained a Cyprus beam from the tomb of Sneferu at Maydum (C-12), and Don

† Deceased September 1980

Collier got us wood from the deck of the funerary ship from the tomb of Sesostris III. This was an interesting episode, for the Committee had not been appointed. We had to deal with the Director, and there was no room for doubt about his position. Namely, he did not see why we should be given a part of the ship to burn. But Don Collier, who was on the staff of the Natural History Museum where the funerary ship was on exhibit, managed for us. From then on, through the good auspices of the Committee, we were blessed with a series of some 800 samples. By the way, I speak tonight only of the work which was done at the University of Chicago by Arnold, Anderson, and myself.

In the following years many other laboratories joined and many tens of thousands of dates now are available. But these dates were measured by us in our Chicago laboratory working with our archaeologist collaborators. That was 30 years ago.

The next sample beyond Sesostris (C-12) on our Chicago Date List is called Ptolemy (C-62). It consisted of wood from a coffin from the Egyptian Ptolemaic Period dated by John Wilson of the Oriental Institute at about 2280 years. We obtained agreement within our rather substantial error which in those days was running about 2 or 3 centuries. This sample was given us by John Wilson and his colleague, Watson Boyes, of the Oriental Institute.

The next sample on our list called Hemaka was submitted by W B Emery of the British Embassy in Cairo through the auspices of our friends in the Oriental Institute. It consists of a slab of wood from the roof beam of the tomb of the Vizier Hemaka who was contemporaneous with the First Dynasty of Sakkara with an expected age according to R J Breakwood of the Oriental Institute of between 4700 and 5100 years. Our average was 4883 ± 200.

Our next sample was middle pre-Dynastic charcoal from El Omari near Cairo, Egypt. This was dated at 5256 ± 230 years, in general agreement with expectations. This material was furnished by Ferand de Bono of the Service of Antiquities of Egypt in Cairo.

The next sample was very exciting — wheat and barley grain from the Upper K level of the Fayum A material submitted by Gertrude Cayton-Thompson and Mrs Elise Baumgartel of the University of Manchester. The date was 6300 years.

Well, you see how after only half a dozen dates we were being blessed by contributions from world distinguished archaeologists. I think that I must turn now to the beginning and fill in some of the gaps.

We had a period of 2 or 3 years of secret research when we believed that the notion of radiocarbon dating was beyond reasonable credence, and therefore, we would not disclose our plans and purposes until we had results. This meant that the funding of our research rested entirely on the University of Chicago and my own meager resources. Fortunately, these were adequate. We chose to break the problem into parts, each part being of interest to some other group who would help finance it. For example, our measurement of the half-life of radiocarbon was financed by the Argonne National Laboratory and, of course, ultimately, by the Atomic Energy Commission.

However, the costs of the counters and electronic equipment and the first crude anticoincidence shield were entirely borne by a $2500 grant by the University through Dean Walter Bartky. I arrived at the University of Chicago in October, 1945, having been appointed Professor in the Institute of Nuclear Studies and the Department of Chemistry. But I had a number of researches in mind. After four years of intensive work on war-time problems, we had a tendency to lean towards problems of no particular application and to try to get away from the intensive concentration characteristic of military research. Sam Allison, our Institute director at that time, said he was going to study the color of butterfly wings. Well, I never said anything of that sort, but we were, however, considering the idea of how to use the cosmic rays to measure human history and time for geological events. The principles are well known to you, but they are: the bombardment of the high atmosphere by cosmic rays produces radiocarbon, mass, 14, half-life 5730 years. This oxidizes and enters the biosphere and renders things radioactive at a constant level because of the long time allowed for mixing. So we predicted from the intensity of cosmic rays measured by our colleague and friend, Serge Korff of New York University, the rate at which ^{14}C atoms were being produced, and assuming that the rate had been true for all of the preceding 50,000 years, we calculated what the general level of ^{14}C should be in living matter. It was the confirmation of this calculation by measurement of the ^{14}C of methane gas derived from Baltimore sewage that gave us the courage to move forward to radiocarbon dating. So at the time that we obtained our very first confirmation, through our friend, Harold Urey, Dr Paul Fejos of the Viking Fund (now the Axel Wenner-Gren Foundation) learned of our work. We had given a seminar at the University of Chicago explaining and giving evidence that we could actually do dates by using it. At that time, Dr Fejos came to the University of Chicago to look into our researches and presented us with a substantial check from the Viking Fund. From this time onward we had enough money to do our dating and we were able to build a new anticoincidence shield and to generally upgrade our equipment. We received several hundred samples.

Though it is very difficult in a few minutes to give proper credit to the dozens and dozens of archaeologists who helped us by giving us samples and advising us in our work, I would like to say that it has been the happiest experience of my long life-time to see how people so different in backgrounds as archaeologists and physical chemists could collaborate on fundamentally interdisciplinary research. They did learn the principles of radiocarbon dating, and we learned something about the field methods of archaeologists. Between us we worked out some guide rules as to how to select and preserve them for dating.

Some results were outstanding. First, although the dates we found were younger, within experimental error, we confirmed the dates of the early dynasties in Egypt. We also showed that the heartwood of the redwood tree with 3000 rings that could be counted directly, showed the proper radiocarbon concentration. We showed that the abundant material from the Greco-Roman Period checked beautifully. However, as time went on and our measurement technique became more accurate, it became clear that our dates at about 5000 years were falling short of the mark by a deviation of about 500 to 800 years. We were able to calibrate this deviation due to the fortunate circumstance that there is rapid worldwide mixing of any ^{14}C introduced into the atmosphere. This knowledge is largely due to Hans Suess at La Jolla, Paul Damon of Arizona, and Elizabeth Ralph of the University of Pennsylvania Museum. The dating of wood from the Bristlecone Pine forest in the Schulman Grove in the White Mountains of the Sierra Nevada in California allowed us to go back to the early dynasties of Egypt and to make an absolute measurement. This curve of correction is now used and applies back to 8000 years. With this in hand, it is possible to recalculate the earlier measurements, and, in fact, to re-measure many of the samples. Through the kindness of Dr Edwards of the British Museum we were able to obtain a second set of samples from the early dynasties of Egypt to re-measure with modern techniques. The use of the Bristlecone Pine correction showed that the agreement with the historical values was excellent.

Thus, it seems that, at the moment, we have a method of worldwide, absolute dating back to 8000 years.

If we go further back in time we have no choice but to record our dates as radiocarbon dates and hope for a future development of other methods of dating which can be used to calibrate. It is just conceivable that an adequate understanding of the earth's magnetic field will help us. Thus, we see that geophysics enters into the problem. It is largely accepted that the general increase in cosmic ray intensity 5000 years ago was due to a weakening of the earth's magnetic field which, at the present time, deflects about half the primary cosmic rays that otherwise would hit the earth.

I want to thank the Archaeological Institute of America for inviting me tonight, but more particularly to thank all of you for the collaboration and help you have given to radiocarbon dating.

[Radiocarbon, Vol 22, No. 4, 1980, P 1021-1027]

AGE REPORTING OF VERY OLD SAMPLES

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ABSTRACT. Problems of the statistical interpretation of radiocarbon age measurements of old samples are discussed, based on the notion of fiducial probability distribution. A probability density function of age has been given. A detailed discussion of different facets of the probability distribution of age has led us to the confirmation of the use of 2σ as the best limiting value between the regions of finite and infinite dates. It has been proposed to make use of the principle of constant probability $P = 0.68$ in the regions of both finite and infinite ages instead of the criterion $N+k\sigma$.

INTRODUCTION

If the measurement of ^{14}C concentration in a sample yields several counts that differ from the number of background counts by the value that is comparable with the measuring error, we can say that the sample is too old to be dated by the ^{14}C method. The result of the measurement is consequently reported as: age $= T > T_0$. In a more general context, we address the problem of the detection of a weak signal in the presence of noise, caused by a counter background (Currie, 1968). Some implications in the case of radiocarbon dating have been discussed recently by Polach (1976), who tried to evaluate the inadequacy of information when results of age measurements of old samples are reported according to the procedure proposed by Callow and Hassal (1970). A statistical approach to the problem of very old samples has been presented by Gough (in press), who, using the Bayesian approach, developed a probability distribution of age. This treatment seems to be incorrect because it implies that there exists a probability distribution of ages of the samples, while, indeed, there is one real age (^{14}C concentration) which must be regarded as the unknown number we wish to estimate.

It is the purpose of this article to present an exact probability description of the results of age measurements of old samples, based on the notion of fiducial probability distribution. We hope our results will clarify some points of the probabilistic interpretation of "infinite" dates and support the use of 2σ limit proposed by Stuiver (1969), and advocated recently by Stuiver and Polach (1977).

Definitions of the limiting value T_0 differ in various laboratories, similar to the criteria of reporting age in the form ">". It is frequently required that the number of counts of the sample must exceed the background by at least twice the measurement error σ in order to quote the result of dating as $T = T' \pm \Delta T$. In some laboratories the criteria of 3σ and even 4σ are in use. In the case of too small counting rates the quantity T_0 is computed in the usual way, as T', but the value $k\sigma$ is added to the obtained net number of counts. When the sample counting rate is smaller than that of the background, its value may be ignored and $k\sigma$ forms the basis of the computations of T_0. The quantity k may be equal to 2, 1.5, 3, or 4.

The main component of errors in radiocarbon measurements is usually connected with counting statistics. Then, the value of the measurement error σ can be calculated with good accuracy, and the probability distribution of the age of the sample may be given. If the result of the measurement is reported as $T = T' \pm \Delta T$ the reader knows that the real age, or rather the age fit to the real concentration of ^{14}C, for example, lies in the interval $(T' - \Delta T, T' + \Delta T)$ with the probability 0.68. In many applications, knowledge of the correct value of ΔT, which has the sense of a standard deviation, 1σ, is very important. It is inadmissible to overestimate it "for security". Similarly, for old samples, the correct interpretation of the result of dating $T > T_0$ may be needed, the probability of the verity of this inequality.

STATISTICAL APPROACH

A correct statistical interpretation of age measurements should be based on the probability distribution of the measured age T. It is noteworthy that for both finite and infinite ages T should be characterized by the fiducial probability distribution (Hacking, 1965; Kendall and Stuart, 1966), which is the measure of confidence of any statement concerning T. Since the sample that has been dated has only one given concentration of ^{14}C, the fiducial probability distribution usually has no frequency interpretation.

The main quantities constituting the result of the measurement of any sample are: the sample counting rate N_s, background counting rate B, counting rate of the standard of modern ^{14}C activity M, and the mean standard errors σ_N and σ_B of N_s and B, respectively. It has been assumed here that σ_N, σ_B and M are known without errors.

The net sample counting rate is given by

$$N' = \gamma\,(N_s - B), \qquad (1)$$

where γ symbolizes all the normalization constants and experimentally derived correction factors, whose errors are negligible. The value of N′ is known with the error

$$\sigma = (\sigma_N^2 + \sigma_B^2)^{1/2}. \qquad (2)$$

The probability distribution of the counting rate N′ is

$$dP = \frac{1}{\sqrt{2\pi}\,\sigma}\exp\left[-\frac{(N-N')^2}{2\sigma^2}\right]dN', \qquad (3)$$

where N denotes the expected value of N′; then the fiducial probability distribution of N for experimentally determined N′ and σ, is given by

$$dP = \frac{1}{\sqrt{2\pi}\,\sigma}\exp\left[-\frac{(N-N')^2}{2\sigma^2}\right]dN. \qquad (4)$$

An obvious confinement arising from the fact that $N \geqslant 0$ can be accounted for by calculating the conditional probability

$$P(N < \hat{N} < N + dN \mid \hat{N} \geqslant 0) =$$

$$= \frac{P(N < \hat{N} < N + dN \text{ and } \hat{N} \geqslant 0)}{P(\hat{N} \geqslant 0)} = \tag{5}$$

$$= \frac{g(N)\, dN}{\frac{1}{\sqrt{2\pi}\,\sigma} \int_0^\infty \exp\left[- \frac{(x - N')^2}{2\sigma^2} \right] dx},$$

where $\hat{N}$ is a random variable (while N is a number) and

$$g(N) = \begin{cases} \frac{1}{\sqrt{2\pi}\,\sigma} \exp\left[- \frac{(N - N')^2}{2\sigma^2} \right] & \text{for } N \geqslant 0 \\ 0 & \text{for } N < 0 \end{cases} \tag{6}$$

is the cut-off normal probability distribution. After substituting to (5)

$$N = M\, e^{-T/\tau}, \tag{7}$$

where τ is the mean lifetime of radiocarbon, we obtain the probability density function of age

$$f(T) = \frac{1}{\sqrt{2\pi}\,\sigma} \exp\left[- T/\tau - \frac{(M\, e^{-T/\tau} - N')^2}{2\sigma^2} \right] / P(N'/\sigma), \tag{8}$$

where

$$P(x) = \frac{1}{\sqrt{2\,\pi}} \int_{-\infty}^{x} e^{-t^2/2}\, dt. \tag{9}$$

The mode of this probability distribution, the most probable value is given by the equation

$$T_M = -\tau \ln \left[\frac{N' + (N'^2 + 4\sigma^2)^{1/2}}{2M} \right], \tag{10}$$

which in the case of $N' > 0$ can be written as

$$T_M = T' - \tau \ln [1/2 + (1/4 + \sigma^2/N'^2)^{1/2}], \tag{11}$$

where

$$T' = -\tau \ln N'/M. \tag{12}$$

The logarithmic term appearing in eq (11) has the meaning of a correction to the value T′, which in the case of finite dates is quoted as the measured age. The value of this correction is negligible for $N' >> \sigma$, for $N' \approx 3\sigma$ its value constitutes ca 1/3 of the age error ΔT. The expected value, or mean, of the probability distribution (8) is based on the frequency interpretation and is not very important in this case.

PRACTICAL INFERENCES

Except for the complicated form of the probability distribution (8) it is easy to calculate the probability of the relation $T > T_\alpha$, based on the tables of normal probability distribution. Denoting the probability that the relation $T < T_\alpha$ is true by α, we have

$$\text{Prob}\,(T > T_\alpha) = 1 - \alpha =$$

$$= \frac{P\left(\dfrac{M \exp(-T_\alpha/\tau) - N'}{\sigma}\right) - P(-N'/\sigma)}{1 - P(-N'/\sigma)} \quad . \qquad (13)$$

This equation is valid irrespective of the sign of N′. Figure 1 presents the plots of the function $\alpha = \alpha\,(T_\alpha)$ for some values of the parameters N′/M and σ/M. The curves A and B correspond to the case of finite age, quoted as "±". The greater slope of curve A is caused by a smaller value of the measurement error σ. The curves D and E correspond to $N' = 0$, the limiting value T_0 of age in this case obviously depends on the measurement error σ. A comparison of curve D with F, for which $N' < O$, indicates an increase of the limiting age T_0 related only by obtaining a counting rate below the background level (both D and F have been plotted for the same value of the measurement error σ). It looks like a paradox, but even at a low value of the factor of merit, for a high value of the measurement error, the limiting value of age can be arbitrarily high, due to chance (by incidental detection of, for example, $N' = -3\sigma$). Assuming correct performance of the measuring apparatus, which means that the estimated value of σ is equal to the real error of measurement, such a conclusion is justified. It is for the experimenter to decide whether he has observed a rare random event, which may occur, on the average, once in a series of 740 measurements (the 3σ level) of an inactive sample, or if the instability of the background counting rate is greater, σ has been underestimated. If the sample does not contain ^{14}C, the probability of obtaining $N' < 0$ is equal to 0.5. Consequently, if the estimated value of σ is accepted, it is unfounded to discriminate half the results.

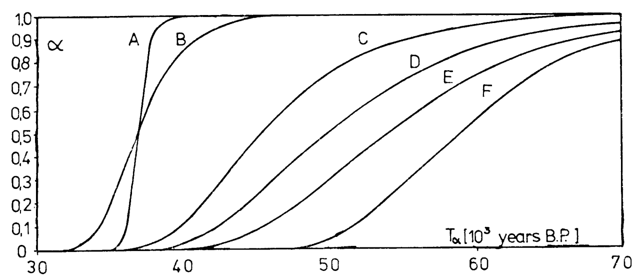

Fig 1. Probability α of the verity of the relation $T < T_\alpha$ as a function of T_α for some values of N′/M and σ/M M: modern counting rate, N′ and σ: measured sample counting rate and measuring error. N′/M and σ/M are equal, respectively, for the curves A: 0.01, 0.001; B: 0.01, 0.003; C: 0.003, 0.003; D: 0, 0.003; E: 0, 0.001; F: −0.003, 0.003.

Using eq (13), we may express T_α as a function of α

$$T_\alpha = -\tau \ln \frac{N'}{M}\left[+ \frac{\sigma}{M} P^{-1}\left(1 - \alpha P\left(\frac{N'}{\sigma}\right)\right)\right], \quad (14)$$

and assuming a certain value of α, we are able to calculate the limiting age T_α of a sample.

For finite dates, quoted as $T = T' \pm \Delta T$, the probability that the inequality $T' - \Delta T < T < T' + \Delta T$ is true, is equal to 0.68. If we want to minimize the differences in the interpretation of dates reported as "±" or ">" we should retain the value of the probability, Prob $(T > T_0) = 0.68$, choose $\alpha = 0.32$.

For $N' > 0$, formula (14) can be written as $T_\alpha = T' + \Delta T_\alpha$, where

$$\Delta T_\alpha = -\tau \ln \left[1 + \frac{\sigma}{N'} P^{-1}\left(1 - \alpha P\left(\frac{N'}{\sigma}\right)\right)\right]. \quad (15)$$

The value of correction ΔT_α depends only on the quotient N'/σ and it has been plotted in figure 2 for some values of α. $\Delta T_{0.5}$ denotes the difference of T' and the median of the probability distribution of age, its value is significant only for $N' < 2\sigma$. The quantities $\Delta T_{0.84}$ and $\Delta T_{0.16}$ correspond to the errors ΔT_1 and ΔT_2 defined by

$$\Delta T_{1,2} = \mp \tau \ln (1 \mp \sigma/N'). \quad (16)$$

The differences between ΔT_1 and $\Delta T_{0.84}$ and between ΔT_2 and $\Delta T_{0.16}$ caused by neglecting the inequality $N \geqslant 0$ became significant for low values of N'/σ. The curve ΔT_M in figure 2 shows a difference between the value of T' and the mode of distribution, defined by eq (10). For

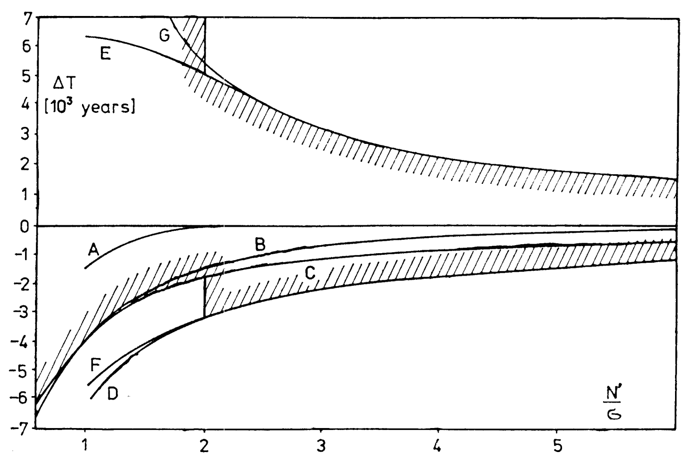

Fig 2. Statistical characteristics of the probability distribution of age. The dashed area denotes age intervals corresponding to the probability 0.68 (for more detailed explanations cf the text). G and F: age errors ΔT_1 and ΔT_2, respectively, according to the eq (16); E, A, C, and D: age differences between $T' = -\tau \ln N'/M$ and T_α defined by eq (14) for the value of probability α equal to 0.84, 0.5 (median), 0.32, and 0.16, respectively; B: difference ΔT_M of the value T' and the mode (eq 10) of the probability distribution of age.

$N' \approx \sigma$, owing to the high asymmetry of the probability distribution (8), we have $\Delta T_M = \Delta T_{0.32}$, while for $-\sigma < N' < 2\sigma$, the difference of these quantities is small in comparison with ΔT_1 or ΔT_2. This property may be used as an additional argument for the acceptance of $T_0 = T_{0.32}$; the reported limiting age would be, at the same time, the most probable age of the sample.

The choice of the value of probability α, at which the statement $T > T_0 = T_\alpha$ is not true, is in fact a question of agreement, as well as the choice of the limiting value of the quotient N'/σ, which marks the boundaries between the regions of "finite" and "infinite" ages. It should be noted that even in the case of $N' < 0$ the age might be quoted as $T' + \Delta T_{0.16} < T < T' + \Delta T_{0.84}$ since $\Delta T_{0.84}$ always has a finite value. From a purely statistical point of view, the procedure of quoting finite age intervals at low values of N'/σ is not justified, since the probability distribution of age is highly asymmetrical. As shown in figure 1, the curves C, D, E, and F have a very low slope in their upper parts, which means that in order to be sure that $T < T' + \Delta T_1$ not at the level 0.84 but at 0.9987, much more than 3 ΔT_1 should be added to T′, as may be expected from a normal probability distribution.

It is difficult to find such a value of the quotient N'/σ, which might be used as a natural boundary between "±" and ">". The curve $\Delta T_{0.84}$ has an inflection at $N'/\sigma = 1.72$ (see fig 2), which means that starting from this point, the value of the upper age limit, $T' + \Delta T_{0.84}$, reveals a slower increase with an increasing measurement error α. Intuition, however, should predict $\Delta T_{0.84}$ to be faster and faster, increasing to infinity. As the value 1.72 does not differ significantly from 2.0, those accepted in most radiocarbon laboratories, and recommended by Stuiver and Polach (1977), and the argument based on the point that inflection is somewhat arbitrary, it seems that 2 should be the best limiting value for the quotient N'/σ. The assumption of greater values is inherently related to a significant loss of information which has been obtained in the measurement. The probability that an inactive sample will produce a counting rate $N' > 2\sigma$ is equal to 0.023.

DISCUSSION AND CONCLUSION

The procedure of treating and reporting results of dating old samples, described above and deduced from rigorous statistical analysis, seems to confirm and supplement the recommendations of Stuiver and Polach (1977). This may be summarized as follows: when the net sample counting rate is greater than twice the standard deviation σ, the age should be reported as $T = T' {}^{+\Delta T_1}_{-\Delta T_2}$ or $T = T' \pm \Delta T$. Otherwise, the result should be reported as $T > T_0$, where T_0 is given by eq (14) for $\alpha = 0.31731$.

The choice of such a value of α is equivalent to accepting the principle of constant probability Prob = 0.68, for the regions of both finite and infinite radiocarbon ages.

The values of ΔT_1 and ΔT_2 should be, in principle, calculated from eq (14) for $\alpha = 0.84$ and $\alpha = 0.16$, respectively, in order to keep constant the probability that $T' - \Delta T_2 < T < T' + \Delta T_1$. Since the difference between the value of $\Delta T_{1,2}$, calculated from eq (16), and $\Delta T_{0.84,0.16}$ does not exceed 10 percent (*cf* fig 2), the simpler equation (16) can be used. In calculations of T_0 eq (14) can be approximated by eq (10); in the interval $-\sigma < N' < 2\sigma$ the error of this approximation does not exceed 300 years (see fig 2).

The use of any value of α is a question of choice, which should be made in agreement with some commonly accepted recommendations. The proposed value of $\alpha = 0.32$ warrants a uniform interpretation of both finite and infinite radiocarbon dates. The procedure of calculating the limiting value of age by assuming $N'' = N' + k\sigma$, where $k = 2$, 3 or 4 is highly asymmetrical and inherently associated with a significant loss of information. If, for example, the 4σ criterion is used, according to the recommendation of Callow and Hassal (1970), and the measured sample counting rate is close to the limiting value $N' \approx 4\sigma$, only the minimum age should be quoted, which in fact corresponds to the 8σ level! There is no reason for using such high values of the significance level. This has been clearly recognized by Stuiver and Polach (1977) who recommend that when the measured sample activity is between 1σ and 2σ, an "apparent age" can be added. As we see it, the procedure of calculating the limiting age by assuming $N'' = N' + k\sigma$ is connected with a risk of the contamination of the sample material with recent carbon. This, however, is quite a different problem which must be solved by means of careful laboratory and field work. As has been indicated by Polach (1976), dating chemical and/or physical fractions of a sample seems to be best for evaluating the possibility and degree of contamination. It should be noted that the problem of sample contamination occurs also for finite radiocarbon ages, where the use of 1σ limits of age, corresponding to a probability of 0.68, has been commonly accepted.

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[RADIOCARBON, VOL 22, No. 4, 1980, P 1028-1030]

DUBLIN RADIOCARBON DATES III

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INTRODUCTION

The dating equipment and operating procedures in the Physical laboratory remained as described previously (R, 1974, v 16, no. 1, p 6-9).

Dates were calculated using the 5568-year half-life with 1950 as the reference year, the modern standard being 0.95 of the activity of the NBS oxalic acid standard. When done, $\delta^{13}C$ was measured on CO_2 produced in the combustion of samples, and results are given relative to the PDB standard. All samples were from Ireland.

ACKNOWLEDGMENTS

I am very grateful to R L Otlet of the Harwell laboratory, who measured the ^{14}C activity and $\delta^{13}C$ ratios of some of the samples and accepted samples of benzene prepared in this laboratory. He kindly allowed me to publish the results in this list; the relevant samples are indicated in the text. Thanks are also due to T J Fitzgerald for making the remaining $\delta^{13}C$ measurements. Financial support from the National Science Council of Ireland is gratefully acknowledged.

I. ARCHAEOLOGIC SAMPLES

Rathgall series, Co Wicklow

Charcoal samples are from a multivallate hillfort with extensive Early Bronze Age settlement and later occupations (Orpen, 1911; Raftery, 1970; 1971) at Rathgall, Rath East townland, 5km E of Tullow, Co Carlow (52° 48′ N, 7° 40′ W, NGR: S 902731) alt 122m. Coll and subm 1969 and 1970 by B Raftery, Dept Archaeol, Univ College, Dublin.

D-133. S151 **2810 ± 110**

Charcoal from pit at SW corner of Hearth 2, Square 32. *Comment* (BR): late Bronze Age provenience.

D-134. S113 **2860 ± 110**

Charcoal from Hearth 1, Square 25. *Comment* (BR): sample from initial late Bronze Age occupation.

D-135. S140 **2490 ± 120**

Charcoal. Wood and cereal grain from upper levels of ditch surrounding circular house, Square 31.

D-132. S400 **2960 ± 110**

$\delta^{13}C = -25.8‰$

Charcoal from upper levels of large basket-lined storage pit outside circular house, Square 18.

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II. GEOLOGIC SAMPLES

D-119. Fethard-on-sea, Co Wexford **4030 ± 120**
$\delta^{13}C = -26.7‰$

Tree roots in gray wedges in glacial deposit lying between high and low water marks on beach at Wood Village, Fethard-on-sea, 10.5km ESE of Waterford (52° 12′ N, 6° 50′ W, NGR: S 803035). Coll and subm 1972 by G F Mitchell, Dept Geol, Univ Dublin. *Comment* (GFM): possible explanation for date is that roots are last vestige of eroded submerged forest that grew at time indicated. Tree roots could not have penetrated to present location if sea stood at present level or higher.

D-136F. Old Head, Co Mayo **10,010 ± 170**
$\delta^{13}C = -25.8‰$

Fine insoluble material <300μm, from organic deposit 3cm thick under 2m glacial till exposed on beach at Old Head, 17km W of Westport, Co Mayo (53° 47′ N, 9° 47′ W, NGR: L 834823). Coll and subm 1972 by G F Mitchell. *Comment*: humic acid fraction dated; D-136H, 10,530 ± 120. Both samples pretreated and converted to benzene in Dublin lab, and counted in Harwell lab as HAR-627 (D-136F) and HAR-628 (D-136H).

Dunmore Cave series, Co Kilkenny

Samples coll during geologic and archaeologic investigations of cave system at Dunmore Cave, 9km N of Kilkenny, Co Kilkenny (52° 44′ N, 7° 15′ W, NGR: S 508658). Coll and subm 1973 by D Huddart and D Drew, Dept Geog, Dublin Univ. *Comment*: all results expresed as % of modern and are uncorrected for isotopic fractionation.

D-137. Sample 1A **40.2 ± 0.9%**
$\delta^{13}C = -6.5‰$

Carbonate from upper 1cm layer of flow-stone floor deposit, 10cm thick, 3m from excavated trench in rabbit burrow area.

D-139. Sample 2 **85.8 ± 1.2%**

Charcoal from immediately above flow-stone floor deposit in excavated trench in rabbit burrow area. *Comment*: sample assoc with archaeologic deposit. Conventional age, 1230 ± 110 BP.

D-141. Sample 4A **53.5 ± 0.9%**
$\delta^{13}C = -6.0‰$

Carbonate from central 2cm core of pendant concretion, 12cm diam, at cave entrance.

D-142. Sample 4B **72.8 ± 1.1%**
$\delta^{13}C = -0.5‰$

Carbonate from outer 2cm layer of same concretion as Sample 4A, D-141.

D-144. Sample 5 **0.7 ± 0.2%**
$\delta^{13}C = -10.8‰$

Carbonate from bottom 1cm layer of flow-stone floor deposit, 5cm thick, in Market Cross chamber. *Comment*: sample activity and $\delta^{13}C$ measured at Harwell lab; HAR-634. Infinite age.

D-149. Sample 9 **44.9 ± 0.4%**
$\delta^{13}C = -3.1‰$

Carbonate from flow-stone floor deposit in Market Cross chamber. *Comment*: sample activity and $\delta^{13}C$ measured in Harwell lab; HAR-637. Sample measured to determine relationship with Sample 5, D-144.

D-147. Sample 7 **114.1 ± 2.6%**
$\delta^{13}C = -14.5‰$

Drip-water sample coll Nov 1973 from Market Cross chamber. *Comment*: sample activity and $\delta^{13}C$ measured in Harwell lab; HAR-635. Bicarbonate in drip-water precipitated as barium carbonate.

D-148. Sample 8 **142.6 ± 1.4%**
$\delta^{13}C = -26.4‰$

Twigs grown summer 1973 from tree growing near cave entrance. Coll Nov 1973. *Comment*: sample activity $\delta^{13}C$ measured at Harwell lab; HAR-636.

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FORTALEZA RADIOCARBON MEASUREMENTS I

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INTRODUCTION

This date list covers a selection of ^{14}C results of hydrologic samples investigated from January 1978 until August 1979. According to convention, the ages were calculated with a ^{14}C half-life of 5568 yr and 0.95% of the activity of NBS oxalic acid standard and are quoted in years before 1950. The recent activity of water is assumed to be 90% modern (Geyh and Kreysing, 1973) and corrections for $^{12}C/^{13}C$ isotopic fractionation have not been made.

The chemical procedure of the sample preparation is to precipitate the carbon already in the field as barium carbonate and then to convert this in the lab to carbon dioxide by treatment with phosphoric acid. The CO_2 is converted to lithium carbide in a reaction with lithium metal (Barker, 1953) and, in a subsequent hydrolysis step, the carbide is transformed to acetylene (Crathorn, 1953).

Acetylene is counted at a pressure of 760 Torr using a copper proportional counter (Geyh, 1967) of an active volume of 690ml, yielding background and standard counting rates of 1.10cpm, respectively, 5.03 cpm.

SAMPLE DESCRIPTIONS

WATER SAMPLES

Picos area series, Piaui, Brazil

Samples described in this section were coll in deep wells in sandstones of Serra Grande aquifer which belongs to basal part of Parnaíba Basin. Exact depth of wells is not known in all cases.

Fixed and free carbonic acid was precipitated by $Ba(OH)_2$. Coll 1978.

FZ-14. Angico Torto **37.1 ± 0.7 % modern**

Well water from 130m depth (07° 06′ 55″ S, 41° 09′ 26″ W); apparent age: 7100 yr.

FZ-34. Barroca **23.1 ± 0.7 % modern**

Well water from (07° 00′ 36″ S, 41° 13′ 50″ W); apparent age: 11,000 yr.

FZ-35. Santo Antonio de Russas **23.9 ± 0.7 % modern**

Well water from 164m depth (06° 59′ 00″ S, 41° 13′ 50″ W); apparent age: 10,650 yr.

FZ-36. Jaicos **37.8 ± 0.8 % modern**

Well water from 89.5m depth (07° 21′ 09″ S, 41° 11′ 01″ W); apparent age: 7000 yr.

FZ-37. Picos-Junco **4.9 ± 0.3 % modern**

Well water from 210m depth (07° 24′ 36″ S, 41° 28′ 06″ W); apparent age: 23,400 yr.

FZ-38. Campestre **9.7 ± 0.4 % modern**

Well water from 77m depth (07° 08′ 36″ S, 41° 27′ 26″ W); apparent age: 18,000 yr.

FZ-40. Itainópolis **27.1 ± 0.7 % modern**

Well water from 120m depth (07° 26′ 54″ S, 41° 28′ 51″ W); apparent age: 9650 yr.

FZ-41. Varzea Grande **10.6 ± 0.8 % modern**

Well water from 141m depth (07° 09′ 00″ S, 41° 29′ 44″ W); apparent age: 17,200 yr.

FZ-43. Pajeu **4.1 ± 0.5 % modern**

Well water from 240m depth (07° 11′ 24″ S, 41° 39′ 12″ W); apparent age: 24,800 yr.

FZ-44. Gameleira **0.7 ± 0.5 % modern**

Well water from 277m depth (07° 09′ 05″ S, 41° 40′ 20″ W); apparent age: 39,000 yr.

FZ-45. Gentil **5.7 ± 1.1 % modern**

Water from artesian well (07° 11′ 52″ S, 41° 41′ 38″ W); apparent age: 22,200 yr.

FZ-53. Curralinho **2.5 ± 0.8 % modern**

Water from artesian well (07° 11′ 18″ S, 41° 45′ 06″ W); apparent age: 28,800 yr.

Iguatú area series, Ceará, Brazil

Samples described in this section were coll in deep wells in metamorphic rock of the Iguatú Basin.

Fixed and free carbonic acid was precipitated by $Ba(OH)_2$. Coll Jan 1978.

FZ-64. Iguatú **11.7 ± 0.3 % modern**

Well water (06° 21′ 05″ S, 39° 17′ 20″ W); apparent age: 16,400 yr.

FZ-65. Quixelô **88.0 ± 0.9 % modern**

Sample from 1st aquifer below surface (06° 15′ 13″ S, 39° 12′ 39″ W); apparent age: 180 yr.

FZ-66. Quixelô **32.8 ± 0.6 % modern**

Sample from 2nd aquifer below surface (06° 15′ 13″ S, 39° 12′ 39″ W); apparent age 9000 yr.

FZ-67. Vila Penha **19.1 ± 0.7 % modern**

Well water from 32m depth (06° 24′ 34″ S, 39° 17° 53″ W); apparent age: 12,450 yr.

FZ-68. Barro Alto **79.9 ± 0.8 % modern**

Well water from 68m depth (06° 26′ 44″ S, 39° 22′ 43″ W); apparent age: 950 yr.

FZ-77. Varzinha **25.6 ± 0.7 % modern**

Well water from 36m depth (06° 19′ 27″ S, 39° 23′ 52″ W); apparent age: 10,100 yr.

FZ-78. Estrada **40.0 ± 0.6 % modern**

Well water from 142m depth (06° 21′ 51″ S, 39° 19′ 14″ W); apparent age: 6500 yr.

FZ-79. Cajazeiras **77.2 ± 1.1 % modern**

Well water from 110m depth (06° 22′ 57″ S, 39° 16′ 15″ W); apparent age: 1230 yr.

Frecheirinha area series, Ceará, Brazil

Samples described in this section were coll in deep wells in metasedimentary rocks of Bambui and Jaibaras Basins.

Fixed and free carbonic acid was precipitated by $Ba(OH)_2$. Coll Feb 1978.

FZ-69. Cipauba **55.4 ± 0.6 % modern**

Well water (03° 47′ 12″ S, 40° 33′ 10″ W); apparent age: 3900 yr.

FZ-70. Coreau **83.6 ± 1.4 % modern**

Well water (03° 33′ 06″ S, 40° 39′ 21″ W); apparent age: 590 yr.

FZ-71. Aprazível **53.9 ± 0.7 % modern**

Well water from 60m depth (03° 45′ 02″ S, 40° 33′ 57″ W); apparent age: 4120 yr.

FZ-72. Posto F Anastácio **71.5 ± 0.9 % modern**

Well water (03° 45′ 06″ S, 40° 49′ 17″ W); apparent age: 1650 yr.

FZ-73. Ibiapina **72.1 ± 1.0 % modern**

Well water (03° 54′ 10″ S, 40° 53′ 36″ W); apparent age: 1780 yr.

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LA JOLLA NATURAL RADIOCARBON MEASUREMENTS IX

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INTRODUCTION

The following date list covers samples dated by the La Jolla Radiocarbon Laboratory during calendar year 1978. All archaeologic, all geologic, and some geochemical and botanical samples measured during that period are included here. Recent measurements of ^{14}C in tree rings and in annual coral rings will be published elsewhere. Plots and discussion of data for corals from Belize and Florida have been published already by Druffel (1980).

Sample preparation technique has remained the same as described by Linick (1977). Results reported here are based on 95% of NBS oxalic acid activity normalized to a $\delta^{13}C$ of −19‰ (PDB). All sample activities have been normalized to a $\delta^{13}C$ of −25‰ (PDB). Mass spectrometric $\delta^{13}C$ measurements were made on all samples and standards using, as previously, CO_2 prepared by recombusting an aliquot of the acetylene counting gas sample. Seven gas proportional counters described by Linick (1977; 1979) were used. Ages listed here are conventional radiocarbon ages BP based on the 5568-year Libby ^{14}C half-life. Uncertainties are given as one sigma statistical standard errors. Where applicable, dates corresponding to the probable true time of origin for terrestrial plant or animal material are given at the end of the sample descriptions. These dates, based on the La Jolla calibration table (Suess, 1979), are presented as possible centuries of growth, with the most probable centuries italicized. The conventional ages for shells and carbonate sediments must be considered to be "apparent ages" only (Linick, 1979).

ACKNOWLEDGMENTS

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I. ARCHAEOLOGIC SAMPLES

A. North America

LJ-4218. Camus, Washington **2500 ± 70**

Charcoal from small limb of Oregon maple tree (*Acer macrophyllum*) from Site 45CL48, Lady I., Camus, Washington (45° 35′ N, 122° 25′ W). Depth 76cm. Assoc with Prehistoric living floor containing nuts of *Quercus* in Unit S7E5. Sample measured to reconstruct paleoenvironment of Lady I. in Columbia R, and to determine rate of midden accumulation at site. Coll June 1977 and subm by J A Woodward, Mt Hood Comm Coll, Gresham, Oregon 97030. Previous ^{14}C dates from site are from other levels: 2370 ± 60, 2320 ± 60, 2420 ± 50 (LJ-3296, -3395, -3398; R, 1977, v 19, p 34); 1970 ± 60 (LJ-3749; R, 1979, v 21). LJ calibration: 7th, *8th,* 9th BC.

LJ-4254. San Joaquin Hills **230 ± 70**

Charcoal from hearth in open shell scatter site in San Joaquin Hills, 6.5km N of Pacific Ocean, 5km E of Upper Newport Bay, Orange Co, California (33° 37′ 22″ N, 117° 49′ 50″ W). Alt 110m. Retrieved from loose, sandy loam from Unit 2, 10 to 20cm sub-surface. Dated to enhance knowledge of aboriginal exploitation/habitation of Upper Newport Bay region of Orange Co. Coll Oct 1977 and subm by William McCawley and John Murray, Archaeol Assoc, 1022-B Victoria St, Costa Mesa, California 92627.

LJ-4255. San Joaquin Hills **330 ± 70**

Charcoal from same site and unit as LJ-4254, above; 30 to 40cm subsurface.

Villa La Cumbre series

Three shell samples from Site SDM-W-147, Villa La Cumbre, N of Alga Rd, La Costa, San Diego Co, California (33° 06′ N, 118° 24′ W). Coll June-July 1977 and subm by C S Bull and M J Hatley, Regional Environmental Consultants, 1094 Cudahy Place, Suite 204, San Diego, California 92110.

LJ-4133. Villa La Cumbre-A **7120 ± 150**

Shells (*Aquipectin*) from Unit E360-N660, 30 to 40cm depth.

LJ-4134. Villa La Cumbre-A **7440 ± 110**

Shells (*Aquipectin*) from Unit E340-N620, 30 to 40cm depth.

LJ-4135. Villa La Cumbre-B **7060 ± 110**

Shells (*Chione* sp) from Unit E354-N327, 30 to 40cm depth.

LJ-4216. Indian Hill, 91 to 107cm **3810 ± 70**

Charcoal from Indian Hill Site 5, a rock shelter in Anza Borrego State Park, San Diego Co, California. Pit D-8, depth 91 to 107cm. Coll April 1961; subm by J L Bada, Scripps Inst Oceanog, La Jolla, California 92093. LJ calibration: 23rd, *24th, 25th* BC.

LJ-4217. Indian Hill, 76 to 91cm **<250**

Charcoal from same site as LJ-4216, above. Pit D-8, depth 76 to 91cm. Coll April 1961; subm by J L Bada.

San Clemente Island series

Twelve samples from San Clemente I., a Southern California coastal island. Samples were measured to date human habitation on the island and to contribute to S coastal chronology. Series started in Linick (1979).

LJ-4130. SCLI/RC-6 **8180 ± 110**

Shells (2 wavy turban shell fragments, 8 abalone shell fragments, and 1 mussel shell fragment) from NE slope of Eel Point dune site SCLI-539 (32° 55′ 07.086″ N, 118° 32′ 38.541″ W). Sample taken from SW side of existing pit at depth of 51 to 66cm. Coll Sept 1977 and subm by L M Axford and R M Carlson, both of Mesa Coll, 7250 Mesa Coll Dr, San Diego, California.

LJ-4131. SCLI/RC-7(A) **5810 ± 90**

Shells (1 wavy turban shell fragment, 7 mussel shell fragments, 1 limpet shell, 11 abalone shell fragments, and 3 sea snail shells) from same location as LJ-4130, above. Sample taken from SW side of existing pit at depth of 38 to 43cm. Coll Sept 1977 and subm by L M Axford and R M Carlson.

LJ-4132. SCLI/RC-7(B) **5650 ± 90**

Single abalone shell from same provenience as LJ-4131, above. Coll Sept 1977 and subm by L M Axford and R M Carlson.

LJ-4170. SCLI/RC-8, charcoal **3110 ± 120**

Charcoal from Site SCLI-1088 (33° 01′ 30.80″ N, 118° 34′ 52.09″ W). Sample taken 41cm below surface in E wall of ravine. Coll Oct 1977 and subm by L M Axford and R M Carlson. LJ calibration: 14th, *15th,* 16th BC.

LJ-4173. SCLI/RC-8, shell **3300 ± 360**

Shell from same provenience as LJ-4170, above. Coll Oct 1977 and subm by L M Axford and R M Carlson. *Comment:* agreement of LJ-4170 and LJ-4173 is very good.

LJ-4168. SCLI/RC-9 **6300 ± 90**

Shells from inside rockshelter, Site SCLI-1093 (33° 01″ 59.80″ N, 118° 35′ 51.35″ W). Taken from depth of 70cm from nominal floor, 140cm down from ceiling. Coll Oct 1977 and subm by L M Axford and R M Carlson.

LJ-4169. SCLI/RC-10 **4950 ± 90**

Shells from same site as LJ-4168, above. Taken at depth of 38 to 43cm from nominal floor, 116cm down from ceiling. Coll Oct 1977 and subm by L M Axford and R M Carlson. Charcoal sample (LJ-4172) from same provenience will be dated in future.

LJ-4219. SCLI/RC-11 **430 ± 70**

Charcoal from Site SCLI-1167, at S end of earth dam in valley NW of national forest on main island rd (32° 58′ 01.453″ N, 118° 32′ 27.240″ W). Taken at depth of 10 to 23cm. Coll Dec 1977 and subm by L M Axford and R M Carlson. Abalone shell sample (LJ-4220) from same provenience will be dated in future.

LJ-4224. SCLI/RC-12 **350 ± 70**

Charcoal from Site SCLI-379, area designation Red/Harding (32° 56′ 09.61″ N, 118° 32′ 55.22″ W). Coll May 1977 and subm by L M Axford. Probable late historic site.

LJ-4532. SCLI/RC-13 **910 ± 50**

Charcoal fragments from fire lens at China Point area site SCLI-1295 (32° 48′ 14.8″ N, 118° 25′ 43″ W). Taken from area 46cm below nominal surface of Unit B. Site is eroding into sea, accelerated by frequent high winds. Coll July 1978 and subm by L M Axford. LJ calibration: AD *12th, 11th,* 10th.

LJ-4533. SCLI/RC-14 **1400 ± 100**

Charcoal fragments from fire lens at same site as LJ-4532, above. Taken 10cm from nominal surface of Unit C. Coll July 1978 and subm by L M Axford. LJ calibration: AD 7th, *6th,* 5th.

LJ-4536. SCLI/RC-15 **36,000 ± 4000**

Abalone shell encrusted with lime deposit from site SCLI-1295, NW of China Point (32° 48′ 14.8″ N, 118° 25′ 32″ W). Other shells in area were also under caliche. Dated to add to SCLI chronology and to study time scale of deposition of caliche over shell.

LJ-4534. Bancroft Ranch, #1 **410 ± 70**

Charcoal from Bancroft Ranch, Site W-389 (32° 44′ 44.15″ N, 117° 00′ 02.81″ W). Unit N15/E160, 46 to 61cm depth. Measured to study chronology of a Kumeyaay Indian village site. Coll June 1975 and subm by L M Axford and D Barbolla.

LJ-4535. Bancroft Ranch, #2 **230 ± 60**

Charcoal from same site as LJ-4534, above. Unit CC-2, 71cm depth. Coll June 1975 and subm by L M Axford and D Barbolla.

B. Europe

Szákmar series

Grain and charcoal samples from Szákmar, a Neolithic Körös site in SE Hungary (46° N, 20° E). Excavated 1975-1976 by Makkay; subm by Marija Gimbutas, Inst Archaeol, Univ California, Los Angeles, California 90024.

LJ-4376. Szákmar, alpha **3260 ± 140**

Caryopsis of cereal grain. Tr (Sj 15) II/neues foed. LJ calibration: 15th, 16th, *17th,* 18th BC.

LJ-4377. Szákmar, beta **3040 ± 140**

Caryopsis of cereal grain. Qr Qs (Sj 16) II/neues foed. LJ calibration: 12th, 13th, *14th, 15th,* 16th BC.

General Comment: LJ-4376 and -4377 were combined for measurement in a larger detector. The measurement of the combined samples gave an age of 3220 ± 100, resulting in an average for the 3 measurements of 3180 ± 70. LJ calibration for single measurement of combined sample: 15th, *16th,* 17th BC. LJ calibration for average: 15th, *16th,* 17th BC. *Comment* (MG): dates are not for a Neolithic settlement.

LJ-4378. Szákmar, gamma **1980 ± 100**

Charcoal. Po Sb (Sj 23) VI/b fakén alsó. LJ calibration: AD *1st; 1st, 2nd,* 3rd, 4th BC.

LJ-4379. Szákmar, delta **3030 ± 110**

Charcoal. Qr Qs (Sj 25) VI/a, b gōdōr-83. LJ calibration: 12th, 13th, *14th, 15th,* 16th BC.

LJ-4380. Szákmar, epsilon **840 ± 130**

Charcoal. Sx (Sj 1) IX/c-gōdōr-85 vèkony cackbar. LJ calibration: AD 13th, *12th, 11th,* 10th.

LJ-4381. Szákmar, zeta **700 ± 130**

Charcoal. Sr (Sj 1) IX/c-gōdōr-85 vèkony cackbar. LJ calibration: AD 15th, 14th, *13th,* 12th, 11th.

General Comment: LJ-4380 and -4381 were combined for measurement in a larger detector. The measurement of the combined samples gave an age of 640 ± 70, resulting in an average for the three measurements of 690 ± 60. LJ calibration for single measurement of combined sample: AD 15th, *14th, 13th.* LJ calibration for average: AD 14th, *13th,* 12th.

LJ-4382. Szákmar, eta **3030 ± 110**

Charcoal. Qr (Sj 5) XIV/b. LJ calibration: 12th, 13th, *14th, 15th,* 16th BC.

Arene Candide series

Charcoal samples from middle to earliest Neolithic levels in cave of Arene Candide, Liguria, Italy (44° 30′ N, 8° 30′ E). Excavated Aug 1977 by Santo Tinè (Univ Genova, Italy); subm by Marija Gimbutas. All depths were measured relative to point 160cm down, and they are given as depth plus 160cm.

LJ-4136. Arene Candide #1 **5940 ± 80**

Charcoal from mid-Neolithic Level 12, Sq R1, depth 176 to 200cm plus 160cm. LJ calibration: 48th, *49th, 50th, 51st,* 52nd BC.

LJ-4137. Arene Candide #2 **5700 ± 90**

Charcoal from mid-Neolithic Level 12, Sq Q1, depth 220 to 225cm plus 160cm. Purpose of dating was to confirm the chronology established by stratigraphy and ceramic typology. LJ calibration: 45th, *46th, 47th, 48th* BC.

LJ-4138. Arene Candide #3 **5940 ± 100**

Charcoal from early Neolithic (or transition between mid and early Neolithic) Level 13A; Sq N3, depth 221 to 228cm plus 160cm; Sq N2, depth 187 to 198cm plus 160cm; and Sq 03, depth 239 to 246cm plus 160cm. Found underlying sherds of painted Rippoli pottery. The 3 squares were coll together as representative of a floor or contemporary horizon due to the find of 3 separate sherds of painted Rippoli fine ceramic (imported ware) in each square. LJ calibration: 48th, *49th, 50th, 51st,* 52nd BC.

LJ-4139. Arene Candide #4 **6230 ± 90**

Charcoal from early Neolithic (or transition between mid and early Neolithic) Level 13B, Sqs M2 and N2, depth 198 to 199cm plus 160cm. Dated to confirm observed stratigraphy and ceramic typology. LJ calibration: *late to mid-6th millennium* BC.

LJ-4140. Arene Candide #5 **6090 ± 90**

Charcoal from early Neolithic Level 13B, Sq N2, depth ca 220cm plus 160cm. From concentration of charcoal found in the *"carbonaia,"* fire pit. LJ calibration: 50th, *51st, 52nd, 53rd, 54th* BC.

LJ-4141. Arene Candide #6 **6220 ± 100**

Charcoal from early Neolithic Level 13C, Sqs M2 and N2, depth 198 to 209cm plus 160cm. LJ calibration: *late to mid-6th millennium* BC.

LJ-4142. Arene Candide #7 **6070 ± 90**

Charcoal from early Neolithic Level 13C, Sq P3, depth ca 268 to 276cm plus 160cm. From the floor around the collapsed domed oven, or *"fourno."* LJ calibration: 50th, *51st, 52nd, 53rd, 54th* BC.

LJ-4143. Arene Candide #8 **6870 ± 100**

Charcoal from earliest Neolithic floor, immediately above Mesolithic Level 15; from Level 14, Sq N2, depth ca 262 to 273cm plus 160cm. Sample is important for dating the first occurrence of the Neolithic in N Italy. LJ calibration: *early 6th millennium to late 7th millennium* BC.

LJ-4144. Arene Candide #9 **6490 ± 100**

Charcoal from earliest Neolithic Level 14, Sq O3, depth ca 279 to 283cm plus 160cm. LJ calibration: *mid-6th millennium* BC.

Toppo Daguzzo series

Four charcoal samples from Toppo Daguzzo, a Bronze age site in Italy. Excavated 1978 by Mirella Cipolloni, Ist Paletnol, Univ Rome; subm by Marija Gimbutas.

LJ-4544. Toppo Daguzzo, 3a **4680 ± 60**

Charcoal from Trench 12—ditch, Level 3-4. LJ calibration: 34th, *35th, 36th, 37th* BC.

LJ-4545. Toppo Daguzzo, 3b **4710 ± 80**

Charcoal from Trench 12–ditch, Level 3-4. LJ calibration: 34th, 35th, *36th, 37th* BC.

LJ-4546. Toppo Daguzzo, 4 **4580 ± 80**

Charcoal from Trench 12—ditch, Level L. LJ calibration: *34th, 35th,* 36th BC.

LJ-4547. Toppo Daguzzo, 4 **4440 ± 70**

Charcoal from Trench 12—ditch, Level L. LJ calibration: 31st, 32nd, 33rd, *34th* BC.

Rendina series

Four charcoal samples from Rendina, a Neolithic site in S Italy (41° N, 16° E). Excavated 1975 by Mirella Cipolloni; subm by Marija Gimbutas.

LJ-4548. Rendina, 1a **7110 ± 140**

Charcoal from C-shaped Ditch No. 4. LJ calibration: *late 7th millennium* BC.

LJ-4549. Rendina, 1b + 1c **6780 ± 100**

Charcoal from C-shaped Ditch No. 4. LJ calibration: *early 6th millennium* BC.

LJ-4550. Rendina, 2a **6530 ± 150**

Charcoal from last level of ditch, No. 14. LJ calibration: *mid-6th millennium* BC.

LJ-4551. Rendina, 2b **6900 ± 150**

Charcoal from last level of ditch, No. 14. LJ calibration: *early 6th to late 7th millennium* BC.

LJ-4449. Achilleion **7490 ± 150**

Charcoal from Achilleion, on edge of Karditsa Plain, near Farsala, Thessaly, Greece (ca 39.3° N, 22.4° E). Settlement is stratified Neolithic site of the Sesklo culture. Includes four periods starting with earliest ceramic period, partially contemporaneous with Anza site in Central Macedonia, Yugoslavia. This sample from Sq A, Quad 1, Level 32; from one of earliest levels at site. Coll and subm by Marija Gimbutas. Many other samples from site previously measured; see Linick (1977). For detailed discussion of archaeology in area, see Gimbutas (1974) and Ferguson *et al* (1976). LJ calibration: *7th millennium* BC.

II. GEOLOGIC SAMPLES

A. Terrestrial

Baja California series

The following wood and charcoal samples were measured to study geologic fault activity in Baja California in the vicinity of 30° 39′ N, 115° 09′ W. All samples from terraces were ironwood (*Olneya tesota*) and were expected to give oldest date for each terrace. Expectations given are those of submitter. Coll and subm by L G Brown, Dept Geol, San Diego State Univ, San Diego, California.

LJ-4365. PSC-1 **360 ± 50**

Wood from Loc 12 (30° 38′ 50″ N, 115° 09′ 15″ W). Coll Nov 1977 to establish upper limit for date of fault's motion. Sample could be older than fault scarp.

LJ-4366. PSC-2 **3530 ± 80**

Charcoal from Excavation 2 (30° 38′ 00″ N, 115° 08′ 36″ W). Coll April 1978 to establish lower limit for date of fault's age. LJ calibration: 18th, *19th, 20th, 21st* BC.

LJ-4383. IA **700 ± 50**

Ironwood from Terrace I (30° 38′ 45″ N, 115° 09′ 10″ W). Coll May 1978. LJ calibration: AD 14th, *13th,* 12th.

LJ-4384. IB **410 ± 70**

Ironwood from Terrace I, Site 14 (30° 38′ 45″ N, 115° 09′ 10″ W).

LJ-4385. IIA **560 ± 50**

Ironwood from Terrace II (30° 38′ 45″ N, 115° 09′ 10″ W). Terrace II expected to be younger than Terrace I. Coll May 1978.

LJ-4386. IIB **330 ± 60**

Ironwood from Terrace II (30° 38′ 45″ N, 115° 09′ 10″ W). Coll May 1978.

LJ-4387. IIIA **340 ± 60**

Ironwood from Terrace III (30° 38′ 45″ N, 115° 09′ 10″W). Terrace III expected to be younger than Terrace II. Coll May 1978.

LJ-4388. IIIB **670 ± 70**

Ironwood from Terrace III (30° 38′ 45″ N, 115° 09′ 10″ W). Coll May 1978.

LJ-4389. IVA **240 ± 60**

Ironwood from Terrace IV (30° 38′ 45″ N, 115° 09′ 10″ W). Terrace IV expected to be younger than Terrace III. Coll May 1978.

LJ-4390. VA **110 ± 30**

Ironwood from Terrace V (30° 38′ 45″ N, 115° 09′ 10″ W). Terrace V expected to be younger than Terrace IV. Coll May 1978.

LJ-4391. VB **850 ± 90**

Ironwood from Terrace V (30° 38′ 45″ N, 115° 09′ 10″ W). Coll May 1978. LJ calibration: AD 13th, *12th, 11th,* 10th.

LJ-4392. VIA **390 ± 60**

Ironwood from Terrace VI (30° 38′ 54″ N, 115° 09′ 18″ W). Was expected to be possibly older than Terrace I, but may be correlative with younger fault movements. Coll May 1978.

B. Marine

LJ-4175. Pacific sediment **14,000 ± 1000**

Coarse fraction of sediment, ca 70% forams, from piston core (32° 09.1′ N, 118° W). M-4-70, 6P, 190 to 210cm depth in core. Sediment had been ultrasonically cleaned to remove fines and then sieved, resulting in fraction >62μ. Ca 10,000 yr BP is date of deglacial meltwater spike. Coll March 1970 and subm by R B Dunbar, Scripps Inst Oceanog.

Indopac-15 sediment series

Organic fraction of deep-sea sediment samples coll on Indopac-15 Expedition of Scripps Inst Oceanog. Box Core 638, coll June 1977 (28° 34.4′ N, 155° 30.3′ W), water depth 5780m. Area is extensive abyssal plain located below low-productivity surface waters. Subm by P M Williams, Scripps Inst Oceanog. Results given in order of increasing depth in core. For interpretation of data, see Williams *et al* (1978).

LJ-4223. 0 to 3cm **10,700 ± 600**

Box Core 2, Sample B, 0 to 3cm depth in core. *Comment:* LJ-4055, previously pub in Linick (1979), from Box Core 2, Sample B, 5 to 7cm depth in core, gave age of 16,000 ± 900.

LJ-4221. 7 to 9cm **18,500 ± 1900**

Box Core 2, Sample A, 7 to 9cm depth in core.

LJ-4222. 11 to 13cm **20,300 ± 2200**

Box Core 2, Sample A, 11 to 13cm depth in core.

LJ-4301. 13 to 15cm **>23,700**

Box Core 2, 13 to 15cm depth in core. *Comment:* LJ-4054, previously pub in Linick (1979), from Box Core 2, Sample B, 19 to 21cm depth in core, gave age of >22,000; date revised to >24,300 in Williams *et al* (1978).

Pleiades sediment series

Four sediment samples from the deep Pacific Ocean (1° 08′ N, 109° 15′ 06″ W), sub-core from box core coll on Pleiades-72 Expedition of Scripps Inst Oceanog. Water depth 3626m. Coll May to Sept 1976 for W H Berger; subm by R C Finkel, both of Scripps Inst Oceanog.

LJ-4518. 0 to 3cm **3980 ± 70**

Sediment from 0 to 3cm depth in core; inorganic fraction.

LJ-4519. 3 to 5cm **4200 ± 100**

Sediment from 3 to 5cm depth in core; inorganic fraction.

LJ-4520. 18 to 20cm **6810 ± 70**

Sediment from 18 to 20cm depth in core; inorganic fraction.

LJ-4521. 35 to 36cm **12,600 ± 180**

Sediment from 34 to 36cm depth in core; inorganic fraction.

III. GEOCHEMICAL SAMPLES

A. Marine organisms

Marine organism series

Three specimens of rat-tail fish (*Coryphaenoides armatus*) caught in gill nets in the deep central Pacific Ocean. Measurements made on muscle sampled from frozen specimens. Coll Dec 1977 on the BMET Cruise. Obtained from K Smith; subm by P M Williams.

LJ-4737. BMET-1-PW $\Delta = +45 \pm 12‰$
$\delta^{13}C = -18.4‰$

Fish from Sta C-48 (32° 33.6′ N, 120° 26.3′ W). Caught 400m above bottom; bottom depth ca 3800m. Dry weight 3.8g.

LJ-4338. BMET-2-PW $\Delta = +27 \pm 7‰$
$\delta^{13}C = -18.3‰$

Fish from Sta C-48 (32° 33.6′ N, 120° 26.3′ W). Caught 300m above bottom; bottom depth ca 3800m. Dry weight 4.2g.

LJ-4339. BMET-3-PW $\Delta = +37 \pm 8‰$
$\delta^{13}C = -19.7‰$

Fish from Sta C-69 (32° 34.3′ N, 120° 28.9′ W). Caught 50m above bottom; bottom depth ca 3800m. *Comment:* ^{14}C was previously measured in rat-tail fish coll June 1977 at 28° 30′ N, 155° 30′ W; coll 800m above bottom; bottom depth 5800m. $\Delta = +37 \pm 10‰$, $\delta^{13}C = -18.7‰$ (LJ-4057; Linick, 1979).

B. Seawater sample

LJ-4256. Ross Ice Shelf Project $\Delta = -73 \pm 7‰$
$\delta^{13}C = -2.4‰$

Dissolved inorganic carbon from 20m below bottom of ice; coll at hole J-9 drilled in Ross Ice Shelf, Antarctica, on 29 Dec 1977 by S Jacobs for author's use. Site is 400km S of edge of Ross Ice Shelf (82° 22.5′ S, 168° 37.5′ W). For interpretation of ^{14}C and tritium data for samples coll at site, see Michel *et al* (1979).

IV. BOTANICAL SAMPLES

Palm tree series

Samples from a palm tree (*Cocos nucifera*) grown near Aracaju, Sergipe state, NE Brazil (ca 11° 00′ S, 37° 01′ W); alt near sea level. Tree had grown for ca 110 to 120 yr. Slices were taken at 1m intervals up the tree. Highest samples, from 17.4m above bottom, were taken just below oldest leaves. At each level, one sample was obtained from the outside of the cross-section (ca 0.5 through 2cm from the bark), and one was obtained from the inside of the cross-section (0 through 3 to 4cm from the center). Palm trees do not form annual rings, but rather grow in a more cylindrical, vertical manner than ring-forming trees. Samples were measured to study growth pattern, using bomb-produced carbon-14 as a tracer. Wood was pretreated with acetone, alkali, and acid; cellulose was not extracted for use in this project. Because annual rings are not formed and the wood analyzed is not of a known age, no decay correction could be made in the Δ values given below. Subm by LHG Wiesberg, Chemistry Dept, Pontifícia Univ Católica Rio de Janeiro, Brazil. *Comment* (LHGW): palm trees, which are monocotyledons, grow primarily cylindrically and vertically with no significant thickening of diam with age, unlike non-monocotyledenous trees. There is a question of whether palms thicken slightly with age, a phenomenon that may be designated "diffuse secondary growth." Vascular bundles are dispersed throughout the stem with widely scattered bundles in the center and more densely concentrated bundles on the outside. A single vascular bundle enters the tree stem at a leaf base and rapidly crosses the cortex to the center of the stem; however, as a tree grows, the bundle will travel gradually toward the periphery.

The high ^{14}C value of the inside sample at 9.4m may indicate that the sample contained an active vascular bundle, allowing late growth to give the stem added strength. At the 16.4m level, the higher bomb ^{14}C level of the inside sample compared to that of the outside sample indicates that cells in the center remain active longer than those near the cortex.

LJ no.	Height above bottom (m)	Inside/outside (I)/(O)	Δ (‰)
-4305	17.4	O	+416 ± 10
-4308	17.4	I	+409 ± 10
-4306	16.4	O	+184 ± 7
-4307	16.4	I	+240 ± 7
-4100	15.4	O	+16 ± 8
-4099	15.4	I	+30 ± 8
-4450	12.4	O	−20 ± 8
-4451	12.4	I	−4 ± 8
-4303	9.4	O	−17 ± 6
-4304	9.4	I	+87 ± 8
-4452	8.4	O	−3 ± 8
-4453	8.4	I	+8 ± 8
-4454	5.4	O	−1 ± 6
-4455	5.4	I	−12 ± 7
-4102	2.4	O	−9 ± 8
-4101	2.4	I	−7 ± 7

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UNIVERSITY OF LUND RADIOCARBON DATES XIII

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INTRODUCTION

Most of the ^{14}C measurements reported here were made between October 1978 and October 1979. Equipment, measurement, and treatment of samples are as reported previously (R, 1968, v 10, p 36-37; 1976, v 18, p 290) except for some minor improvements of the electronic equipment. Sediment samples too small to allow pretreatment, are now burned at <650°C in order to avoid pyrolysis of carbonates that may be present in the samples. Same max combustion temperature is used for samples with suspected graphite contamination. A movable thermocouple (Philips TERMOCOAX TCI 30/50/3) in the combustion zone is used for checking the temperature.

Age calculations are based on a contemporary value equal to 95% of the activity of NBS oxalic acid standard and on the conventional half-life for ^{14}C of 5568 yr. Results are reported in years before 1950 (years BP). Errors quoted ($\pm 1\sigma$) include standard deviations of count rates for the unknown sample, contemporary standard, and background.

Corrections for deviations from $\delta^{13}C = -25.0‰$ in the PDB scale are applied for all samples; also for marine shells. The apparent age for marine material due to the reservoir effect must be subtracted from our dates on such samples.

The remark "undersized; diluted", in *Comments* means the sample did not produce enough CO_2 to fill the counter to normal pressure and "dead" CO_2 from anthracite was introduced to make up the pressure. "% sample" indicates amount of CO_2 derived from the sample present in the diluted counting gas; the rest is "dead" CO_2. Organic carbon content reported for bone samples is calculated from yield of CO_2 by combustion of gelatine remaining after treatment. Organic carbon lost during treatment is not included in calculated percentage.

The description of each sample is based on information provided by the submitter.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Sweden

Abisko series (I)

Sediment from Lake Vuolep Njakajaure (68° 20′ N, 18° 45′ E) and Lake Vuoskojare (68° 21′ N, 19° 03′ E) in Abisko valley, N Sweden. Coll

1977-78 by M Hjelmroos, J Mikaelsson, and G Digerfeldt; subm by M Hjelmroos, Dept Quaternary Geol, Univ Lund. Dating is part of palaeoecologic study, belonging to IGCP Subproject 158B (Berglund, 1979), of postglacial vegetational history in area. Depths refer to sediment surface. All samples consisted of fine detritus gyttja or clayey gyttja (Vuoskojaure), and were pretreated with HCl. Six samples undersized; diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample".

Vuolep Njakajaure, Profile 1

Coll 1977. Water depth at sampling point 13.9m.

Lu-1517. Vuolep Njakajaure 1, 228 to 230cm **7280 ± 75**
$\delta^{13}C$ = –30.3‰

Lu-1518. Vuolep Njakajaure 1, 218 to 220cm **6640 ± 75**
$\delta^{13}C$ = –30.1‰

Lu-1587. Vuolep Njakajaure 1, 208 to 210cm **3810 ± 60**
$\delta^{13}C$ = –28.0‰

Lu-1519. Vuolep Njakajaure 1, 194 to 196cm **3470 ± 60**
$\delta^{13}C$ = –28.5‰

Lu-1520. Vuolep Njakajaure 1, 168 to 170cm **3180 ± 70**
$\delta^{13}C$ = –28.4‰

Comment: 66% sample.

Lu-1521. Vuolep Njakajaure 1, 130 to 134cm **2300 ± 50**
$\delta^{13}C$ = –28.0‰

Lu-1522. Vuolep Njakajaure 1, 122 to 126cm **1850 ± 50**
$\delta^{13}C$ = –27.9‰

Lu-1523. Vuolep Njakajaure 1, 100 to 104cm **1540 ± 55**
$\delta^{13}C$ = –27.5‰

Comment: 91% sample.

Vuolep Njakajaure, Profile 2

Coll 1978. Water depth at sampling point 13.75m.

Lu-1672. Vuolep Njakajaure 2, 100 to 105cm **2570 ± 55**
$\delta^{13}C$ = –27.6‰

Lu-1671. Vuolep Njakajaure 2, 75 to 80cm **2050 ± 50**
$\delta^{13}C$ = –28.2‰

Lu-1670. Vuolep Njakajaure 2, 50 to 55cm **1580 ± 50**
$\delta^{13}C$ = –27.7‰

Lu-1669. Vuolep Njakajaure 2, 32.5 to 37.5cm **900 ± 50**
$\delta^{13}C$ = –27.5‰

Vuoskojaure

Coll 1978. Water depth at sampling point 12.8m.

Lu-1653. Vuoskojaure, 125 to 130cm **6830 ± 90**
$\delta^{13}C = -26.4‰$

Comment: 72% sample.

Lu-1654. Vuoskojaure, 94 to 98cm **4490 ± 75**
$\delta^{13}C = -26.5‰$

Comment: 73% sample.

Lu-1655. Vuoskojaure, 72 to 76cm **3480 ± 70**
$\delta^{13}C = -26.3‰$

Comment: 73% sample.

Lu-1656. Vuoskojaure, 23 to 27cm **1970 ± 70**
$\delta^{13}C = -26.4‰$

Comment: 65% sample.

Bjärsjön series

Sediment from Lake Bjärsjön, Billingen, S Sweden (58° 20′ N, 13° 40′ E). Alt 255m; area 15ha; max depth 8m. Coll 1976 and subm by G Digerfeldt, Dept Quaternary Geol, Univ Lund. Dating is part of study of Late Weichselian development of lake and surrounding region. Samples come from profile in E part of lake (Livingstone corer, diam 10cm). Water depth 4m at sampling point. Depths given are below sediment surface. All samples pretreated with HCl.

Lu-1589. Bjärsjön, 613 to 615cm **11,260 ± 100**
$\delta^{13}C = -24.7‰$

Clay gyttja.

Lu-1590. Bjärsjön, 598 to 600cm **10,890 ± 90**
$\delta^{13}C = -25.8‰$

Clay gyttja. *Comment*: sample undersized; diluted; 92% sample. (3 1-day counts.)

Lu-1591. Bjärsjön, 582 to 584cm **10,830 ± 100**
$\delta^{13}C = -24.1‰$

Clay gyttja.

Lu-1592. Bjärsjön, 574 to 576cm **10,450 ± 100**
$\delta^{13}C = -23.9‰$

Clay gyttja.

Lu-1593. Bjärsjön, 563 to 565cm **10,220 ± 95**
$\delta^{13}C = -22.5‰$

Clay gyttja.

Lu-1594. Bjärsjön, 551 to 553cm **9840 ± 95**
$\delta^{13}C = -23.5‰$

Clay gyttja.

Lu-1595. Bjärsjön, 537 to 539cm **9560 ± 90**
$\delta^{13}C = -26.6‰$

Detritus gyttja.

Lu-1588. Bergsjön, 249 to 253cm **11,970 ± 105**
$\delta^{13}C = -19.8‰$

Silty clay gyttja from Lake Bergsjön, Mösseberg, S Sweden (58° 12′ N, 13° 30′ E). Alt 306m; area 0.9ha; max depth 4.5m. Coll 1976 and subm by G Digerfeldt. Dating is part of same study as Bjärsjön series, above. Sample comes from profile in E part of lake (Livingstone corer, diam 10cm). Water depth 1m at sampling point. Depth given is below sediment surface. *Comment*: no pretreatment because of small organic content. Burned at <650°C to avoid pyrolysis of carbonates that may be present in untreated samples.

Växjösjön series

Sediment from Lake Växjösjön at town of Växjö, S Sweden (56° 52′ N, 14° 49′ E). Alt 161m; area 87ha; max depth 6.5m. Coll 1972-73 and subm by G Digerfeldt. Dating is part of study of development of lake and surrounding region during last *ca* 2500 yr. For other dates from this lake, see R, 1974, v 16, p 312-314. Samples come from profile in central part of lake (Livingstone corer, diam 6cm). Water depth 5.5m at sampling point. Depths given are below sediment surface. Pretreated with HCl.

Lu-1639. Växjösjön, 415 to 420cm **2500 ± 55**
$\delta^{13}C = -27.9‰$

Detritus gyttja.

Lu-1640. Växjösjön, 395 to 400cm **1710 ± 50**
$\delta^{13}C = -28.1‰$

Detritus gyttja.

Lu-1638. Växjösjön, 375 to 380cm **1610 ± 65**
$\delta^{13}C = -27.4‰$

Detritus gyttja. *Comment*: sample undersized; diluted; 60% sample.

Central Blekinge series (II)

Sediment from Lake Logylet (56° 18′ N, 14° 59′ E), alt 61m, and Lake Halsjön (56° 14′ N, 15° 19′ E), alt 30m, Central Blekinge, S Sweden. Coll 1978 and subm by S Björck, Dept Quaternary Geol, Univ Lund. Dating is part of study of Late Weichselian stratigraphy and shore-line displacement in Blekinge (Björck, 1979). For additional dates in same series, see R, 1979, v 21, p 389-391. Samples are from cores taken with Livingstone sampler, 10cm diam. Depths refer to water surface. No pretreatment because of low organic content. Chronozones below according to Mangerud *et al* (1974).

Logylet

Lu-1597. Logylet 2, 1015 to 1018cm **11,810 ± 190**
$\delta^{13}C = -23.2‰$

Clay gyttja. Lower part of Alleröd Chronozone. *Comment*: sample undersized; diluted; 40% sample. (3 1-day counts.)

Lu-1598. Logylet 3, 995 to 998cm **11,040 ± 150**
$\delta^{13}C = -25.5‰$

Clayey gyttja. Boundary between Alleröd and Younger Dryas Chronozones. *Comment*: undersized; diluted; 47% sample. (3 1-day counts.)

Halsjön

Lu-1599. Halsjön 1, 532 to 538cm **12,890 ± 190**
$\delta^{13}C = -23.3‰$

Clay. Uppermost part of Alleröd Chronozone according to pollen analysis. The reason for difference between radiocarbon age and expected age is discussed by submitter (Björck, 1979, p 119-120). *Comment*: undersized; diluted; 45% sample. (3 1-day counts.)

Lu-1600. Halsjön 2, 525 to 530cm **12,090 ± 145**
$\delta^{13}C = -25.0‰$

Clay. Lowermost part of Younger Dryas Chronozone. *Comment*: undersized; diluted; 55% sample. (3 1-day counts.)

Lu-1601. Halsjön 3, 507 to 511cm **10,760 ± 100**
$\delta^{13}C = -22.8‰$

Muddy clay. Middle part of Younger Dryas Chronozone.

Lu-1602. Halsjön 4, 502 to 507cm **10,560 ± 100**
$\delta^{13}C = -24.0‰$

Muddy clay. Middle part of Younger Dryas Chronozone.

Lu-1603. Halsjön 5, 498 to 502cm **10,740 ± 105**
$\delta^{13}C = -24.6‰$

Slightly muddy clay. Upper part of Younger Dryas Chronozone. *Comment*: undersized; diluted; 92% sample.

Lu-1604. Halsjön 6, 491 to 495cm **10,260 ± 95**
$\delta^{13}C = -24.1‰$

Clay gyttja. Upper part of Younger Dryas Chronozone.

Lu-1605. Halsjön 7, 482 to 485cm **9760 ± 90**
$\delta^{13}C = -25.9‰$

Clayey gyttja. Lowermost part of Pre-Boreal Chronozone.

Håkulls mosse series (II)

Sediment from bog Håkulls mosse on hill ridge Kullaberg, NW Scania (56° 17′ N, 12° 31′ E). Alt *ca* 125m. Coll 1975 and subm by B E Berglund, Dept Quaternary Geol, Univ Lund. Samples are from core taken with Livingstone sampler, 10cm diam. Depths refer to bog surface.

Dated as complement to Håkulls mosse series (R, 1978, v 20, p 416-417). Pretreated with HCl.

Lu-1618. Håkulls mosse 11, 838 to 840cm **11,700 ± 105**
$\delta^{13}C$ = −23.2‰

Clayey gyttja. Rational *Empetrum* curve. Beginning of Alleröd.

Lu-1619. Håkulls mosse 12, 768 to 770cm **10,500 ± 100**
$\delta^{13}C$ = −25.8‰

Clayey gyttja. Upper *Artemisia*-zone boundary. Middle of DR 3.

Lu-1686. Kroksjön **580 ± 50**
$\delta^{13}C$ = −28.6‰

Detritus gyttja, 75 to 77.5cm below sediment surface, from Lake Kroksjön, Kristdala parish, S Sweden (57° 24′ N, 16° 06′ E). Coll 1979 and subm by M Aronsson and Th Persson, Dept Quaternary Geol, Univ Lund. Level with marked increase of *Juniperus* and herbs, indicating human activity. Pollen analysis by M Hjelmroos. Pretreated with HCl.

Svedaskogen series (II)

Barnacle and bivalve shells from gravel pit at Svedaskogen, *ca* 3km N of Fjärås church, Halland (57° 29′ N, 12° 10′ 30″ E). Coll 1978 and subm by Å Hillefors, Dept Phys Geog, Univ Lund. Dated as complement to Svedaskogen series (R, 1979, v 21, p 393).

Lu-1675. Svedaskogen 1978, *Balanus* **13,110 ± 115**
$\delta^{13}C$ = +0.1‰

Barnacle shells (*Balanus* sp) from shell bank with eroded upper surface overlain by glaciofluvial sand and wave-washed material. *Comment*: outer 73% removed by acid leaching.

Lu-1676. Svedaskogen 1978, *Mytilus* **13,080 ± 115**
$\delta^{13}C$ = −1.0‰

Mytilus fragments from same shell bank as Lu-1675, above. *Comment*: outer 30% removed by acid leaching.

General Comment: corrections for deviations from $\delta^{13}C$ = −25‰ PDB are applied also for shell samples. No corrections are made for apparent age of shells of living marine organisms due to the reservoir effect.

B. Norway

Østrevand series

Sediment from Lake Østrevand, Varanger Peninsula, N Norway (70° 09′ 15″ N, 29° 28′ E). Coll 1976 and subm by B Malmström and O Palmér, Dept Phys Geog, Univ Lund. Depths are below sediment surface. Dated as complement to Varanger Peninsula Series II (R, 1978, v 20, p 422-423). No pretreatment; small samples; burned at <650°C to avoid carbonate pyrolysis and graphite oxidation.

Lu-1620. Østrevand 7-Ib, 69 to 74cm **7180 ± 75**
$\delta^{13}C$ = −24.8‰

Clayey gyttja.

Lu-1621. Østrevand 8-lb, 109 to 114cm **9220 ± 100**
$\delta^{13}C = -26.0‰$

Clayey gyttja. *Comment*: sample undersized; diluted; 80% sample.

Lerøy series

Sediment samples from small lakes on Lerøy I., Hordaland, W Norway (60° 14′ N, 5° 11′ E). Coll 1978 and subm by K Krzywinski, Bot Mus, Univ Bergen. Dated as part of study of sea-level changes in area. For other dates from area, see R, 1978, v 20, p 423-424; 1979, v 21, p 394-395. Acid-precipitated part of NaOH-soluble fraction used for dating.

Lu-1580A. Storevatn, Lerøy, No. 10573 **7330 ± 75**
$\delta^{13}C = -28.1‰$

Lacustrine gyttja with diatoms indicating brackish water. Absolute max of Tapes transgression.

Lu-1581A. Storevatn, Lerøy, No. 10590 **9420 ± 85**
$\delta^{13}C = -22.9‰$

Lacustrine gyttja from level for 1st isolation of lake basin.

Lu-1582A. Austretjønn, Lerøy, No. 10351 **2860 ± 55**
$\delta^{13}C = -30.5‰$

Lacustrine gyttja from isolation contact.

Lu-1583A. Vestretjønn, Lerøy, No. 10393 **3600 ± 55**
$\delta^{13}C = -28.5‰$

Lacustrine gyttja from isolation contact.

Rondane series

Subfossil wood from 3 small lakes in Rondane mt area, Østlandet, Norway. Samples pretreated with HCl and NaOH.

Lu-995. Kåsi, Mysuseter **4890 ± 65**
$\delta^{13}C = -25.1‰$

Wood (*Pinus* sp) id by T Bartholin from bottom of unintentionally drained small lake near Kåsi Mt, *ca* 1km N of Mysuseter (61° 49′ N, 9° 40′ E). Alt *ca* 1000m. Coll 1974 and subm by A Lima-de-Faria, Dept Molecular Cytogenetics, Univ Lund. Sample taken from firmly rooted stump. Site described by submitter (Lima-de-Faria, 1977).

Lu-1692. Haverdalen **8240 ± 80**
$\delta^{13}C = -23.7‰$

Wood (*Pinus silvestris*) from *ca* 50cm thick tree-trunk from small lake 500m SE of Haverdalsseter (62° 02′ N, 9° 40′ E). Alt 1030m. Treetop visible at lake surface. Coll 1976 by E K Barth, Zool Mus, Oslo; subm by E K Barth and A Lima-de-Faria. *Ca* 20km to nearest *Pinus* forest today. Sample contained 41 tree rings in *ca* 20mm and probably came from outer part of tree.

Lu-1693. Illmanndalen **8320 ± 80**
$\delta^{13}C = -26.5‰$

Wood (*Betula* sp) id by T Bartholin from peat 7cm above bedrock and 18m from shore of Fremre Illmanntjern (61° 52.5′ N, 9° 49′ E). Alt 1220m. Coll 1972 by P Vassrusten; subm by E K Barth and A Lima-de-Faria. *Ca* 15km to nearest *Betula* forest today. Sample probably piece of small root with *ca* 15 indistinct tree rings.

C. Iceland

Vatnskotsvatn series

Sediment from 2 profiles in Lake Vatnskotsvatn, Skagafjördur area, N Iceland (65° 42′ 05″ N, 19° 28′ 50″ W). Coll 1977 and subm by M Hallsdóttir, Dept Quaternary Geol, Univ Lund. Dated as part of study of Postglacial vegetational history of surrounding region and for correlation of volcanic ash layers in the profiles with similar layers dated in other areas. Samples taken with Livingstone sampler, 6cm diam. Depths refer to water surface. All samples except Lu-1644 and Lu-1648 undersized; diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample". No pretreatment. Burned at <650°C to avoid pyrolysis of carbonates.

Lu-1641. Vatnskotsvatn 793:1, 760 to 765cm **2330 ± 55**
$\delta^{13}C = -21.2‰$

Detritus gyttja. *Comment*: 70% sample. (3 1-day counts.)

Lu-1642. Vatnskotsvatn 793:2, 710 to 715cm **1830 ± 55**
$\delta^{13}C = -20.9‰$

Detritus gyttja. *Comment*: 90% sample.

Lu-1643. Vatnskotsvatn 793:3, 660 to 665cm **1850 ± 60**
$\delta^{13}C = -20.6‰$

Detritus gyttja. *Comment*: 75% sample.

Lu-1644. Vatnskotsvatn 793:4, 610 to 615cm **1700 ± 50**
$\delta^{13}C = -20.0‰$

Detritus gyttja.

Lu-1645. Vatnskotsvatn 793:5, 560 to 565cm **1530 ± 50**
$\delta^{13}C = -19.2‰$

Detritus gyttja. *Comment*: 94% sample.

Lu-1646. Vatnskotsvatn 793:6, 510 to 515cm **1320 ± 55**
$\delta^{13}C = -19.6‰$

Detritus gyttja. *Comment*: 80% sample.

Lu-1647. Vatnskotsvatn 793:7, 460 to 465cm **1330 ± 55**
$\delta^{13}C = -18.7‰$

Detritus gyttja. *Comment*: 78% sample.

Lu-1648. Vatnskotsvatn 793:8, 410 to 415cm **1380 ± 50**
$\delta^{13}C = -19.3‰$

Detritus gyttja.

Lu-1649. Vatnskotsvatn 793:9, 360 to 365cm **1450 ± 55**
$\delta^{13}C = -20.9‰$

Detritus gyttja. *Comment*: 79% sample.

Lu-1650. Vatnskotsvatn 793:10, 297 to 302cm **1590 ± 60**
$\delta^{13}C = -20.3‰$

Detritus gyttja. *Comment*: 67% sample.

Lu-1651. Vatnskotsvatn 793:11, 247 to 252cm **1390 ± 60**
$\delta^{13}C = -21.2‰$

Detritus gyttja. *Comment*: 74% sample.

Lu-1682. Vatnskotsvatn 416:13, 386 to 393cm **8990 ± 155**
$\delta^{13}C = -21.3‰$

Fine detritus gyttja. No *Betula* pollen. *Comment*: 33% sample (3 1-day counts.)

Lu-1683. Vatnskotsvatn 416:14, 338 to 343cm **7660 ± 115**
$\delta^{13}C = -17.7‰$

Coarse detritus gyttja. 1st *Betula* min. *Comment*: 53% sample.

Lu-1684. Vatnskotsvatn 416:15, 309 to 316cm **6570 ± 75**
$\delta^{13}C = -20.3‰$

Fine detritus gyttja. A few cm below 2nd *Betula* max. *Comment*: 85% sample.

Lu-1685. Vatnskotsvatn 416:16, 267 to 272cm **6040 ± 100**
$\delta^{13}C = -19.8‰$

Coarse detritus gyttja. *Comment*: 56% sample.

Lu-1724. Vatnskotsvatn 416:17, 228 to 234cm **4470 ± 95**
$\delta^{13}C = -20.9‰$

Coarse detritus gyttja. *Comment*: 51% sample.

Lu-1725. Vatnskotsvatn 416:18, 176 to 182cm **2710 ± 70**
$\delta^{13}C = -17.5‰$

Coarse detritus gyttja. *Comment*: 65% sample.

D. Poland

Wielkie Gacno series

Sediment from Lake Wielkie Gacno, NW Poland (53° 47′ 40″ N, 17° 33′ 45″ E). Coll 1977-78 by G Digerfeldt and M Hjelmroos; subm by M Hjelmroos. Dating is part of study of Postglacial vegetational history of surrounding area. Study belongs to IGCP Subproject 158B (Berglund, 1979). Depths refer to sediment surface. All samples pretreated with HCl except Lu-1637, which is wood from dugout canoe from bottom of lake (pretreated with HCl and NaOH).

Profile 1

Coll 1977. Water depth at sampling point *ca* 5m.

Lu-1531. Wielkie Gacno, 799 to 803cm **9870 ± 90**
$\delta^{13}C = -25.5‰$

Silty algal gyttja.

Lu-1532. Wielkie Gacno, 775 to 780cm **9280 ± 90**
$\delta^{13}C = -19.7‰$

Algal gyttja.

Lu-1533. Wielkie Gacno, 750 to 755cm **8830 ± 85**
$\delta^{13}C = -21.7‰$

Algal gyttja.

Lu-1534. Wielkie Gacno, 725 to 730cm **8350 ± 80**
$\delta^{13}C = -23.5‰$

Algal gyttja.

Lu-1535. Wielkie Gacno, 675 to 680cm **8120 ± 80**
$\delta^{13}C = -22.9‰$

Algal gyttja.

Lu-1536. Wielkie Gacno, 625 to 630cm **7160 ± 75**
$\delta^{13}C = -22.9‰$

Algal gyttja.

Lu-1469. Wielkie Gacno, 575 to 580cm **6590 ± 70**
$\delta^{13}C = -17.3‰$

Algal gyttja.

Lu-1537. Wielkie Gacno, 525 to 530cm **5950 ± ± 65**
$\delta^{13}C = -21.0‰$

Algal gyttja.

Lu-1538. Wielkie Gacno, 475 to 480cm **5430 ± 65**
$\delta^{13}C = -20.6‰$

Algal gyttja.

Lu-1539. Wielkie Gacno, 445 to 450cm **5130 ± 60**
$\delta^{13}C = -21.0‰$

Algal gyttja.

Lu-1470. Wielkie Gacno, 425 to 430cm **4810 ± 60**
$\delta^{13}C = -15.6‰$

Algal gyttja.

Lu-1540. Wielkie Gacno, 75 to 80cm **1220 ± 50**
$\delta^{13}C = -23.7‰$

Detritus gyttja.

Lu-1541. Wielkie Gacno, 25 to 30cm **780 ± 50**
$\delta^{13}C = -26.0‰$

Detritus gyttja.

Profile 2

Coll May 1978. Water depth at sampling point *ca* 5m.

Lu-1608. Wielkie Gacno, 390 to 395cm **4230 ± 60**
$\delta^{13}C = -15.5‰$

Algal gyttja.

Lu-1609. Wielkie Gacno, 340 to 345cm **3740 ± 55**
$\delta^{13}C = -16.5‰$

Algal gyttja.

Lu-1610. Wielkie Gacno, 290 to 295cm **3320 ± 55**
$\delta^{13}C = -18.7‰$

Algal gyttja.

Lu-1611. Wielkie Gacno, 240 to 245cm **2650 ± 55**
$\delta^{13}C = -19.9‰$

Algal gyttja.

Lu-1612. Wielkie Gacno, 195 to 200cm **2250 ± 50**
$\delta^{13}C = -22.8‰$

Algal gyttja.

Lu-1613. Wielkie Gacno, 140 to 145cm **1790 ± 50**
$\delta^{13}C = -22.5‰$

Algal gyttja.

Profile 3

Coll Oct 1978. Water depth at sampling point 1.7m.

Lu-1678. Wielkie Gacno, 197 to 201cm **11,840 ± 110**
$\delta^{13}C = -25.7‰$

Algal gyttja.

Lu-1679. Wielkie Gacno, 186 to 190cm **11,380 ± 100**
$\delta^{13}C = -22.9‰$

Clayey and sandy algal gyttja.

Lu-1680. Wielkie Gacno, 178 to 182cm **11,100 ± 105**
$\delta^{13}C = -22.1‰$

Muddy clay.

Lu-1681. Wielkie Gacno, 165 to 170cm **11,000 ± 100**
$\delta^{13}C = -24.6‰$

Muddy clay.

Lu-1637. Wielkie Gacno, wood **810 ± 50**
$\delta^{13}C = -25.2‰$

Wood (*Pinus* sp) from dugout canoe from bottom of lake.

Lu-1632. Weglewice II **35,100 +1000 −900**
$\delta^{13}C = -26.7‰$

Sample from 25 to 30cm thick continuous layer of organic silt, 520 to 550cm below surface of periglacial terrace of Prosna R, 300m SE of village Węglewice, Kalisz Voivodship, SW Poland (51° 23′ 20″ N, 18° 13′ 10″ E). Layer is overlain and underlain by rhythmically stratified periglacial flood deposits (Rotnicki, 1966). Coll 1976 by K Tobolski and K Rotnicki; subm by K Tobolski, Dept Geog, Adam Mickiewicz Univ, Poznań, Poland. *Comment*: pretreated with HCl and NaOH.

Lu-1632A. Weglewice II, soluble **$36,400 {+1200 \atop -1000}$**

$\delta^{13}C = -26.1‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-1632.

E. Switzerland/France

Lu-1606. Messery **3230 ± 85**

$\delta^{13}C = -28.5‰$

Wood from carbonaceous silty lake sediments from Lake Geneva near village Messery, France (46° 22′ N, 6° 17′ E). Coll 1975 by R Thompson; subm by C Reynaud, Dept Geol, Univ Geneva, Switzerland. Only HCl pretreatment due to small sample size. Diluted; 53% sample.

Corsier series

Organic material from shore deposits overlain by limnic sediments in Lake Geneva near village Corsier, Switzerland (46° 16′ N, 6° 12′ E). Coll 1979 and subm by C Reynaud. Dated as part of study of lake level changes. No pretreatment; small samples. Burned at <650°C to avoid pyrolysis of carbonates.

Lu-1696. Corsier C1 **5140 ± 120**

$\delta^{13}C = -27.4‰$

Slightly carbonaceous shore-peat. *Comment*: sample undersized; diluted; 31% sample. (3 1-day counts.)

Lu-1697. Corsier C9 **5090 ± 65**

$\delta^{13}C = -27.4‰$

Slightly carbonaceous shore-peat.

II. ARCHAEOLOGIC SAMPLES

A. Sweden

Löddeköpinge No. 10 series (II)

Human bones from grave field at Löddeköpinge No. 10, Löddeköpinge parish, E Scania (55° 45′ N, 13° 00′ E). Coll 1977 and subm by T Ohlsson, Hist Mus, Univ Lund. All samples are from structures with finds of datable coins; dated to gain information about obvious discrepancy between radiocarbon dates and expected max age of structures, reported in 1st part of series (R, 1979, v 21, p 400-402). Collagen extracted as described previously (R, 1976, v 18, p 290), but only Lu-1543 received NaOH treatment. Vertebrae and other bones with thin outer walls, consisting mainly of spongy bone, were not crushed before extraction.

Lu-1542. Löddeköpinge No. 10, Structure 182 1010 ± 50

$\delta^{13}C = -18.3‰$

Collagen from 2 heel bones and 2 ankle bones assoc with coin minted for Olof Hunger AD 1085 to 1096. *Comment*: organic carbon content: 6.3%.

Lu-1543. Löddeköpinge No. 10, Structure 393 1060 ± 50

$\delta^{13}C = -18.2‰$

Collagen from 2 large heel bones and 1 ½ ankle bones assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment*: organic carbon content: 5.3%.

Lu-1544. Löddeköpinge No. 10, Structure 398 1070 ± 50

$\delta^{13}C = -18.3‰$

Collagen from mixture of small bones assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment*: organic carbon content: 7.2%.

Lu-1545. Löddeköpinge No. 10, Structure 406 1060 ± 50

$\delta^{13}C = -17.8‰$

Collagen from a heel bone and fragments of tubular bones assoc with coin minted for Harald Hein AD 1075 to 1080. *Comment*: organic carbon content: 6.6%.

Lu-1546. Löddeköpinge No. 10, Structure 416 1060 ± 50

$\delta^{13}C = -18.2‰$

Collagen from shin bone assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment*: organic carbon content: 7.5%

Lu-1547. Löddeköpinge No. 10, Structure 464 960 ± 50

$\delta^{13}C = -18.1‰$

Collagen from fragments of tubular bones and heel bone assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment*: organic carbon content: 6.5%.

Lu-1548. Löddeköpinge No. 10, Structure 471 1010 ± 50

$\delta^{13}C = -17.7‰$

Collagen from mixture of ill-preserved bone fragments assoc with coin minted for Heinrich II AD 1002 to 1024. *Comment*: organic carbon content: 4.3%.

Lu-1549. Löddeköpinge No. 10, Structure 488 1040 ± 50

$\delta^{13}C = -17.8‰$

Collagen from mixture of bone fragments assoc with coin minted for Knut den Store (the Great) AD 1018 to 1035. *Comment*: organic carbon content: 5.8%.

Lu-1550. Löddeköpinge No. 10, Structure 535 970 ± 50

$\delta^{13}C = -19.0‰$

Collagen from an ankle bone, some vertebra fragments, and 3 hand or foot bones assoc with German coin, probably minted AD 1036 to 1059. *Comment*: organic carbon content: 6.9%.

Lu-1551. Löddeköpinge No. 10, Structure 596 **960 ± 50**
$\delta^{13}C = -18.0‰$

Collagen from tubular bone assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment*: organic carbon content: 5.7%.

General Comment: probable time of deposition for total coin assembly is AD 1050 to 1100 according to numismatologists G Galster and J Steen Jensen, Copenhagen.

Ängdala series

Charcoal from flint mines in Senonian chalk at Ängdala, S Sallerup parish, S Sweden (55° 35′ 20″ N, 13° 07′ 20″ E). Coll 1977 by U Säfvestad; subm by B Salomonsson, Malmö Mus. Pretreated with HCl and NaOH.

Lu-1633. Ängdala, 6120:G4 **5010 ± 65**
$\delta^{13}C = -22.1‰$

Sample from Mine No. 4.

Lu-1635. Ängdala, 6120:27:8:2 **2760 ± 55**
$\delta^{13}C = -23.7‰$

Sample from Level II with Late Bronze age artifacts.

Lu-1636. Ängdala, 6120 **5080 ± 65**
$\delta^{13}C = -24.9‰$

Sample from post-hole. *Comment*: sample undersized; diluted; 60% sample. (3 1-day counts.)

S Lappland series

Charcoal from five sites in Vilhelmina parish, S Lappland, N Sweden. Subm by A Huggert, Västerbottens Mus, Umeå. For other dates from same region, see Varris series and Vojmsjöluspen series (R, 1979, v 21, p 396-398). Nine samples were small (Lu-1561, -1562, -1566, -1569 to -1571, -1573, -1576, and -1577) and, therefore, received only mild pretreatment with NaOH and HCl. All other samples received normal pretreatment with HCl and NaOH.

Site Raä 235

(64° 40′ N, 16° 20′ E). Coll Aug 1978 by L Flodström.

Lu-1558. Raä 235, A5 **7280 ± 75**
$\delta^{13}C = -25.9‰$

Charcoal from 180cm below ground level in hunting pit.

Lu-1559. Raä 235, A8 F2/F3 **1100 ± 50**
$\delta^{13}C = -23.7‰$

Charcoal from 180cm below ground level in hunting pit.

Lu-1560. Raä 235, A14 K2 **1380 ± 50**
$\delta^{13}C = -24.4‰$

Charcoal from 180cm below ground level in hunting pit.

Lu-1561. Raä 235, A17 K2 **1520 ± 50**
$\delta^{13}C = -25.2‰$

Charcoal from 200cm below ground level in hunting pit.

Lu-1562. Raä 235, A18 Sample 1 **6160 ± 70**
$\delta^{13}C = -24.9‰$

Charcoal from 40cm below surface under mound situated beside hunting pit.

Lu-1563. Raä 235, A18 Sample 2 **4700 ± 60**
$\delta^{13}C = -23.7‰$

Charcoal from 180cm below ground level in hunting pit.

Lu-1564. Raä 235, A23 **1370 ± 50**
$\delta^{13}C = -24.6‰$

Charcoal from 180cm below ground level in hunting pit.

Site Raä 180

(64° 52′ N, 16° 44′ E). Coll June 1977 by L G Spång.

Lu-1565. Raä 180, 111/416 K4 **2460 ± 55**
$\delta^{13}C = -23.4‰$

Charcoal from *ca* 5cm below recent surface in hearth or cooking pit in eroded area near lake. Assoc with quartz scraper.

Lu-1566. Raä 180, 116/369 K2 **8830 ± 110**
$\delta^{13}C = -24.9‰$

Charcoal from 10cm below surface in cooking pit. Assoc with bones. *Comment*: sample undersized; diluted; 67% sample.

Site Raä 553

(64° 52′ N, 16° 44′ E). Coll July-Sept 1977 by L G Spång, B Syse, and L Kallerskog.

Lu-1567. Raä 553, A2 K21 **8180 ± 80**
$\delta^{13}C = -24.5‰$

Charcoal from bottom of earth oven 30cm below surface.

Lu-1568. Raä 553, A4 K14 **2120 ± 50**
$\delta^{13}C = -24.2‰$

Charcoal from hearth 30 to 35cm below surface.

Lu-1569. Raä 553, A6 K11 **4440 ± 80**
$\delta^{13}C = -24.4‰$

Charcoal from 15 to 20cm below surface. *Comment*: undersized; diluted; 65% sample.

Lu-1570. Raä 553, A7 K15 **5270 ± 90**
$\delta^{13}C = -24.2‰$

Charcoal from earth oven (?) 30 to 40cm below surface. *Comment*: undersized; diluted; 56% sample.

Lu-1571. Raä 553, A9 K28 **450 ± 55**
$\delta^{13}C = -24.4‰$

Charcoal from hearth 5cm below surface. *Comment*: undersized; diluted; 77% sample.

Lu-1572. Raä 553, K3 **5570 ± 65**
$\delta^{13}C = -24.5‰$

Charcoal from cooking pit (?) 20cm below surface. Assoc with bones.

Lu-1573. Raä 553, K23 **7850 ± 115**
$\delta^{13}C = -24.5‰$

Charcoal under layer of burned stones 6cm below surface. *Comment*: undersized; diluted; 52% sample.

Lu-1574. Raä 553, K33 **4120 ± 60**
$\delta^{13}C = -23.4‰$

Charcoal from hearth 6cm below surface.

Lu-1575. Raä 553, A1 K7:3 **1280 ± 50**
$\delta^{13}C = -24.4‰$

Charcoal (*Pinus* sp) id by T Bartholin from bottom of earth oven 25cm below surface.

Site Raä 190

(64° 52′ N, 16° 44′ E). Coll July-Sept 1977 by K Wijkander and G Rydström.

Lu-1576. Raä 190, A11 **2550 ± 75**
$\delta^{13}C = -24.5‰$

Charcoal from hearth 5cm below surface. *Comment*: undersized; diluted; 60% sample.

Lu-1577. Raä 190, A10 **3590 ± 100**
$\delta^{13}C = -24.5‰$

Charcoal from hearth 5cm below surface. *Comment*: undersized; diluted; 31% sample. (3 1-day counts.)

Lu-1578. Raä 190, A14 **7070 ± 75**
$\delta^{13}C = -23.3‰$

Charcoal from bottom of earth oven 30cm below surface.

Site Raä 921

(64° 52′ N, 16° 44′ E). Coll June 1977 by L Flodström.

Lu-1579. Raä 921, 110/301 K1 **2310 ± 55**
$\delta^{13}C = -23.6‰$

Charcoal from 20cm below surface. Assoc with asbestos ceramics.

Lu-1677. Strimasund **<150**
$\delta^{14}C = -1.6 \pm 5.7‰$
$\delta^{13}C = -25.0‰$

Wood (*Betula* sp) id by T Bartholin from hole for handle in iron object from Feature No. 46, Strimasund, Tärna parish, Västerbotten Co, N Sweden (66° 04′ N, 14° 52.5′ E). Coll 1974 by S af Ekenstam, Hemavan; subm by A Huggert. Only mild pretreatment with NaOH and HCl due to small sample size.

Ingelstorp series

Charcoal from settlement area and grave field at Ingelstorp, Scania (55° 25′ N, 14° 02′ E). Coll 1977 and subm by M Strömberg, Hist Mus, Univ Lund. For other dates from Ingelstorp, see R, 1976, v 18, p 314; 1977, v 19, p 435-436; 1978, v 20, p 430-432. Only mild pretreatment with NaOH and HCl due to small sample size.

Lu-1615. Ingelstorp 41, Sample 1:HT78 **2830 ± 55**
$\delta^{13}C = -25.4‰$

Charcoal from hearth in house foundation at Ingelstorp 41 (Strömberg, 1977, p 62-63). Assoc with pottery and flints.

Lu-1616. Ingelstorp 32:5, Sample 2:HT78 **2660 ± 60**
$\delta^{13}C = -23.6‰$

Charcoal from fire pit (Grave 67, Field 4) at Ingelstorp 32:5 (Strömberg, 1977, p 14-15). Assoc with burned bones. *Comment*: sample undersized; diluted; 86% sample.

Valleberga series

Animal bones from Bronze age settlement area at Valleberga 36, SE Scania (55° 24′ N, 14° 03′ E). Coll 1975 and subm by M Strömberg. For other dates from Valleberga, see R, 1974, v 16, p 324-325; 1975, v 17, p 192-193; 1976, v 18, p 313-314; 1979, v 21, p 398. Collagen extracted as described previously (R, 1976, v 18, p 290). Lu-1652 and -1674 received NaOH treatment but not Lu-1673.

Lu-1652. Valleberga 36, Sample 3:78-79 **2710 ± 60**
$\delta^{13}C = -20.2‰$

Collagen from ill-preserved lower jaw bone of *Sus* from cultural layer, Trench 1, Sq x = +4, y = +6, lower stratum. Assoc with Late Bronze age pottery. *Comment*: sample undersized; diluted; 80% sample. Organic carbon content: 1.9%.

Lu-1673. Valleberga 36, Sample 4:78-79 **2800 ± 55**
$\delta^{13}C = -20.4‰$

Collagen from well-preserved ulna of *Bos* from cultural layer, Trench 1, Sq x = +0, y = +7, lower stratum. Assoc with Late Bronze age pottery. *Comment*: organic carbon content: 6.0%.

Lu-1674. Valleberga 36, Sample 5:78-79 **2860 ± 55**
$\delta^{13}C = -20.1‰$

Collagen from an ankle bone and 3 phalanges of *Bos* from cultural layer, Trench 1, Sq x = +2, y = +4. Assoc with Late Bronze age pottery. *Comment*: organic carbon content: 2.4%.

Lu-1614. Gislöv 7 **1100 ± 50**
$\delta^{13}C = -24.0‰$

Charcoal from House 1:77 at Gislöv 7, Nöbbelöv parish, SE Scania (55° 29′ N, 14° 17′ E). Coll 1977 by M Strömberg. Assoc with pottery and objects of bronze and iron, indicating Viking age.

General Comment (MS): on Lu-1614 to -1616, -1652, -1673, and -1674 all dates agree well with archaeol estimates based on assoc finds.

Lu-1617. Bulltoftagården **6660 ± 80**
$\delta^{13}C = -25.6‰$

Hazel-nut shells from Layer 5a at Bulltoftagården, Malmö, S Scania (55° 35′ 40″ N, 13° 04′ 20″ E). Coll 1972 and subm by L Larsson, Hist Mus, Univ Lund. Assoc with transverse arrowheads and core axes (Early Ertebølle culture). Pretreated with HCl and NaOH. Sample undersized; diluted; 78% sample.

Ageröd V series

Hazel-nut shells and animal bone from refuse layer of Mesolithic settlement Ageröd V at raised bog Ageröds mosse, Munkarp parish, Scania (55° 56.5′ N, 13° 25′ E). Coll 1978 and subm by L Larsson. Results of study of settlement area pub by submitter (Larsson, 1978). For other dates from Ageröd V, see R, 1976, v 18, p 307-308. Hazel-nut shells pretreated with HCl and NaOH; bone collagen extracted as described previously (R, 1976, v 18, p 290) without NaOH treatment.

Lu-1622. Ageröd V, No. 016/003 **6680 ± 70**
$\delta^{13}C = -25.3‰$

Well-preserved hazel-nut shells assoc with transverse and oblique arrowheads and blade tools (Early Ertebølle culture).

Lu-1623. Ageröd V, No. 016/003/0102 **6860 ± 70**
$\delta^{13}C = -22.0‰$

Collagen from bone (centratarsale navicula cuboide) of *Alces alces* assoc with same artifact assembly as Lu-1622. *Comment*: organic carbon content: 7.3%.

General Comment (LL): on Lu-1617, -1622, and -1623 dates agree well with estimate based on artifact assemblage.

B. Denmark

Lu-1607. Svendborg, Franciscan monastery, IV A-AB 1 **780 ± 50**
$\delta^{13}C = -24.8‰$

Charcoal (*Fagus* sp) id by T Bartholin from fire-stratum in chancel of monastery church in town of Svendborg, Fyn (55° 03′ N, 10° 36′ E). Coll 1978 by J Bech; subm by H M Jansen, Svendborg & Omegns Mus, Svendborg. For other dates from Svendborg, see R, 1976, v 18, p 318-319; 1977, v 19, p 437. Pretreated with HCl and NaOH.

C. Egypt

Sakkara series

Three samples assoc with mummy coll Aug 1735 in catacombs of Sakkara (*ca* 29° 51′ N, 31° 14′ E) by C F von Höpken and E Carlson (Leche, 1739, p 22-26); subm by E Cinthio, Hist Mus, Univ Lund. X-ray examination showed that mummy was embalmed with crossed arms, which places mummy approx between 1500 BC and 1085 BC (Ahlström, Håkansson, and Olin, 1978, p 33).

Lu-1503. Sakkara, Sample 1 **2410 ± 55**
$\delta^{13}C = -24.5‰$

Wood from coffin in which mummy was found according to account of journey to Sachara by von Höpken and Carlson (Leche, 1739, p 26). Dated sample consisted of *ca* 20 tree-rings. Pretreated with NaOH.

Lu-1504. Sakkara, Sample 2 **3480 ± 55**
$\delta^{13}C = -24.0‰$

Pieces of "pure" resin used for embalming of mummy. No pretreatment.

Lu-1505. Sakkara, Sample 3 **3460 ± 55**
$\delta^{13}C = -22.9‰$

Pieces of resin with traces of bandages from mummy wrapping. No pretreatment.

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[RADIOCARBON, VOL 22, No. 4, 1980, P 1064-1072]

NANCY NATURAL RADIOCARBON MEASUREMENTS VI

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The following list includes some measurements made during 1978 and 1979 in the radiocarbon laboratory of the Ecole Nationale Supérieure de Géologie Appliquée et de Prospection Minière (ENSG) de Nancy. Equipment, measurement and treatment of samples are as reported previously (R, 1979, v 21, p 453-464) where the sample is synthesized to benzene. Radiocarbon ages are calculated using the ^{14}C half-life of 5568 years and 95% activity of NBS oxalic acid is used as modern standard. Anthracite coal and Merck commercial benzene are used for the dead carbon run.

Counting errors are expressed at 1σ confidence level. AD/BC* dates are corrected using the half-life of 5730 years and according to the MASCA correction curve (Ralph, Michael, and Han, 1973). Description and comments are generally based on information supplied by submitters.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. France

Château de la Hunaudaye, Plédéliac, Côtes-du-Nord

Castle destroyed in 1347 and rebuilt soon after. N part was modified about 1420 and two houses were built, the first in the 16th century and the second in the 17th century. Castle was set on fire by revolutionists in 1793 (Delumeau, 1969; 1971).

570 ± 80
Ny-547. **AD 1370 ***

Carbonized wood. Coll by J Y Gervais under flagstone of castle yard; subm 1978 by P Henry. *Comment:* ^{14}C date agrees with repairs about 1420.

320 ± 80
Ny-548. **AD 1510 ***

Carbonized wood. Same origin as Ny-547. *Comment:* ^{14}C date agrees with known date of building in 16th century.

710 ± 80
Ny-669. Avioth, Meuse **AD 1250 ***

Head of a wooden statue. Subm 1979 by R Sommesous, parson of Avioth, 55 Montmédy, France. May belong to old wooden statue. Possibly a more recent copy (Vigneron, 1972; 1979). *Comment:* ^{14}C date does not conflict with first hypothesis (*cf* Ny-336, R, 1978, v 20, p 63).

* Centre de Pédologie Biologique, Nancy-Vandoeuvre

Jabreille-les-Bordes series, Lieu-dit Le Chatelard (Haute-Vienne)

Samples date rampart of fence. Coll and subm by J M Desbordes, Dir Antiquités Hist Limousin, Limoges, France. Estimated age: Gallo-Roman period.

Ny-555. **1690 ± 80**
AD 270 *

Charcoal. Foundations of W part of rampart.

Ny-556. **1820 ± 80**
AD 150 *

Charcoal. Middle of W part of rampart.

Ny-557. **730 ± 120**
AD 1230 *

Charcoal. Upper part of W part of rampart.

Ny-671. **2190 ± 270**
330 BC*

Charcoal. Core of the W part of rampart.

Ny-670. **2150 ± 180**
300 BC *

Charcoal. Shoulder of fence, S part, median level.

Ny-672. **1920 ± 180**
AD 60 *

Charcoal. Shoulder of fence, S part, lower level.

General Comment (JMD): ^{14}C dates agree with expected age (early Roman age for construction of hill-fort).

Solignac series, Haute-Vienne

Coll and subm 1979 by J M Desbordes.

Ny-634. **970 ± 80**
AD 1010 *

Charcoal. Estimated age: 10th century.

Carbonized wood from sepultures close by the apse of a church dedicated in 1143.

Ny-674. Sepulture 0 **340 ± 110**
AD 1490 *

Ny-695. Sepulture 1 **730 ± 100**
AD 1230 *

Ny-696. Sepulture 2a **1030 ± 90**
AD 950 *

Ny-693. Drilling **840 ± 110**
AD 1140 *

General Comment: dates agree with expected age.

980 ± 80
Ny-635. Javerdat, Haute-Vienne **AD 1000 ***

Coll 1978 by G Lintz; subm by J M Desbordes. Charcoal. Estimated age: 11th or 12th century. *Comment* (JMD): dates agree with age of broken pottery.

1760 ± 80
Ny-552. Tarnac, Corrèze **AD 200 ***

Charcoal at foot of tumulus (No. 5). Coll 1978 by G Lintz; subm by J M Desbordes. Estimated age: Tène or Roman period. *Comment* (JMD): no material. ^{14}C gives one and only date.

1320 ± 90
Ny-646. La Vallade Saint Victor, Creuse **AD 650 ***

Charcoal coll 1978 by Valladas; subm by J M Desbordes. May date early ploughing.

B. Italy

Monte Amiata district series, Grossetto and Sienna

Oak from regular timbering of shallow seated mines. Discovered 1970 by O Strappa; coll and subm 1978 by F Saupé.

First sample

Ny-411.1 **5730 ± 100**

Ny-411.2 **5720 ± 110**

Second sample

Ny-411.3 **5720 ± 100**

Ny-411.4 **5710 ± 100**

Ny-411.5 **5770 ± 100**

Comment: Mean: 5730 BP. Much too old to be attributed to one of known civilizations in Italy.

Mofettes — Monte Amiata dist, Grossetto and Sienna Prov, Italy. Coll and subm 1978 by F Saupé.

Ny-526. **22,570 ± 1000**

Drill hole Sienna 2. Dismantled power-plant of Piancastagnaio, Sienna.

Ny-524. **>41,000**

Drill hole No. 10, 12th level, Solforate mine.

Ny-525. **>41,000**

Drill hole 100m N of former mine of Argus.

Ny-522. **30,580 ± 1000**

Drill hole ENEL "PN 4" (open tank).

General Comment: two emanations have a high pressure and show virtually no ^{14}C (Ny-524,-525). Two others have a pressure close to atmospheric and small amounts of ^{14}C were introduced by atmospheric contamination (Ny-522,-526).

Living plants (trees, bushes, and reeds) growing near volcanic emanations. Coll and subm by F Saupé 1978.

Ny-483. **540 ± 80**

Alder (*Alnus* sp), S bank of Rondi naia Creek, front of blowing exhaust shaft of Pietrineri mine, Sienna.

Ny-484. **370 ± 80**

Cherry. A few m from S Giovanni shaft, Sienna.

Ny-519. **4350 ± 90**

Wild cherry (*Cerasus* sp). Same as above.

Ny-516. **1820 ± 100**

Reed (*Phragmites* sp), immediately below Renaioli drift, next to putizze di Renaioli, Abetoso Creek, Grossetto.

Ny-517. **2450 ± 80**

Broom (*Sarothamnus scoparius*), Putizze di S Giovanni, Sienna.

Ny-518. **4350 ± 80**

Broom (*Sarothamnus scoparius*), Putizze di Pietrineri sink-hole, Sienna.

Ny-535. **Modern**

Blank oak (*Quercus robur*), NW of Palazzo di Pietrineri, outside of presently active mofette. *Comment*: dating of plants grown in vicinity of volcanic emanations emitting CO_2 can yield pseudo-ages with too high results.

General Comment: study performed in order to check working hypothesis of volcanic contamination made to explain results of Ny-411.

II. SOIL SAMPLES

Podzols

Landes du Medoc series, France

The Landes du Medoc, near Bordeaux, are characterized by a covering of quartz sand and the presence of groundwater very close to the surface. Soils here are fairly hydromorphic podzols. Righi (1977) studied the evolution of a podzolic sequence on a very short soil catena, 12m long at Lagunan (45° 11′ 20″ N, 0° 57′ 24″ W). Altitudinal difference between foot and top of hill is ca 30cm. Best drained podzols at top of hill have cemented spodic horizon (B_{22h}). Most hydromorphic podzols at foot of the hill have loose B_{2h} horizon. B horizon samples, coll and subm by D Righi, Univ Poitiers, are further described according to vertical topographic sequence. Lateral distance between each sampled profile is ca 3m.

Ny-609. Lagunan 3 B_{21h} **1440 ± 80**
50 to 55cm, C %: 1.8 C/N = 19

Ny-610. Same location, cement B_{22h} **2810 ± 70**
60 to 65cm, C %: 1.5 C/N = 39

Ny-611. Same location B_3 **3390 ± 80**
75 to 80cm, C %: 0.9 C/N = 47

Ny-612. Lagunan 3-2, cemented B_{22h} **2380 ± 70**
60 to 65cm, C %: 1.0 C/N = 36

Ny-613. Lagunan 2, slightly cemented 3_{22h} **2000 ± 70**
55 to 60cm, C %: 1.1 C/N = 34

Ny-614. Same location B_3 **2440 ± 70**
65 to 70cm, C %: 0.7 C/N = 33

Ny-615. Lagunan 2-4 B_{2h} **1220 ± 70**
40 to 45cm, C %: 1.9 C/N = 22

Ny-616. Lagunan 4 B_{2h} **770 ± 80**
30 to 35cm, C %: 1.9 C/N = 22

Ny-617. Same location B_3 **770 ± 80**
40 to 45cm, C %: 0.9 C/N = 23

General Comment: most striking aspects of series are very good agreement between longest mean residence times of organic matter (Ny-610-614) and micromorphologic features of corresponding horizons. In these horizons the N poor organic matter is assoc with mainly alumina-polymers to form grain coatings which solder skeleton grains together. In the other horizons, better biologic activity is demonstrated by shorter mean residence times, lower C/N ratios of organic matter and, above all, a microstructural organization of silt and organic matter as pellets and aggregates (Righi and Guillet, 1977).

Bassin Parisien series, France

During the Pleistocene and Holocene the sands of the Tertiary (Auversian Beauchamp sands and Stampian Fontainebleau sands) were more or less recovered and mixed by silt. Even in the case of a moderate sitation rate (≅10%) the developed soils are podzols or podzolic soils in which an A_2 horizon is slightly differentiated. Samples coll near Villers Cotterets (49° 13′ 48″ N, 2° 59′ 40″ E) and Fontainebleau (48° 25′ 44″ N, 2° 39′ 10″ E) and subm 1976 by A M Robin, Univ Paris VI.

Ny-510. Villers Cotterets 11 B_h **50 ± 90**
30 to 40cm, C %: 0.6 C/N = 24

Ny-501. Fontainebleau 3 B_h **210 ± 50**
40 to 55cm, C %: 0.5 C/N = 24

Ny-511. Villers Cotterets 12 B_h **Modern**
33 to 45cm, C %: 0.3 C/N = 18

Ny-512. Villers Cotterets 13 B_{21h} **160 ± 90**
63 to 70cm, C %: 1 C/N = 19

Ny-514. Same profile B_s **Modern**
70 to 75cm, C %: 0.8 C/N = 26

Ny-508. Villers Cotterets 9 B_h **320 ± 100**
65 to 75cm, C %: 1.6 C/N = 29

Ny-509. Same profile B_s **460 ± 100**
75 to 85cm, C %: 0.8 C/N = 27

Ny-502. Villers Cotterets 1 B_{h1} **1890 ± 100**
30 to 37cm, C %: 4.7 C/N = 52

Ny-503. Same profile B_{2h} **1820 ± 100**
77 to 85cm, C %: 1.6

Ny-507. Villers Cotterets 3 B_{h2} **2930 ± 100**
120 to 130cm, C %: 0.9

Ny-504. Fontainebleau, buried II A **1750 ± 90**
40 to 55cm, C %: 2.7

Ny-505. Same profile II B_{21h} **1660 ± 90**
100 to 110cm, C %: 1.5

Ny-506. Same profile, II B_{22h} **2510 ± 100**
General Comment: series was classified according to two criteria. First seven dates correspond to podzols presently under deciduous forest (oak and beech) that received weak eolian silt contamination. With respect to low mean residence time of organic carbon, these forest podzols behave as biologically active soils with relatively low C/N ratio. The other profiles are in steady state equilibrium with a degraded vegetation (*Pinus silvestris, Calluna vulgaris*) and received no silt contamination. Although the last podzols are not necessarily older than the forest podzols, the large quantity of organic matter is biologically more stable since the mean residence times in B_h horizons are close to 2000 years. Note also the higher C/N ratio of the organic matter. According to Robin (1979) clay mineral composition must be considered in explaining the difference. In forest podzols, weathering ferromagnesian clay minerals must liberate iron which stimulates biologic activity and catalytic decay of organic matter. For the second group of podzols, the only clay minerals are kaolinite and feldspars, the weathering of which releases alumina. It is now well known (Guillet, 1979) that Al-hydroxypolymers assoc with organic matter in B_h skeleton grain coatings have a depressive effect on mineralization and decay of organic matter.

History of vegetation during Holocene in estuary of the Loire R and in "Grande Brière" Loire Atlantique, France (Visset, 1979). Samples coll and subm 1977-1979 by L Visset.

Trignac, Canal de Fougères series

Palynology shows invasion of site by *Alnus,* forming a real *alnetum* that declines towards the end of the Sub-Boreal and disappears at limit of Sub-Boreal-Sub-Atlantic.

Ny-494. **4180 ± 90**

Brown peat, *Alnetum,* depth, −154 to −160cm.

Ny-493. **3770 ± 90**

Brown peat, declining *alnetum,* depth, −125 to −131cm.

Ny-492. **3480 ± 90**

Black peat, disappearance of *alnetum,* depth, −119 to −125cm.

Tree series

At some time, increase of fresh-water level causes formation of a phragmites bog. *Quercetum* cannot survive in this anaerobic environment and gradually declines. The trees die progressively.

Ny-496. Trignac **4000 ± 80**

Ny-523. Trignac **4120 ± 90**

Ny-544. Rozé **4100 ± 90**

General Comment: trees of the same area but originating from different sites have been dated by other laboratories: (Sa-35: 4040 ± 300 BP; Sa-40: 3880 ± 300 BP; Sa-46: 4260 ± 300 BP; Gif-3536: 4230 ± 110 BP). Close correspondence of all results confirm validity of date.

Ny-495. **4260 ± 90**

Organic mud, depth, −180 to −185cm. *Comment:* agrees with results obtained from trees (Ny-496,-523,-544). Brown peat, Ny-494, does not show meaningful differences with Ny-495, indicating short peaty mud period.

Ny-491. **2110 ± 80**

Black peat from top of layer, depth, −45 to −49cm. *Comment*: interruption of peat formation by sediments of tidal mud, as a result of rising sea level and penetration in bog (cf Ny-6, R, 1968, v 10, p 122).

Pierre blanche series

Ny-476. **2280 ± 80**

Brown peat.

Ny-475.1. **2120 ± 80**

Black peat.

Ny-475.2. **2070 ± 80**

Black peat.

General Comment: estimated age: brown peat, 4000 BP, black peat, 3500 BP. Dates corresponding to Sub-Atlantic disagree with pollen record and geologic history of site.

Rozé series

Ny-545. **3340 ± 90**

Bark and wood of birch in peat in transitional brown peat — black peat during disappearance of *Betuletum*. *Comment*: date agrees with Ny-492.

Charcoal fragments at the base of black peat in a well characterized level of a fire.

Ny-546.1. **3570 ± 80**

Ny-546.2. **3490 ± 90**

Ny-546.3. **3390 ± 80**

Comment: date of 3400 can be retained in agreement with Ny-492 and Ny-545.

Ny-633. Ile d'Errand **2510 ± 80**

Oak wood fragment.

Ny-474. Quatre canaux **6830 ± 100**

Drilling −15.55m WGF. Oisters. *Comment*: date agrees with palynologic results and places this sediment (1m thick) around Middle of Atlantic period.

History of the vegetation of the Pleistocene in the valley of the Loire R.

Ny-543.1. Roc-en-Pail **19,400 ± 560**

Ox bone.

Ny-543.2. **19,510 ± 620**

Same sample. *Comment*: prehistoric site of Mousterian at Chalonnes sur Loire (assumed age: 35,000 yr).

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QUEENS COLLEGE RADIOCARBON MEASUREMENTS III

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This list contains analyses completed between January, 1976 and April, 1977. Details of laboratory operation are contained in our first list (R, 1975, v 18, p 205). Samples submitted for analysis are reviewed by a committee consisting of W DeBoer, E Hansen, Anthropology; L Marcus, Biology; W S Newman, D L Thurber, Earth and Environmental Sciences; and Richard Pardi, Radiocarbon Laboratory.

All results are based on the conventional half-life of ^{14}C, *ie*, 5568 ± 30 years. Results are 1δ, based on the combined statistical counting error of the sample, background and standard. $^{12}C/^{13}C$ measurements and corrections have not been made for these samples.

Samples sub-labeled with letters are re-analyses of identical or equivalent samples. Those sub-labeled with numbers are repeat or duplicate counts on split samples of prepared benzene, unless otherwise noted.

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I. GEOLOGIC SAMPLES

Sea level series

Peats (basal) coll and subm by W S Newman and L Cinquemani, Dept Earth Environmental Sci, Queens Coll, Oscawana I Tidal Marsh, Hudson R, New York (41° 13′ 45″ N, 73° 55′ 50″ W); Constitution I Tidal Marsh, Hudson R, New York (41° 23, 5N, 73° 58′ W); Piermont Tidal Marsh, Hudson R, New York (41° 1′ 30″ N, 73° 54′ W); Pelham Bay Park, Bronx, New York (40° 52.1′ N, 73° 47.6′ W); Ring Meadow, Iona I., Hudson R, New York (41° 13′ 30″ N, 73° 58′ 40″ W). All samples treated with hot dilute HCl.

QC-221A. Oscawana I, 7.5m **5150 ± 210**

Depth 7.5m below MHW.

QC-221B. Oscawana I, 6.8m **4570 ± 120**

Depth 6.8m below MHW.

QC-228. Oscawana I, 2.7m **1870 ± 90**

Depth 2.7m below MHW.

QC-264. Oscawana I, 7m **4500 ± 100**

Depth 7m below MHW.

QC-189. Constitution I, 9.45m **5900 ± 300**

Depth 9.45m below MHW.

QC-226. Constitution I, 3.9m **2320 ± 100**

Depth 3.9m below MHW.

QC-227. Constitution I, 7.7m **4230 ± 120**

Depth 7.7m below MHW.

QC-276. Constitution I, 6.15m **4110 ± 100**

Depth 6.15m below MHW.

QC-262. Piermont, 5.05m **3460 ± 100**

Depth 5.05m below MHW.

QC-261. Piermont, 8.54m **4610 ± 120**

Depth 8.54m below MHW.

QC-211. Piermont, 3m **2300 ± 160**

Depth 3m below MHW.

QC-295. Pelham Bay, 2.25m **1800 ± 90**

Depth 2.25m below MHW.

QC-274. Ring Meadow, 4.6m **3610 ± 120**

Depth 4.6m below MHW.

QC-186. Ring Meadow, 10.75m **3940 ± 140**

Depth 10.75m below MHW. *Comment* (WSN): further field check disclosed that tidal marsh at this point extends to greater depth.

QC-187. Ring Meadow, 4.75m **3800 ± 160**

Depth 4.75m below MHW.

Long Island sea level series

Peats (basal) coll and subm by M Rampino, Goddard Inst for Space Studies, Wantagh, Nassau Co, Long Island, New York (40° 39′ N, 73° 31″ W). Back barrier area, Cedar Beach Suffolk Co, New York (40° 37′ N, 73° 23′ W).

General Comment (MR): depth estimate error may be as great as .15m due to compaction.

QC-314. Cedar Beach, A76-32 **5060 ± 120**

Depth 10.1m below MSL.

QC-315. Wantagh, C1-BP **1020 ± 100**

Depth 1.12m below MSL.

QC-316. Wantagh, C3-BP **300 ± 90**

Depth 0.27m below MSL.

Bergen County mastodon series

Bone, wood, and peat samples from a mastodon site, Bergen Co, New Jersey (40° 59′ N, 73° 57′ W). Coll and subm by S Averill, 8 Willow Brook Rd, Hillsdale, New Jersey.

QC-141. #5 **5220 ± 120**

Dentine from mastodon, depth ca 1.4m below surface. Sample had been shellaced. An attempt was made to remove the shellac via soxhlet extraction in hot ethanol for 3 to 4 days. *Comment* (SA): previous date I-6828: 9125 ± 150 on lower stratigraphic level.

QC-142. #6 **6340 ± 100**

Bone from mastodon. Also shellaced; treated same as QC-141.

QC-144. #8 **5080 ± 160**

Peat from above mastodon, depth ca 1.2m below surface. Sample diluted with "dead" benzene.

QC-296. #9 **12,130 ± 210**

Peat from ca 1.8m below surface. Large sample was sieved through 40-mesh screen and treated with hot dilute HCl and KOH. *Comment* (SA): from 20 to 28cm above thin tan lacustrine clay over coarse outwash of most recent glaciation. Peat from which mastodon, dated QC-141 and -142, was removed.

QC-297. #10 **12,820 ± 200**

Peat treated same as QC-296. *Comment* (SA): from 5 to 15cm above tan lacustrine clay.

Malaspina Glacier series

Samples coll and subm by J H Hartshorn, Univ Massachusetts, from Malaspina Glacier, Alaska.

QC-160. MAL 15-70 **650 ± 80**

Wood (Sitkagi Spruce?) torn up and embedded in till in front of glacier (59° 44′ N, 140° 30′ W). *Comment* (JHH): till is subglacial; date gives age of last readvance of Malaspina Glacier to sea at Sitkagi Bluffs.

QC-161. MAL 26-70 **2770 ± 90**

Wood embedded in a superglacial esker (gravel) emerging from beneath glacier (59° 50′ N, 140° 4′ W). *Comment* (JHH): date to be used in recreating history of advance and retreat of Malaspina Glacier. Location of wood in englacial (now superglacial) esker is unusual.

QC-162. MAL 28-70 **3630 ± 130**

Shell coll from surface of esker recently emerged from ice (59° 47′ N, 140° 10′ W). *Comment* (JHH): in 1951, esker was beginning to emerge from beneath ice. Shells date from period of ice recession when sea was far N of present limits. When ice readvanced, shells were incorporated in till or ice and then treated as gravel by meltwater streams.

Almond (Kent) Glacier series

Dates used to reconstruct history and limits of Almond (Kent) Glacier. Coll and subm by E H Muller and P Willette, Dept Geol, Syracuse Univ.

QC-232. PW-75-264 **10,830 ± 220**

Peat with wood fragments and cones, Sargent's Peat Bog, New York (42° 17′ 32″ N, 78° 11′ 0″ W), alt ca 450m, depth 3m below bog surface. *Comment* (EHM): date will provide upper limit for Kent glaciation in Genesee Valley.

QC-233. PW-75-38 **6270 ± 340**

Wood fragments contained in stratified, well-sorted, unoxidized silt, probably of alluvial origin, Estabrook site, Allegheny Co, New York (42° 25′ 14″ N, 78° 8′ 20″ W), alt ca 370m, depth 4.5m below surface. Very small sample, diluted with "dead" benzene (date too young). *Comment* (EHM): post-dates Almond (Kent) Glacier, related to early phase of erosional terrace development in reach of Genesee Stream upstream from Portageville and Letchworth Canyon.

QC-238. EM60-185C $\mathbf{25{,}450\ {}^{+6680}_{-3600}}$

Wood fragments contained in silty, sparsely to moderately stony, gray till, unconformably overlain by modern alluvial-fan gravels, Rush Creek, 600m E of West Hill Rd, Allen Township, Fillmore Quad, Livingston City New York (42° 25′ 50″ N, 78° 3′ 10″ W), alt ca 420m, 60cm above stream. *Comment* (EHM): till predates Kent glaciation; is 1st such date in central New York. Analysis of 2nd, larger wood sample coll in vicinity of QC-233.

QC-263. PW-75-38-2 **7950 ± 100**

Repeat analysis on larger sample of same wood as QC-233. *Comment* (EHM): 2nd date agrees well with field relationships and provides a datum point in downcutting which followed Lake Belfast-Fillmore and was controlled by bedrock incision directly N of Portageville.

Adak I series

Peat and fine organic sediments from drained pond (Black, 1975), Adak I., Alaska (51° 54′ 54″ N, 176° 37′ 56″ W). Coll and subm by R H Black, Univ Connecticut, Storrs. QC dates are all on > 40-mesh size fraction, treated with hot, dilute HCl and NaOH.

General Comment (RFB): some fine organic sediments probably washed and blown in. Geochron dates on fraction < 80-mesh.

QC-204A. 75A-182 **3830 ± 110**

Depth 79 to 89cm below surface. Treated with hot, concentrated HCl and NaCl04. Previously dated GX-4028: 3440 ± 165. *Comment* (RFB): most reliable date of series; from above Sandwich Ash.

QC-205. 75A-183 **3770 ± 100**

Depth 99 to 109cm below surface. Previously dated GX-3970: 4390 ± 150. *Comment* (RFB): from below Sandwich Ash.

QC-206B. 75A-184 **5110 ± 200**

Depth 127 to 137cm below surface. Previously dated GX-3971: 6800 ± 175. *Comment* (RFB): from above Intermediate Ash.

QC-207. 75A-185 **3040 ± 370**

Small sample severely diluted with "dead" benzene (date too young), depth 145 to 155cm below surface; previously dated GX-3972: 5705 ± 200. *Comment* (RFB): from below Intermediate Ash.

QC-208. 75A-186 **6660 ± 90**

Depth 181 to 191cm below surface, previously dated GX-4029: 8310 ± 265. *Comment* (RFB): from above Main ash, Geochron date too old.

QC-244. 76A-5 **4460 ± 180**

Comment (RFB): from above Intermediate Ash, equivalent to 75A-184.

QC-245. 75A-6 **6960 ± 100**

Comment (RFB): from below Intermediate Ash, equivalent to 75A-185.

Deep-Sea Core series

From Core V30-101K (44° 06′ N, 32° 30′ W). Coll and subm by A McIntyre, Lamont-Doherty Geol Observatory, Palisades, New York. *General Comment* (AMcI): results on QC-247, QC-248, and QC-249 were judged too old by about 10,000 yr each. QC-317 was run as a check, result agrees with Lamont date on split of same sample, 18,590 ± 800 (L-1447B). Other dates on same core are QC-198 at 16,360 ± 220 years, from depth of 63.5 to 71.5cm, GX-4491 at 13,520 ± 410 yr from depth 32.5cm, and GX-4492 at 16,760 ± 515 years from depth 39cm. No explanation has been found for apparently anomalous results on the three deepest samples.

QC-246. V30-101K, 25cm **10,850 ± 280**

Ca 66% $CaCO_3$.

QC-247. V30-101K, 40cm **$27,200^{+1300}_{-1200}$**

Ca 45% $CaCO_3$.

QC-248. V30-101K, 50cm **$29,500^{+1900}_{-1600}$**

Ca 41% $CaCO_3$.

QC-249. V30-101K, 55cm **$31,400^{+1650}_{-1450}$**

Ca 45% $CaCO_3$.

QC-317. V30-101K, 46.8cm **18,300 ± 660**

Ca 45% $CaCO_3$.

II. ARCHAEOLOGIC SAMPLES

QC-112. #12 **700 ± 120**

Charcoal from hearth on much used camping floor, Dogan Pt, Haverstraw, New York (41° 14′ 10″ N, 73° 56′ 50″ W). Depth 40cm below surface. Coll and subm by L A Brennan, Briarcliff Coll, Ossining, New York. *Comment* (LAB): sample too young; evidence of much camping and many fills; charcoal subm along with soil matrix. Assoc with small stemmed (Taconic) points, Perkiomen, small side-notched points (Twombly), and distinctive industry probably related to Susquehanna. There was no pottery.

Pipins Rock series

Charcoal and shell *(C virginica)* from Pipins Rock site (41° 10′ N, 73° 52′ W). Coll and subm by L A Brennan.

QC-225. #1 and #2 **3370 ± 170**

Charcoal from apparent fire pit extending downward in basal sands, depth 60 to 70cm below surface. Sample dated is composite of 3 small charcoal samples from same region. *Comment* (LAB): fire pit is within 15 cm of shell deposit and is assoc with small series of excurvate sided triangular points with basal flute flake removed.

QC-224. 13E34S **4400 ± 100**

Shell from same level as QC-225, in undisturbed sand 25cm from hearth. *Comment* (LAB): Taconic stemmed point found in vicinity; 4400 BP is good date for Taconic series here.

QC-239. S Side Midden #1 **4370 ± 90**

Small oyster shells, depth 56cm below surface.

QC-240. S Side Midden #2 **4940 ± 100**

Three large oyster shell valves, depth 61cm below surface.

QC-241. S Side Midden #3 **2480 ± 340**

Charcoal from small pit hearth in midden, depth 56cm below surface, assoc with QC-243.

QC-243. S Side Midden #5 **4490 ± 90**

Oyster shells from around and beneath hearth, depth 51cm below surface.

QC-270. S Side Midden #6 **1) 4600 ± 80**
2) 4700 ± 90

Small shells from yellow sand-clay basement under midden, depth 56 to 61 cm below surface.

Spruce Swamp series

Spruce Swamp site, East Norwalk, Connecticut (41° 5′ 16″ N, 73° 23′ 18″ W). Coll and subm by E L Claypool, SW Connecticut Archaeol Comm, 23 Plymouth Rd, Stamford, Connecticut 06906.

QC-217. SS-1 **2290 ± 90**

Shell (*C virginica*), depth 80cm below MSL. *Comment* (ELC): from Feature #1, earth wholly enclosed in glacial sand and gravel. Sample dates earliest known aboriginal occupation at Spruce Swamp site.

QC-231. SS-2 **130 ± 90**

Acorns (*Quercus* sp), uncharred and decomposed, from storage pit (Feature #15), in black soil midden between shell midden and glacial deposits containing *C virginica* shells dated at QC-217. Depth 6cm above to 50cm below MSL. *Comment* (ELC): dates only known acorn storage pit in New England, estimated age was 2500 yr BP, based on sea level curve and relationship to QC-217. Possible sources of contamination: salt water, sewage, sludge, marine engine waste from adjacent marina, and heavy penetration of roots.

QC-273. SS-3 **80 ± 50**

Twigs (tree sp unidentified) from lining of Feature #15, acorn storage pit, uncarbonized and decomposed.

QC-298. SS-4 **750 ± 90**

Wood (sp unknown) from either remains of prehistoric post or tree root. Solid wood, not decomposed, showing possible rings, depth 45 to 72cm below MSL. *Comment* (ELC): adjacent to Feature #15. Same contamination possibilities as QC-231.

QC-318. SS-5 **610 ± 350**

Charcoal assoc with pottery from above Feature #15, depth 18cm below MSL. Very small sample, diluted with "dead" benzene. *Comment* (ELC): date is minimum for Feature #15.

QC-332. SS-6 **1050 ± 80**

Shell (*Venus mercenaria*), depth 23cm below surface, alt 7cm above MSL. Result suggests that dates on acorns, QC-231, and twigs, QC-273, from storage pit (Feature #15) are too young, since, even correcting for expected apparent age of recent shell material (Mangerud, 1972), shells should not be younger than ca 850 yr. *Comment* (ELC): from Stratum 2 above acorn storage pit.

QC-307/8. #1 and #2 **2850 ± 220**

Bone fragments from hearth, rockshelter, Brewster, New York (41° 22.5′ N, 73° 30′ W), depth 1.3 to 1.4cm below surface; coll and subm by R C Thompkins, Poughkeepsie. Combined sample was very small, and was diluted with "dead" benzene. *Comment* (RCT): sample assoc with Palmer-like projectile point.

Shawnee-Minisink site

From flood plain of Delaware R at confluence with Brodford Creek near Stroudsburg, Pennsylvania (50° 59′ 0″ N, 75° 8′ W). Coll and subm by C W McNett, American Univ.

QC-250. **1990 ± 80**

Charcoal from Sqs 25 and 25, Level 04, depth 60cm below surface.

QC-259. **1610 ± 100**

Charcoal from Sqs 5 and 9, Level 08, depth 85cm below surface.

QC-157/8. S6E66-1 and S2W6-19 **1040 ± 120**

Charred wood from possible fire pit (Feature 1), Mason I II site (18M013), Maryland (39° 10′ 50-53″ N, 77° 29′ 45-55″ W), depth 47 to 68cm below surface. Coll and subm by K Franklin, American Univ. *Comment* (KF): date is additional for Montgomery focus-related pottery type in Potomac Valley and evidence to suggest its temporal relationship to Luray focus.

QC-222. Sesuit Harbor **1) 1790 ± 120** **2) 1760 ± 80**

Wood, white cedar *(Chamaecyparis thyoides)* from possible site, Sesuit Harbor, Massachusetts (41° 45′ 10″ N, 70° 10′ 21″ W), coll and subm by S Coughlin, Queens Coll, and R Prescott, Cape Cod Mus Nat Hist, Brewster, Massachusetts. *Comment* (SC): sample from former fresh-water swamp now located in mire intertidal zone. Area subject to daily tidal flooding.

South Windsor series

Site #6Ht89, South Windsor, Connecticut (45° 50′ W, 72° 37′ 30″ N). Coll and subm by K McBride and W Stinson, Univ Connecticut.

QC-301. N5W5/4 **3510 ± 140**

Charred wood from hearth overlain with ca 1.1m floodplain silt loam, alt 7.6m ASL.

Gatecliff Shelter series

Gatecliff Shelter, Nevada (39° 00′ N, 116° 47′ W); coll and subm by D H Thomas, American Mus Nat Hist, New York.

QC-287. GU-9, #402 **1) 2900 ± 90** **2) 3130 ± 90**

Charcoal, Unit X, Feature 1, depth 300cm.

QC-288. GU-9, #409 **3140 ± 90**

Charcoal, Unit II, Feature 7, depth 293cm.

QC-289. GU 4-74, #416 **5290 ± 180**

Charcoal, Unit XX, Feature 1, depth 594cm.

QC-290. GU 6-74, #418 **4850 ± 100**

Charcoal, Unit XXIII, depth 592cm.

QC-291. GU 1-74, #419 **7080 ± 680**

Charcoal, Unit XX, depth 535cm. Very small sample, severely diluted with "dead" benzene. *Comment* (DHT): despite large statistical error, date is roughly as expected.

QC-292. GU 6-74, #421 **4140 ± 130**

Charcoal, Unit X.

QC-293. GU 4-74, #422 **5100 ± 100**

Charcoal, Unit XXIII.

QC-294. B-5, #441 **1) 5390 ± 150**
2) 5410 ± 270

Charcoal, from Triple T shelter, West Northumberland Canyon, Nye Co, Nevada (39° 00′ N, 116° 55′ W), alt +2073m, depth 340 to 350cm. Coll and subm by H A Thomas.

QC-271. Excavation 1, Level 7 **A) 2650 ± 80**
B) 2805 ± 130

Charcoal from hearth (Feature #1), Parmana village site, Guarico State, Venezuela (8° N, 66° W) depth 125 to 145cm below surface. B pretreated, as in Haynes (1966). Coll and subm by A Roosevelt, Mus American Indian. *Comment* (AR): possible contamination from rootlets and lignite. Sample from Early Corozal phase.

Ronquin Sombra series

Ronquin sombra site, Dist Infante, Guarico State, Venezuela (8° N, 66° W). Coll and subm by A Roosevelt.

QC-311A. Excavation 8, Level 7 **1170 ± 100**

Charcoal, depth 95 to 110cm below surface. *Comment* (AR): from Ronquin phase.

QC-311B. Excavation 8, Level 8 **1450 ± 70**

Charcoal, depth 110 to 125cm below surface. *Comment* (AR): from Ronquin phase.

QC-327. Excavation 9, Level 9 **1300 ± 90**

Charcoal, depth 137 to 147cm below surface.

Corozal series

Corozal site, Guarico State, Venezuela (8° N, 66° W), 3km NE of Parmana village. Site in tropical gallery forest. Coll and subm by A Roosevelt.

QC-272. Excavation 2, Level 20 **A) 23,900 ± 650**
B) 24,700 ± 1250

Lignite, depth 147 to 160cm below surface. B bleached with perchlorate after regular pretreatment. *Comment* (AR): from Early Corozal phase.

QC-275. Excavation 2, Level 20 **A) 25,400 ± 650**
B) 24,700 ± 200

Lignite, B treated with perchlorate after regular pretreatment.

QC-309. Excavation 3, Level 4 **860 ± 70**

Charcoal, shiny and not very dense, depth 30 to 53cm below surface. Some rootlets removed. *Comment* (AR): from Late Camoruco phase.

QC-310. Excavation 3, Level 10 **A 1) 510 ± 70**
2) 540 ± 80
B 1) 410 ± 80
2) 340 ± 90

Charcoal, depth 130 to 143cm below surface. B separately coll equivalent sample. *Comment* (AR): from Middle Camoruco phase.

QC-319. Excavation 2, Level 7 **720 ± 80**

Charcoal, depth 112 to 138cm below surface. *Comment* (AR): from Middle to Late Camoruco phase.

QC-320. Excavation 2, Level 8 **260 ± 80**

Charcoal, depth 138 to 153cm below surface. *Comment* (AR): from Middle Camoruco phase.

QC-321. Excavation 2, Level 9 **410 ± 90**

Charcoal, depth 153 to 167cm below surface. *Comment* (AR): from Early Camoruco phase.

QC-322. Excavation 2, Level 12 **820 ± 90**

Charcoal, depth 210 to 230cm below surface. *Comment* (AR): from Late Corozal period.

QC-323. Excavation 2, Level 14 **1740 ± 100**

Charcoal, depth 250 to 275cm below surface. *Comment* (AR): from Middle Corozal phase.

QC-324A. Excavation 3, Level 11A **460 ± 80**

Charcoal, depth 145 to 153cm below surface. *Comment* (AR): from Early to Middle Camoruco phase.

QC-325. Excavation 3, Level 12A **830 ± 90**

Charcoal, depth 153 to 170cm below surface. *Comment* (AR): from Early Camoruco to Late Corozal phase.

QC-326. Excavation 3, Level 15 **1200 ± 90**

Charcoal, depth 198 to 210cm below surface. *Comment* (AR): from Early Camoruco to Late Corozal phase.

QC-335. Excavation 2, Level 20 **1) 23,080 $^{+910}_{-820}$**
2) 22,420 $^{+820}_{-740}$
3) 3720 ± 270

Lignite. Dates 1) and 2) are duplicate runs on same pretreated sample. Date 3) is date on extracted humic acids from 1) and 2).

Los Mangos series

Los Mangos site, Infante Dist Guarico State, Venezuela (8° N, 66° W), 100m SE Parmana village. Coll and subm by A Roosevelt.

QC-312A. Excavation 1, Level 17 **A) 340 ± 80**
B) 900 ± 90

Charcoal, depth 260 to 280cm below surface. B stratigraphically equivalent to A. B small sample diluted with "dead" benzene. *Comment* (AR): from Middle to Late Corozal phase.

QC-313A. Excavation 1, Level 18 **A) 1170 ± 90**
B) 760 ± 100

Charcoal, depth 280 to 300cm below surface. A stratigraphically equivalent to B. *Comment* (AR): from Middle to Late Corozal phase.

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[RADIOCARBON, VOL 22, No. 4, 1980, P 1084-1089]

TARTU RADIOCARBON DATES X

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The present list includes 74 dates of geologic samples determined using the liquid scintillation ^{14}C method at the Geobiochemical sector of the Institute of Zoology and Botany, Academy of Sciences, Estonian SSR.

Benzene synthesized from wood of AD 1850 ± 10 served as a reference standard. All radiocarbon dates in BP were calculated using 5568 ± 30 yr as the half-life value of ^{14}C.

Peat bogs of Estonia

Palasi series

Palasi bog lies in Rapla Dist, 14km SE of Rapla, and is formed of complex, *Sphagnum fuscum, Eriophorum* with *Sphagnum fuscum* and forest sedge peats. At sec a surface layer of ca 1m had been removed by peat manufacturing. Sample coll 1969 by E Ilves and A Sarv.

TA-290. Palasi **2170 ± 70**
Peat from depth 10 to 20cm.

TA-292. Palasi **2470 ± 60**
Peat from depth 60 to 70cm.

TA-293. Palasi **2940 ± 60**
Peat from depth 80 to 90cm.

TA-312. Palasi **3920 ± 50**
Peat from depth 120 to 130cm.

TA-295. Palasi **4260 ± 70**
Peat from depth 180 to 190cm.

TA-313. Palasi **4390 ± 70**
Peat from depth 200 to 210cm.

TA-296. Palasi **4520 ± 70**
Peat from depth 220 to 230cm.

TA-297. Palasi **4680 ± 70**
Peat from depth 270 to 280cm.

TA-291. Palasi **5800 ± 90**
Peat from depth 340 to 350cm.

TA-298. Palasi **6570 ± 70**
Peat from depth 420 to 430cm.

TA-294. Palasi **7720 ± 70**
Peat from depth 510 to 520cm.

TA-299. Palasi **8490 ± 70**
Peat from depth 520 to 530cm.

TA-314. Palasi **8500 ± 70**
Peat from depth 530 to 540cm.

TA-315. Palasi **8570 ± 70**
Peat from depth 570 to 580cm.

TA-300. Palasi **8730 ± 90**
Sapropel from depth 590 to 600cm.

Linnusaare series

Linnusaare raised bog belongs to the Endla bog system in Jõgeva dist, 7km NW of Jõgeva. Sample coll 1973 by E Ilves and A Sarv.

TA-696. Linnusaare **240 ± 60**
Peat from depth 190 to 200cm.

TA-697. Linnusaare **2370 ± 70**
Peat from depth 270 to 280cm.

TA-699. Linnusaare **3830 ± 70**
Peat from depth 360 to 370cm.

TA-700. Linnusaare **6330 ± 70**
Peat from depth 440 to 450cm.

TA-701. Linnusaare **6980 ± 70**
Peat from depth 550 to 560cm.

TA-702. Linnusaare **8710 ± 80**
Peat from depth 580 to 590cm.

TA-703. Linnusaare **9140 ± 80**
Peat from depth 620 to 630cm.

TA-704. Linnusaare **9360 ± 80**
Peat from depth 630 to 640cm.

Peat bogs of west Siberia

Pangoda series

Tomsk region, Yamal-Nenets natl dist, between Nazym and Pura Rivers, near Pangoda settlement. Sample coll from basal layers of peat deposits and subm 1974 by O Liss (M V Lomonosov Moscow State Univ).

TA-743. Pangoda 1 **2870 ± 60**
Carex-Sphagnum fen peat from depth 140 to 145cm.

TA-744. Pangoda 2 **6680 ± 70**

Sedge fen peat from depth 280 to 300cm.

TA-745. Pangoda 3 **750 ± 60**

Sphagnum fen peat from depth 65 to 75cm.

TA-746. Pangoda 4 **5610 ± 70**

Wood from depth 300cm.

TA-752. Pangoda 5 **5810 ± 70**

Sphagnum fen peat from depth 320 to 330cm.

Tevriz series

Tomsk region, between Chizhapka and Chuzika Rivers, 60km SW of Chudino settlement. Sample coll and subm 1975 by O Liss.

TA-510. Tevriz **190 ± 50**

Sphagnum fuscum raised peat from depth 90 to 100cm.

TA-509. Tevriz **3220 ± 60**

Complex raised peat from depth 225 to 235cm.

TA-508. Tevriz **3610 ± 60**

Sedge-*Sphagnum* mesotrophic peat from depth 250 to 260cm.

TA-507. Tevriz **3710 ± 60**

Sedge-*Sphagnum* mesotrophic peat from depth 275 to 285cm.

TA-506. Tevriz **7740 ± 70**

Forest sedge fen peat from depth 410 to 430cm.

Novyi Tevriz series

Tomsk region, near Novyi Tevriz settlement on Vasyugan R. Sample coll and subm 1977 by O Liss.

TA-1037. Novyi Tevriz **4260 ± 80**

Bryales-sedge fen peat from depth 0 to 10cm.

TA-1036A. Novyi Tevriz **8300 ± 70**

Forest sedge *Sphagnum* fen peat from depth 185 to 195cm.

TA-1036B. Novyi Tevriz **8400 ± 70**

Repeated date. Wood of willow family. Id. by U Veibri, Estonian Acad Agric.

TA-617. Novyi Vasyugan 1 **2390 ± 70**

Forest sedge fen peat from depth 10 to 20cm covered by mineral sediments, 200cm thick, from Tomsk region, Vasyugan R near settlement Novyi Vasyugan. Sample coll and subm 1973 by O Liss.

TA-618. Novyi Vasyugan 2 **6120 ± 80**

Forest sedge fen peat from depth 210 to 220cm.

TA-666. Parabel **7260 ± 90**

Forest sedge fen peat from depth 550 to 570cm. Tomsk region, settlement Parabel. Sample coll and subm 1973 by O Liss.

Arkadyevo series

Tomsk region, Kozhevnikov dist, near Arkadyevo village. Sample coll 1976 by O Liss and N Berezina, subm by O Liss.

TA-909. Arkadyevo 1 **1580 ± 80**

Forest sedge peat from depth 100 to 120cm.

TA-910. Arkadyevo 2 **1930 ± 60**

Peat from depth 130 to 150cm.

TA-911. Arkadyevo 3 **5660 ± 80**

Peat-like sapropel from depth 480 to 500cm.

Nazym Lyamin series

Tyumen region, Hanty-Mansy Natl dist, between Nazym and Lyamin Rivers 130km E of Karymkary settlement. Sample coll and subm 1973 by A Nagaiceva (trust "Geoltorfrazvedka").

TA-667. Nazym-Lyamin 1 **8610 ± 90**

Bryales fen peat from depth 300 to 340cm.

TA-668. Nazym-Lyamin 2 **7490 ± 80**

Forest sedge (mesotrophic) peat from depth 400 to 450cm.

TA-669. Nazym-Lyamin 3 **7080 ± 90**

Forest sedge fen peat from depth 350 to 380cm.

TA-933. Kayukovo **8140 ± 80**

Forest sedge fen peat from depth 580 to 600cm. Tyumen region, between Demyanka and Yuganka Rivers, 180km S of Nefteyugansk settlement, near Kayukovo lake. Sample coll and subm 1976 by O Liss.

TA-934. Salmo-Yugansk **8900 ± 90**

Peat-like sapropel from depth 480 to 500cm. Tyumen region, between Demyanka and Yuganka Rivers, 180km SE of Nefteyugansk settlement. Sample coll and subm 1976 by O Liss.

TA-1037. Purpe **6330 ± 80**

Grass fen peat from depth 200cm. Tyumen region, Yamalo-Nenets natl dist, near Purpe R. Sample coll 1977 by O Turkina; subm by O Liss.

TA-1038. Nizhnevaratovsk **8000 ± 80**

Bryales-sedge fen peat from depth 600 to 625cm. Tyumen region, Nizhnevaratovsk dist, 2km W of Lake Samotlor. Sample coll 1977 by O Poloshnikova, subm by O Liss.

TA-901. Guskovskij-Ryam 1 **4180 ± 70**

Fen peat from depth 260 to 280cm. Novosibirsk region, Chulymsk dist, near Kabinetnaya sta. Sample coll and subm 1976 by O Liss.

TA-902. Guskovskij-Ryam 2 **3580 ± 70**

Fen peat from depth 900 to 920cm.

Baksinskoye series

Novosibirsk region, Kolyvanovsk dist, Baksinskoye peat deposit. Sample coll 1978 by O Liss and N Berezina; subm by O Liss.

TA-903. Baksinskoye 1 **Modern**

Fen peat from depth 30 to 50cm, at bog edge.

TA-904. Baksinskoye 2 **440 ± 80**

Forest sedge peat from a small hollow ("saucer"), from depth 20 to 40cm.

TA-905. Baksinskoye 3 **1640 ± 70**

Forest sedge-*phragmites* peat from depth 180 to 200cm.

TA-906. Baksinskoye 4 **2610 ± 70**

Fen peat from depth 265 to 275cm.

TA-907. Baksinskoye 5 **3380 ± 80**

Forest sedge-*phragmites* fen peat from depth 415 to 425cm.

TA-908. Baksinskoye 6 **3050 ± 70**

Fen peat from depth 190 to 210cm.

TA-596. Ubinskoye 1 **4350 ± 70**

Grass fen peat from depth 300 to 310cm. Novosibirsk region, Ubinskoye settlement. Sample coll and subm 1973 by O Liss.

TA-597. Ubinskoye 2 **2140 ± 80**

Carex-Sphagnum fen peat from depth 125 to 135cm.

Lakes of Estonia

Ulemiste series

Ulemiste lake lies on SW border of Tallinn, on N Estonian plateau, at ca +36m. Area, 9.6km^2, max depth, 6m. Sample coll and subm 1974 by L Saarse, Inst Geol (IG), ESSR Acad Sci.

TA-691. Ulemiste 1 **8300 ± 90**

Limy sapropel from depth 570 to 580cm.

TA-690. Ulemiste 2 **5330 ± 80**

Sapropel from depth 370 to 380cm.

TA-689. Ulemiste 2 **5330 ± 80**

Sapropel from depth 410 to 420cm.

Rätsma series

Rätsma Lake belongs to Kurtna lake system in NE Estonia. Area, 0.18km^2, max depth, 10.8m. Sample coll and subm 1974 by L Saarse; pollen analyses by R Pirrus (IG).

TA-688. Rätsma 1 **12,040 ± 100**

Aleuritic sand with admixture of *Bryales* moss from depth 530 to 540cm.

TA-686. Rätsma 2 **4080 ± 60**

Lake lime with plant remains from depth 90 to 100cm.

TA-687. Rätsma 2 **12,050 ± 120**

Lake lime with admixture of *Bryales* moss from depth 360 to 370cm.

Elistvere series

Elistvere Lake is one of drumlin country lakes in E Estonia, 4.5km SE of Järve settlement. Area of this low level lake is $1.8km^2$. Sample coll and subm 1974 by L Saarse; pollen analyses by R Pirrus.

TA-683. Elistvere **860 ± 60**

Phragmites peat from depth 70 to 80cm.

TA-684. Elistvere **1330 ± 60**

Sapropelized forest phragmites peat from depth 170 to 180cm.

TA-685. Elistvere **8990 ± 90**

Sapropel containing distributed wood remains and detritus of subfossil mollusk from depth 380 to 390cm.

Pangodi series

Pangodi Lake lies in N part of moraine-type Otepää Heights, 10km SE of Elva, at +105m; area, $1.15km^2$. Sample coll and subm 1974 by L Saarse.

TA-652. Pangodi **1540 ± 80**

Sapropel containing distributed fragments of mollusks from depth 500 to 510cm.

TA-651. Pangodi **4590 ± 80**

Sapropel from depth 930 to 940cm.

TA-650. Pangodi **6660 ± 90**

Sapropel containing distributed fragments of mollusks from depth 1160 to 1170cm.

Kirikumäe series

Kirikumäe Lake lies in Vôru dist, 7.5km SE of Vastseliina, at +183m; area, $0.61km^2$, max depth, 3.5m.

TA-677. Kirikumäe **2680 ± 80**

Sphagnum peat from depth 450 to 460cm.

TA-678. Kirikumäe **3210 ± 70**

Bryales-phragmites peat from depth 570 to 580cm.

TA-679. Kirikumäe **8530 ± 80**

Sapropel layered with plant remains from depth 780 to 790cm.

[RADIOCARBON, VOL 22, No. 4, 1980, P 1090-1115]

UNIVERSITY OF TEXAS AT AUSTIN RADIOCARBON DATES XIV

S VALASTRO, JR, E MOTT DAVIS, ALEJANDRA G VARELA, and CAROLYN EKLAND-OLSON

Radiocarbon Laboratory, Balcones Research Center, The University of Texas at Austin

This list reports certain ^{14}C measurements completed by December 1979; other projects completed by this time will be reported later. Age calculations are based on ^{14}C half-life of 5568 yr and modern standard of 95% NBS oxalic acid, supplemented by tree rings of pre-industrial wood from a log cut in the 1850's (Tx-540; R, 1970, v 12, p 249). Deviations reported are based on counting statistics of sample, background and modern, and are ± 1σ, except that when sample count approaches either modern or background, 2σ limits are reported. Unless noted, $^{12}C/^{13}C$ measurements were not made and results are not corrected for ^{13}C fractionation (assumed ratio = −25‰ WRT PDB). Our laboratory uses liquid scintillation counting of benzene, with Li_2C_2 and vanadium-activated catalyst in preparation; chemical yields range between 95% and 99%. Three counters are employed; a Packard Tri-Carb Model 3002 and 2 Beckman LS230 spectrometers obtained through a grant from the National Science Foundation.

We acknowledge with gratitude the administrative support and assistance of W G Reeder and Saralind Mings of the Texas Memorial Museum.

I. OCEANOGRAPHIC SAMPLES

Bahamas

Great Bahama Bank series, Bahamas

Samples of carbonate sediment from slope N of Great Bahama Bank, Bahama Is. Coll to determine origin and rate of deposition of breccia deposits and rates of coral growth. Coll 1978 by A C Neumann and subm by M Boardman, Marine Sci Program, Univ North Carolina, Chapel Hill.

4010 ± 60
Tx-2997. E-29262/40cm $\delta^{13}C = +3.8‰$

30km S of Freeport (26° 19′ N, 78° 33′ W), 39 to 41cm in core.

26,500 ± 1000
Tx-2998. E-29262/80cm $\delta^{13}C = +1.8‰$

Same location as Tx-2997, 79 to 81cm in core.

35,800 ± 2200
Tx-2999. E-29262/100cm $\delta^{13}C = +2.8‰$

Same location as Tx-2997, 99 to 101cm in core.

2610 ± 60
Tx-3000. E-29262/20cm $\delta^{13}C = +3.7‰$

Same location as Tx-2997, 18.5 to 21.5cm from surface.

Tx-3001. E-29283/7cm **1970 ± 60**
$\delta^{13}C = +3.5‰$

15km S of McLean's Town (26° 27′ N, 78° 05′ W), 6 to 8cm in core.

Tx-3002. E-29283/20cm **3860 ± 60**
$\delta^{13}C = +3.5‰$

Same location as Tx-3001, 19 to 21cm in core.

Tx-3003. E-29283/40cm **6550 ± 90**
$\delta^{13}C = +3.2‰$

Same location as Tx-3001, 39 to 41cm in core.

Tx-3004. E-29283/60cm **12,260 ± 160**
$\delta^{13}C = +1.6‰$

Same location as Tx-3001, 59 to 61cm in core.

Tx-3005. E-29283/88cm **30,600 ± 2400**
$\delta^{13}C = +2.1‰$

Same location as Tx-3001, 88cm in core.

Tx-3006. E-34631/47cm **3870 ± 60**
$\delta^{13}C = +3.6‰$

40km S of McLean's Town (26° 11′ N, 78° 07′ W), 45 to 50cm in core.

Tx-3007. E-34631/7cm **1790 ± 60**
$\delta^{13}C = +3.6‰$

Same location as Tx-3006, 5 to 10cm in core.

General Comment on Tx-2997 to Tx-3007 (MB): data have been coupled with mineralogic, minor element, and stable isotope data with following results: 1) Holocene deposits have higher aragonite and strontium content than late Pleistocene, calcite-rich sediments; 2) Holocene deposition rates are approx 5 times greater than late Pleistocene rates; 3) major change in mineralogy and minor element concentrations occurs at 5000 to 7000 BP; 4a) isotope data from Holocene sediments are distinctly clumped ($\delta^{18}O \cong -0.5$ to 0.0, $\delta^{13}C \cong +3$ to +4), and this range is indistinguishable from shallow carbonate sediments; 4b) isotope data from Pleistocene sediments are $\delta^{18}O \cong +0.8$ to +1.6, $\delta^{13}C \cong +1.5$ to +2.8. These data strongly support hypothesis that when sea level flooded banktops, offbank transport of carbonate sediments began and now dominate deposition of carbonate sediments in deep channels. Roughly 80% of deep-sea sediments in NW Providence Channel is of banktop origin.

Tx-3008. 764-F17 **80 ± 40**
$\delta^{13}C = +1.6‰$

Deep water coral (BASE), 4km W of Memory Rock (26° 50′ N, 79° 10′ W).

Tx-3009. 764/F17 **Ultra modern**
$\delta^{13}C = +2.1‰$

Coral (TIPS), 4km W of Memory Rock, same location as Tx-3008.

General Comment on Tx-3008 and Tx-3009 (MB): dates demonstrate that this deep-sea (ahermatypic) coral grows quite rapidly. Coral, ca 50cm high, appears to have grown 50cm in 80 yr.

4650 ± 70
Tx-3027. E-34652-15-SED $\delta^{13}C = +3.7‰$

NW Providence Channel (25° 56′ N, 78° 31′ W), 405m water depth, 15cm below sediment-water interface.

22,670 ± 290
Tx-3028. E-34652-110-SED $\delta^{13}C = +3.2‰$

Same location as Tx-3027, 110cm below sediment surface.

17,210 ± 310
Tx-3029. E-34652-88-RX $\delta^{13}C = +3.6‰$

$CaCO_3$ rock fragments, same location as Tx-3027, 88cm below sediment surface.

26,250 ± 680
Tx-3030. E-34652-140-SED $\delta^{13}C = +3.2‰$

Same location as Tx-3027, 140cm below sediment surface.

21,260 ± 490
Tx-3031. E-34652-88-SED $\delta^{13}C = +3.3‰$

Same location as Tx-3027, 88cm below sediment surface.

20,880 ± 490
Tx-3032. E-34652-140-RX $\delta^{13}C = +3.6‰$

$CaCO_3$ rock fragments, same location as Tx-3027, 140cm below sediment surface.

8380 ± 110
Tx-3033. E-34658-20-SED $\delta^{13}C = +3.5‰$

NW Providence Channel (25° 54′ N, 78° 32′ W), 295m core depth, 20cm deep in core.

13,880 ± 150
Tx-3034. E-34658-80-RX $\delta^{13}C = +3.5‰$

$CaCO_3$ rock fragments, same location as Tx-3033, 80cm deep in core.

9970 ± 90
Tx-3035. E-34664 $\delta^{13}C = +3.2‰$

$CaCO_3$ rock, NW Providence Channel (25° 53′ N, 78° 33′ W), 200m water depth.

General Comment on Tx-3027 to Tx-3035 (MB): dates demonstrate that sediments and rock fragments of breccia zones are late Pleistocene, not Holocene; so modern chemical conditions are of little direct interest in lithification processes of these rock fragments. Rocks are 4000 to 5000 yr younger than surrounding sediment. Deposition rates of these breccia-filled cores are 8 to 15cm/1000 yr; this suggests mass movement of sediment as deposition process.

Abaco Sound series, Bahamas

Shell and sediment samples from 3 cores of lagoon sediments in Abaco Sound, NE margin of Little Bahama Bank near Great Abaco I., Bahamas. Coll 1977 by A C Neuman and subm by S Locker, Dept Marine Sci, Univ North Carolina, Chapel Hill. Cm figures are depths in core.

Tx-3229. C7714-18-30 **5840 ± 80**

Anodontia alba shells, ca 3.7km N of Marsh Harbour (26° 35′ N, 77° 3.9′ W), 489 to 493cm.

Tx-3230. C7714-16-22 **4410 ± 100**

Chione cancellata shells, ca 4.6km NW of Treasure Cay (26° 43.7′ N, 77° 19.7′ W), 415 to 417cm.

Tx-3231. C7714-14-19 **8230 ± 260**

Anodontia alba shells, ca 11km NW of Treasure Cay (26° 46.7 ′N, 77° 22.6′ W), 424 to 427cm.

Tx-3232. C7714-14-19 **4120 ± 100**

Chione cancellata shells, same location as Tx-3231 above, 245 to 247cm.

Tx-3233. C7714-14-19 **6940 ± 80**

$CaCO_3$ sediment, same location as Tx-3231, above, 420 to 422cm.

Tx-3234. C7714-14-19 **6510 ± 90**

$CaCO_3$ sediment, same location as Tx-3231, above, 376 to 378cm.

Tx-3235. C7714-18-30 **3800 ± 100**

$CaCO_3$ sediment, same location as Tx-3229, above, 410 to 413cm.

Tx-3236. C7714-18-30 **3920 ± 90**

$CaCO_3$ sediment, same location as Tx-3229, above, 310 to 313cm.

Tx-3237. C7714-14-19 **1190 ± 80**

Codakia orbicularis shell, same location as Tx-3231, above, 69 to 73cm.

Tx-3238. C7714-18-30 **1640 ± 50**

$CaCO_3$ sediment, same location as Tx-3229, above, 110 to 113cm.

Tx-3239. C7714-18-30 **1060 ± 50**

$CaCO_3$ sediment, same location as Tx-3229, above, 10 to 13cm.

Tx-3240. C7714-16-22 **2040 ± 140**

$CaCO_3$ sediment, same location as Tx-3230, above, 200 to 202cm.

Tx-3241. C7714-16-22 **1110 ± 70**

$CaCO_3$ sediment, same location as Tx-3230, above, 100 to 102cm.

Tx-3242. C7714-18-30 **1940 ± 70**

$CaCO_3$ sediment, same location as Tx-3229, above, 210 to 213cm.

General Comment (SL): sedimentation rate in core C7714-14-19 is ca 58cm/1000 yr and in Core C7714-16-22 is 101cm/1000 yr. In Core C7714-18-30 rate is 97cm/1000 yr with increase during last 1000 yr (as indicated by highest 3 dates, Tx-3238, -3239, -3242) to 300cm/1000 yr, comparing with Pb-210 data from Core C7714-16-22 indicating maximum rate of 300cm/1000 yr.

II. GEOLOGIC SAMPLES

United States

Tx-2561. MGM 1CD1, Nevada **>40,000**

Wood from E wall MGM GRAND-Reno Pit site, 34m depth, Reno, Nevada (39° 31′ 15″ N, 119° 46′ 30″ W). NW 1/4, NE 1/4, Sec 18, T19N, R20E, MDBM. Coll 1976 and subm by J Bell, Nevada Bur Mines & Geol, Univ Nevada, Reno. *Comment* (JB): date supports interpretation that outwash deposit is Tahoe (early Wisconsinan) age.

Mexico, Venezuela

Tlapacoya series, Mexico

Dark lacustrine mud from Trench Beta, SE side Cerro Tlapacoya, N of Puebla toll rd ca 28km SE of Plaza de Constitucion, D F, Mexico (19° 17′ 30″ N, 98° 55′ 00″ W). Coll to establish ages for sediments used in paleomagnetic investigation. Coll 1973 by P W Lambert, U S Geol Survey, and subm by Lambert and Valastro, this lab.

Tx-1784. Tlapacoya, 73L61 **13,180 ± 290**

NE side of trench, 23m from reference point.

Tx-1913. Tlapacoya, 12/15/73/1 **14,540 ± 90**

N wall of trench, 30m from reference point. Date is average; sample split and 2 parts prepared and counted separately: 14,450 ± 120, 14,630 ± 130.

Tx-1914. Tlapacoya 12/16/73/2 **14,450 ± 100**

NE wall of trench, 22.5 to 23.2m from reference point. Date is average; sample split as in Tx-1913: 14,210 ± 140, 14,690 ± 130.

General Comment (SV,Jr): paleomagnetic directions and ^{14}C dates do not support existence of geomagnetic field excursion formerly reported in 14,500 yr mud at Tlapacoya (Liddicoat and Coe, 1974; Liddicoat *et al,* 1979). Tx-1784 believed contaminated by root hairs.

North-Central Coastal Range series, Venezuela

Samples from Holocene outcroppings along N-central coast between Arrecifes and Borburata, DF, Venezuela. Coll to determine velocity of uplift of coastal range (Caribbean Mts). Coll 1975 and subm by C Schubert, Inst Venezolano Investigaciones Científicas, Caracas, Venezuela. Last number in sample title refers to elev in m above sea level.

Tx-2274. ARR-3, 0 **1170 ± 80**

Conglomeratic beach rock, on Taguao Bay, ca 1.5km W of Arrecifes (10° 33′ N, 67° 08′ W).

Tx-2275. ARR-4, 0.5 **4480 ± 50**

Coral, same general loc as Tx-2274.

Tx-2276. ARR-6, 0.5 **1020 ± 60**

Coral, on Taguao Bay, ca 1.7km W of Arrecifes (10° 33′ N, 67° 08′ W).

Tx-2277. ARR-10, 0.5 **970 ± 70**

Coral, on Taguao Bay, ca 1.8km W of Arrecifes (10° 33′ N, 67° 08′ W).

Tx-2278. ARR-11, 0.5 **1040 ± 60**

Shell, same loc as Tx-2277, above.

Tx-2279. ARR-13, 0 **Modern** **$\delta^{14}C = +35.7 \pm 4.7‰$**

Shell on La Salina Bay, ca 2.1km W of Arrecifes (10° 33′ N, 67° 08′ W).

Tx-2280. ARR-15, 0 **2840 ± 80**

Conglomeratic beach rock, same loc as Tx-2279, above.

Tx-2281. ARR-18, 2 **3260 ± 50**

Coral, on La Salina Bay, ca 3km W of Arrecifes (10° 33′ N, 67° 08′ W).

Tx-2282. ARR-19, 0.5 **1860 ± 60**

Coral, same loc as Tx-2281, above.

Tx-2283. ARR-20, 0.5 **1500 ± 50**

Coral, same loc as Tx-2281, above.

Tx-2325. CH-2, 15-18 **310 ± 100**

Coral, ca 2km W of Puerto Colombia (10° 30′ N, 67° 38′ W).

Tx-2326. PAT-1, 0.5 **4500 ± 80**

Coral, W side Patanemo Bay, ca 4.5km E Puerto Cabello (10° 30′ N, 67° 58′ W).

Tx-2327. PAT-3, 1.2 **3620 ± 90**

Coral, W side Patanemo Bay (10° 30′ N, 67° 58′ W).

Tx-2328. PAT-5, 1.0 **3380 ± 50**

Coral, same loc as Tx-2327, above.

Tx-2329. BOR-2, 0 **3430 ± 70**

Coral, W end Borburata beach, ca 3.5km E Puerto Cabello (10° 30′ N, 67° 59′ W).

Tx-2330. BOR-5, 0 **990 ± 50**

Shell, same loc as Tx-2329, above.

Tx-2331. BOR-6, 0 **620 ± 70**

Coral, same loc as Tx-2329, above.

Tx-2332. BOR-10, 1 **1310 ± 60**

Coral, ca 300m W Tx-2329, above.

General Comment (CS): velocity of uplift of Coastal Range varies between 0.054, 0.061, and 0.0033cm/yr. However, real velocity of uplift probably higher because age of coral and shell fragments contained in beachrock may be considerably older than rock itself. For report, see Schubert *et al* (1977).

III. PALEOBOTANICAL SAMPLES

Idaho, Washington

Hager Pond series, Idaho

Peat samples from Core 1 (except as indicated) at Hager pond, mire ca 3.2km S of Nordman, Idaho (48° 36′ N, 116° 57′ W). Coll 1973 by R N Mack and subm by V M Bryant, Anthropol Research Lab, Texas A & M Univ, College Station, Texas. Figures in titles are depths in cm below surface.

Tx-2103. Hager Pond #31, 913-916 **9110 ± 110**

Core 2.

Tx-2104. Hager Pond #32, 643-645 **6980 ± 480**

Tx-2105. Hager Pond #33, 339-343 **3030 ± 110**

Tx-2108. Hager Pond #36, 920-923 **9510 ± 190**

Core 2.

Tx-2110. Hager Pond #38, 904-908 **8280 ± 120**

Tx-2113. Hager Pond #41, 279-283 **2940 ± 80**

Tx-2115. Hager Pond #43, 161-166 **2670 ± 100**

Tx-2116. Hager Pond #44, 600-605 **6630 ± 80**

Tx-2119. Hager Pond #47, 395-399 **4310 ± 990**

Tx-2121. Hager Pond #49, 500-505 **6390 ± 230**

Tx-2673. Hager Pond C-1, 760-771 **7680 ± 40**

Tx-2674. Hager Pond C-1, 805-810 **7960 ± 310**

General Comment (RNM): Mazama ash is between Tx-2121 and Tx-2116. Dates confirm and define environmental events of last 10,000 yr or more accurate time scale than in previous analyses of this mire (Hansen, 1939; Rumley, 1956). For complete report, see Mack *et al* (1978a).

Simpsons Flats series, Washington

Samples from Core 7 in mire in closed depression at Simpsons Flats on Colville Indian Reservation, 45km N of confluence of Sanpoil and Columbia Rivers (48° 25′ N, 118° 15′ W). Coll 1973 and subm by R N Mack, Dept Botany, Washington State Univ, Pullman, Washington. Figures in sample titles are depths in cm below surface.

Tx-2214. Simpsons Flats, 225-228 **1970 ± 160**

Fibrous peat.

Tx-2215. Simpsons Flats, 264-268 **2630 ± 160**

Gyttja.

Tx-2216. Simpsons Flats, 340-344 **3260 ± 100**
Gyttja.

Tx-2217. Simpsons Flats, 411-414 **4120 ± 170**
Gyttja.

Tx-2218. Simpsons Flats, 477-480 **4380 ± 240**
Gyttja.

Tx-2219. Simpsons Flats, 526-529 **4790 ± 230**
Gyttja.

Tx-2220. Simpsons Flats, 632-635 **5850 ± 240**
Gyttja.

Tx-2222. Simpsons Flats, 840-845 **10,000 ± 150**
Wood.

Tx-2223. Simpsons Flats, 848 **10,010 ± 220**
Wood.

Tx-2418. Simpsons Flats, 710 **9270 ± 280**
Wood.

Tx-2470. Simpsons Flats, 730-735 **9560 ± 110**
Wood.

General Comment (RNM): Mazama ash was at 680cm. Dates give rate of vegetational change with recession of glacial ice and subsequent climatic change. Sharp discontinuity between Tx-2418 and Tx-2220 suggests no preserved records for events between ca 9000 and 6700 yr. For complete report, see Mack, Rutter, & Valastro (1978).

Big Meadow series, Washington

Gyttja from two cores from mire at Big Meadow on Meadow Creek, Pend Oreille Co, NE Washington (48° 43′ N, 117° 33′ W). Coll 1972 and subm by R N Mack. Numbers in titles refer to cm depths of samples in core. Samples listed in stratigraphic order from highest to lowest.

Tx-2203. Big Meadow, 76 **1170 ± 100**

Tx-2295. Big Meadow, 149 **2480 ± 130**

Tx-2416. Big Meadow, 253 **3050 ± 70**

Tx-2414. Big Meadow, 307 **3390 ± 100**

Tx-2415. Big Meadow, 363 **4210 ± 110**

Tx-2073. Big Meadow, 563 **8910 ± 80**

Tx-2417. Big Meadow, 581 **9130 ± 320**

Tx-2226. Big Meadow, 607 **10,460 ± 320**

General Comment (RNM): dates establish late Quaternary chronology of pollen record from Big Meadow and confirm relatively warmer climate than today between 9700 and 3330 BP. Present climatic conditions emerged ca 2400 BP. For complete report see Mack *et al* (1979).

Waits Lake series, Washington

Gyttja core samples from Core 1, S shore Waits Lake ca 10m from waterline, 2km W of Colville R Valley, Washington (48° 11′ N, 117° 48′ W). Subm to establish chronology for late Quaternary vegetational history in area. Coll 1972 and subm by R N Mack. Figures in titles are depths in cm below surface.

Tx-2657. Waits Lake, 125-135 **3530 ± 80**

Tx-2658. Waits Lake, 275-294 **6250 ± 100**

Tx-2659. Waits Lake, 315-330 **7910 ± 100**

Tx-2660. Waits Lake, 440-456 **8480 ± 260**

Tx-2661. Waits Lake, 570-590 **9880 ± 150**

Tx-2662. Waits Lake, 660-684 **9980 ± 160**

Tx-2663. Waits Lake, 830-850 **11,950 ± 200**

General Comment (RNM): dates evidently unreliable in absolute sense since Tx-2660 and Tx-2659 bracket Mazama ash, dated elsewhere (Fryxell, 1965) at 6700 BP. Also Tx-2663 is above Glacier Peak ash, dated elsewhere (Mehringer *et al,* 1977) between 11,200 and 11,300 BP. Present dates probably about 1300 yr old, due to contamination with older carbon. They provide useful within-the-core relative time frame. For complete report, see Mack *et al* (1978b).

Mud Lake series, Washington

Gyttja from two cores on NW margin of Mud Lake, 10km NE Concunully, Washington (48° 34′ N, 119° 30′ W). Numbers in title refer to cm depth in core. Coll 1972 and subm by R N Mack.

Tx-2686. Mud Lake, 254-260 **8030 ± 150**

Tx-2687. Mud Lake, 326-332 **8840 ± 940**

Tx-2688. Mud Lake, 355-360 **9440 ± 120**

Tx-2689. Mud Lake, 424-466 **11,300 ± 560**

Tx-2690. Mud Lake, 458-466 **11,500 ± 560**

General Comment (RNM): series is below Mazama ash. For discussion, see Mack, Rutter, & Valastro (1979).

Bonaparte Meadows series, Washington

Peat from two cores from middle of fen, Bonaparte Meadows, 28km NW Republic, Washington (48° 54′ N, 119° 02′ W). Coll 1972 and subm by R N Mack. Numbers in title refer to cm depths in core.

Tx-2676. Bonaparte, 55-60 **1480 ± 60**

Tx-2677. Bonaparte, 115-119 **2170 ± 220**

Tx-2678. Bonaparte, 150-155 **2440 ± 100**

Tx-2679. Bonaparte, 190-195 **2570 ± 70**

Tx-2680. Bonaparte, 245-250 **3340 ± 90**

Tx-2681. Bonaparte, 305-310 **4780 ± 240**

Tx-2682. Bonaparte, 350-355 **6750 ± 190**

Tx-2683. Bonaparte, 410-415 **6790 ± 130**

Tx-2882. Bonaparte, 415-421 **6810 ± 190**

Tx-2881. Bonaparte, 435-439 **6870 ± 110**

Tx-2883. Bonaparte, 468-473 **6930 ± 110**

Tx-2884. Bonaparte, 492-497 **8300 ± 80**

Tx-2684. Bonaparte, 525-530 **9000 ± 420**

Tx-2685. Bonaparte, 572-577 **10,000 ± 220**

General Comment (RNM): Tx-2676 to Tx-2683 are between St Helens W and Mazama ash. Tx-2882 immediately above Mazama ash. Tx-2881 and Tx-2883 between 2 Mazama ash units; confirms earlier field evidence that Mazama ash represents 2 separate eruptions (Mack, Okazaki, & Valastro, 1979). Tx-2884, -2684, and -2685 below Mazama ash. For general discussion, see Mack, Rutter, & Valastro (1979).

Massachusetts

Tx-2948. Ned's Ditch 9, Massachusetts **3020 ± 380**

Small twigs embedded in black and orange silt and fine sand, 305 to 310cm below water surface, Core 9, Ned's Ditch, center of oxbow lake of Connecticut R within city limits of Northampton, Massachusetts (42° 17′ 30″ N, 72° 37′ 30″ W). Coll 1975 and subm by M H Sackett, Dept Biol Sci, Smith Coll, Northampton, Massachusetts. *Comment* (MHS): date is oldest obtained from oxbow. From same core, 349cm, was Gx-4378, 710 ± 130 (Sackett, 1977, p 72); backcaving may have occurred at base of core.

Granby Bog series, Massachusetts

Peat samples from NE corner of Granby Bog, 0.8km S of Bachelor Brook Rd, 9.3km SSE of Amherst (42° 15′ N, 72° 30′ W). Coll 1977 by Sackett and Sailor and subm by M H Sackett.

Tx-2945. Granby D-14 **8520 ± 200**

902 to 927.4cm depth; near base of Pollen Zone C1.

Tx-2946. Granby D-21 **10,300 ± 370**

1205 to 1230cm depth; Pollen Zone A4.

General Comment (MHS): chronology of Granby Bog agrees well with other ^{14}C-dated pollen diagrams in S New England (Beetham and Niering, 1961; Flint and Deevey, 1951; Totoket series in R, 1959, v 1, p 146-147).

IV. ARCHAEOLOGIC SAMPLES

Texas

Tx-3173. Castner Range **3080 ± 160**

Charcoal from Castner Range site (31:106:3:75), E side of Franklin Mt, El Paso, Texas (31° 52′ 46″ N, 106° 25′ 45″ W). From ash lens ca 35cm below surface; late San Pedro Cochise phase. Coll 1978 by M Thompson and subm by L Herrington, Texas Hist Comm, Austin, Texas. *Comment* (LH): agrees with other dates of comparable cultural assignment in Hueco Bolson (Thompson & Beckett, 1979).

McDonald site series

Charcoal samples from hearth, 87cm below surface, early component of McDonald site (X41HI171), E bank of Hackberry Creek, 2.1km WNW of Vaughn, Texas, in Aquilla Reservoir basin (31° 55′ 12″ N, 97° 11′ 37″ W). Coll 1978 and subm by S A Skinner, Archaeol Research Prog, Southern Methodist Univ, Dallas.

Tx-3168. X41HI171/23/1 **780 ± 70**

Tx-3169. X41HI171/23/2 **1010 ± 70**

General Comment (SAS): dates not in 1σ agreement. Component includes Coles Creek Incised sherd; Tx-3169, agreeing with late part of date range usually assigned to this type, is probably nearer actual age than Tx-3168.

George C Davis site

Samples from George C Davis site (41CE19), early Caddo site E side Neches R valley, 9.6km SW of Alto, Cherokee Co, Texas (31° 35′ N, 95° 10′ W). Previous series from site are in R, 1970, v 12, p 626-629, and R, 1975, v 17, p 71-76. For extensive review of ^{14}C dating of site, see Story and Valastro (1977).

George C Davis village series

Samples from hitherto uninvestigated part of site, NE of previously investigated portions. Coll 1978 and subm by D Creel, Dept Sociol & Anthropol, Texas A & M Univ, College Station. "Corrected" ages are corrected for $\delta^{13}C$ and dendrochronology (Damon *et al,* 1974).

Tx-3267. 41CE19/237 **560 ± 60**
$\delta^{13}C = -11.8‰$

Charred corn cob cupules and fragments, Unit 43, Feature 184-3. Corrected, 794 ± 66.

Tx-3268. 41CE19/242 **1040 ± 230**
$\delta^{13}C = -26.9‰$

Woody charcoal from bottom of pit, Unit 45, Feature 185-4. Corrected, 984 ± 232.

Tx-3269. 41CE19/244A **740 ± 70**
$\delta^{13}C = -27.1‰$

Woody charcoal, Unit 44, Feature 186-1. Corrected, 700 ± 80.

Tx-3270. 41CE19/244B **770 ± 70**
$\delta^{13}C = -12.0‰$

Charred corn cob cupules, Unit 44, Feature 186-1. Corrected, 970 ± 80.

Tx-3271. 41CE19/246A **790 ± 80**
$\delta^{13}C = -26.9‰$

Woody charcoal, Unit 46, Feature 187-3. Corrected, 748 ± 89.

Tx-3272. 41CE19/247 **780 ± 100**
$\delta^{13}C = -25.2‰$

Woody charcoal, Unit 46, Feature 187-5. Corrected, 765 ± 107.

Tx-3273. 41CE19/250A **950 ± 80**
$\delta^{13}C = -26.4‰$

Woody charcoal, Unit 48, Feature 189-6. Corrected, 930 ± 89.

Tx-3274. 41CE19/250B **440 ± 90**
$\delta^{13}C = -10.4‰$

Charred corn cob cupules, Unit 48, Feature 189-6. Corrected, 700 ± 104.

Tx-3275. 41CE19/254A **910 ± 90**
$\delta^{13}C = -26.4‰$

Woody charcoal, Unit 45, Feature 185-11. Corrected, 883 ± 98.

Tx-3276. 41CE19/254B **550 ± 60**
$\delta^{13}C = -10.1‰$

Charred corn cob cupules, Unit 45, Feature 185-11. Corrected, 802 ± 66.

Tx-3307. 41CE19/matrix sample 468 **880 ± 110**
$\delta^{13}C = -10.3‰$

Charred corn cob cupules, Unit 48, Feature 189-1. Corrected, 1099 ± 117.

Tx-3308. 41CE19/253B **620 ± 100**
$\delta^{13}C = -25.6‰$

Charred hickory nut shell, Unit 43, Feature 184-4. Corrected, 625 ± 104.

Tx-3309. 41CE19/238 **1170 ± 100**
$\delta^{13}C = -20.4‰$

Charred hickory nut fragments, Unit 45, Feature 185-8. Corrected, 1215 ± 105.

Tx-3310. 41CE19/239 **610 ± 100**
$\delta^{13}C = -11.8‰$

Charred corn cob cupules, Unit 45, Feature 185-1. Corrected, 828 ± 104.

Tx-3311. 41CE19/246B **1140 ± 160**
$\delta^{13}C = -26.6‰$

Probable charred cane, Unit 46, Feature 187-3. Corrected, 1100 ± 163.

Tx-3312. 41CE19/253A **1190 ± 80**
$\delta^{13}C = -27.2‰$

Probable charred cane, Unit 43, Feature 184-4. Corrected, 1128 ± 87.

General Comment (DC): all samples except Tx-3268 are from small charcoal-filled features which may be smudging pits of short-term use. Dates generally agree with previous dating of early Caddoan occupation at Davis site (Story & Valastro, 1977) and appear to relate mostly to later part of this occupation, although there is some indication of early occupation as well.

George C Davis F193-1 series

Wood charcoal from fill of pit, Feature 193-1, in Unit 62, W of Mound C, George C Davis site. Coll 1978 and subm by P Thurmond and U Kleinschmidt, Texas Archeol Research Lab, Univ Texas, Austin.

Tx-3399. Davis F193-1, 299 **990 ± 60**

Zone 4.

Tx-3400. Davis F193-1, 255 **1020 ± 60**

Zone 5.

Tx-3401. Davis F193-1, 288 **800 ± 40**

Zone 10 (deepest).

General Comment (PT, UK): pit fill was distinctly stratified, but matching sherds from different zones show that deposition was all one event. Occurrence of youngest date (Tx-3401) in deepest zone supports this conclusion. If Tx-3401 represents date of deposition, event was late in occupation of site.

Arkansas

Amos site series

Samples from Late Caddoan component, Amos site (3MN62), Upper Caddo Valley, 0.4km SW of Caddo Gap, Montgomery Co, Arkansas (34° 23.5′ N, 93° 37.5′ W). Coll 1976 by F Schambach and subm by A M Early, Arkansas Archeol Survey, Henderson State Univ, Arkadelphia, Arkansas.

Tx-2858. 76-690-62 **230 ± 50**

Woody twigs from Feature 4, small pit filled with twigs, nut hulls, and possible cultigens. Unit N18W42, 35cm depth. *Comment* (AME): date too recent to refer to Late Caddoan component.

Tx-2859. 76-690-127-1 **440 ± 70**

Wood charcoal from concentration of organic refuse on perimeter of Feature 3, Unit N16W44. *Comment* (AME): date appropriate for Late Caddoan component.

Boydell site series

Carbonized log samples from Boydell site (3AS58), Bartholomew phase Plaquemine, E side Bayou Bartholomew, in Boydell, Arkansas (30° 22′ N, 91° 29′ W). Coll 1977 and subm by P Stacy, Arkansas Archeol Survey, Univ Arkansas, Monticello.

Tx-2885. Boydell 77-764-1 **790 ± 50**

S central part of mound, 1.2m below surface; Feature 1.

Tx-2886. Boydell 77-764-27 **690 ± 60**

N side Feature 2, ca 2m below surface.

Tx-2887. Boydell 77-764-41 **750 ± 80**

W side Feature 2, ca 2m below surface, with Burial 5.

General Comment (JM House): dates help confirm Rolingson's (1976, p 119) estimate of AD 1200 to 1400 for Bartholomew Phase of Plaquemine, and strengthen proposed chronologies for Winterville (Brain, 1969, p 279-282), lower Yazoo (Phillips, 1970, p 955-961), and Tensas (Hally, 1966).

Oklahoma

Tx-3248. 34SM-20/#2 **1270 ± 60**

Charcoal and charred nut hulls from Block D, Level 3, Roulston-Rogers site (34Sm-20), on ridge N side Little R, ca 4.8km NW Sasakwa, Seminole Co, Oklahoma (34° 59′ 70″ N, 96° 35′ 60″ W). Component A, Plains Woodland. Coll 1972 and subm by R Drass, Oklahoma Archaeol Survey, Norman. *Comment* (RD): date as expected; agrees with UGa-2510, 1310 ± 105, from same component (Drass, pers commun).

Blessingame site series

Samples from Blessingame site (34Pu-74), Archaic and early Caddoan site in Jackfork Valley 5.6km N of Clayton, in Clayton Reservoir basin, Pushmataha Co, Oklahoma (34° 38′ 25″ N, 95° 21′ 20″ W). Coll 1978 and subm by C Lintz, Archaeol Research & Management Center, Univ Oklahoma, Norman. UGa dates cited are from Lintz (pers commun). Comments by CL.

Tx-3280. 34Pu-74, #2 **1010 ± 50**

Charred wood from roof fall, Structure 1, Sample C-6, Level 3, Sq B35-17. Early Caddo. *Comment*: sample pretreated at Texas lab, split, half-dated at Univ Georgia: UGa-2721, 890 ± 65. Georgia date not inconsistent with present date; both dates consistent with early Caddo materials. Another date from same structure is UGa-2532, 185 ± 60, anomalously young. See also Tx-3283, below.

Tx-3281. 43Pu-74, #4 **1000 ± 50**

Charred wood, roof fall post, Structure 2, Level 2, Sq C64-11. Early Caddo. *Comment*: sample pretreated at Texas lab, split, half-dated at Univ Georgia: UGa-2720, 790 ± 65, later than present date, but both dates consistent with early Caddo assignment. Another date from same structure is UGa-2533, 565 ± 60, anomalously young.

Tx-3282. 43Pu-74, #8 **500 ± 40**

Charred wood from fill of Feature 78-9, rock hearth, Level 2, S half Sq A21-18. *Comment*: UGa-1518, 220 ± 100, from same feature; dates do not agree.

Tx-3283. 43Pu-74, #7 **530 ± 50**

Charred cane from roof fall, Structure 1, Level 4, Sqs B35-11, B35-9, B35-10, B35-12. *Comment*: date significantly younger than other dates from this structure (see comment for Tx-3280, above). *Lab Comment*: no $\delta^{13}C$ determination made. Anomalous date possibly due to fractionation in cane; our experience is that some species of cane fractionate, others do not. Present sample not identified botanically.

Tx-3284. 43Pu-74, #10 **1920 ± 60**

Charred wood, probably assoc with Feature 78-6, rock hearth, Level 2 (10 to 20cm), Sq A20-14. *Comment*: date inexplicably early; stratigraphically equivalent to Feature 78-9 (Tx-3282, above, and UGa-1518, 220 ± 100) and is stratigraphically above UGa-2534, 175 ± 175.

North Carolina

Parker site series

Charcoal samples from Parker site (31Dv4), late Woodland site 250m S of Yadkin R on Horseshoe Neck, ca 11km NW of Churchland, North Carolina (35° 50′ N, 80° 31′ W). Coll 1972 and subm by J N Woodall, Mus of Man, Wake Forest Univ, Winston-Salem, North Carolina.

Tx-2818. Parker A **970 ± 80**

From postmold, Sq N95/E98, Level 3, 30 to 39cm below surface.

Tx-2819. Parker B **1340 ± 60**

Sq N78/E100, Level 3, 30 to 45cm below surface.

Tx-2820. Parker C **120 ± 260**

Trash pit in Sq N95/E100, 99.33 to 99.36m above datum. Pit had late Woodland sherds and points, 2 late Archaic points, mussel shells, animal bones.

General Comment (JNW): Tx-2818 and -2819 agree with evidence of Late Archaic point assocs that net-impressed pottery (and large Yadkin R sites with this ware) is not protohistoric in age. Reason for late date of Tx-2820 not apparent, but fill of trash pit was dark and intrusions might have been present without being detected.

Ohio

Tx-2374. Eddie Paul Rockshelter **660 ± 50**

Eddie Paul Rockshelter, on top of hill W of Stump Run, 1.6km S of Frazeysburg, Ohio (40° 05′ N, 82° 07′ W). Earliest occupation of site, assoc with Late Woodland occupation including triangular projectile points and Peters cord-marked pottery. From 0.55m depth, lowest occupation level. Coll 1972 by J Carskadden and subm by J P Morton, Dept

Geol Sci, Univ Texas, Austin. *Comment* (JPM): date later than expected; should be earlier than Philo phase (see Richards site series, below) which has shell-tempered pottery. Reason for late date unknown.

Tx-2462. Merry's Cave **2290 ± 50**

Charcoal from Merry's Cave site, on Salt Creek, 1.6km N of junction with White Eyes Creek, 8km WNW of Chandlersville, Ohio (39° 55′ N, 81° 52′ W). From layer D-3, lowest level where pottery occurs: Early Adena. Coll 1969 by J Carskadden and subm by J P Morton. *Comment* (JPM): date recent for Early Adena.

Richards site series

Richards site (HA-13), Middle Fort Ancient aspect, Philo phase, on N bank Muskingum R, 0.8km W of Duncan Falls (39° 52′ N, 81° 55′ W). Coll 1975 by Carskadden and subm by J P Morton.

Tx-2344. Richards HA-13-A **660 ± 60**

Bottom of Fire Pit A, 0.76m below plow zone; assoc with Philo Punctate pottery.

Tx-2345. Richards HA-13-B **680 ± 50**

Bottom of Fire Pit B, 0.6m below plow zone.

Tx-2346. Richards HA-13-C **600 ± 70**

Bottom of Fire C, 0.76m below plow zone.

General Comment (JPM): dates consistent with previous estimates for age of Philo phase.

Hilltop Mound Group series

Hilltop Mound Group (HA-3), Adena and Late Hopewell site on N bank of Muskingum R, on ridge above Richards site 0.8km W of Duncan Falls (39° 52′ N, 81° 55′ W). Coll 1975 by J Carskadden and subm by J P Morton.

Tx-2347. Hilltop Mounds, HA-3D-1 **2990 ± 80**

Mound D, Feature 1, central fire basin on primary mound, Mound D. *Comment* (JPM): most assocs are Late Hopewell, but Early Woodland pottery was nearby; date indicates Early Woodland.

Tx-2373. Hilltop Mounds, HA-3B-1 **1650 ± 60**

Charred log in fire basin on floor of primary mound, Mound B. *Comment* (JPM): date consistent with Late Hopewell.

Tx-2375. Hilltop Mounds, HA-3E-1 **2160 ± 60**

From living area of House E, Late Adena. *Comment* (JPM): date consistent with Late Adena and Early Hopewell.

Washington

Tx-3304. Miller site #55, Washington **2400 ± 110**

Charcoal fragments from Miller site (45FR5) on Strawberry I, in Snake R, 6.4km upstream from its mouth, Franklin Co, Washington (46°

14′ N, 118° 59′ W). Side of 43.5 E wall, 59.4S to 60.0S, alt 103.60 to 103.70cm. Coll 1978 and subm by R R Mierendorf, Washington State Univ, Pullman, Washington. *Comment* (RRM): date assoc with non-housepit occupation; underlies large housepit occupation.

Montana

Tx-3066. Iron Jaw Wilcox Burial **1790 ± 50**

Wood charcoal from Iron Jaw Wilcox Burial (24RB93), on first alluvial terrace above Iron Jaw Creek, ca 6.4km S of Hathaway, Montana (46° 13′ 38″ N, 106° 13′ 11″ W). Above and among bones of primary burial, 2 to 30cm subsurface. Coll 1978 by J Clark and subm by R A Teegarden, U S Bur Land Management, Miles City, Montana. *Comment* (RAT): no grave goods assoc; ^{14}C date allows placement of burial in time.

Benson's Butte series

Charcoal from hearths and bone from rock-walled dwelling in Benson's Butte site (24BH1726; Fredlund, 1979). Late Prehistoric site on spring fork of Young's Creek, tributary of Tongue R, Crow Indian Reservation, Big Horn Co, Montana, ca 32km N of Sheridan, Wyoming (45° 01′ 34″ N, 107° 01′ 13″ W). Coll and subm 1977, 1978 by L B Fredlund, Montana Tech Alumni Foundation, Mineral Research Center, Butte, Montana. For previous dates, see R, 1977, v 19, p 317. Cm figures are depths below surface.

Tx-2795. Benson's Butte #6 **940 ± 60**

Charcoal, Feature 16, 35 to 40cm, 1S38W.

Tx-2796. Benson's Butte #7 **1510 ± 60**

Charcoal, Feature 18, 40 to 50cm, 2N/3N 37W/38W.

Tx-2797. Benson's Butte #8 **4230 ± 50**

Charcoal, Feature 20, 60cm, 6N38W.

Tx-2798. Benson's Butte #9 **1140 ± 50**

Charcoal, Feature 20, 40 to 50cm, 6N38W.

Tx-3111. Benson's Butte #10 **1000 ± 90**

Bone, Feature 19, 40 to 60cm, various locations.

Tx-3112. Benson's Butte #11 **1770 ± 200**

Bone, Feature 19, 40 to 60cm, various locations.

General Comment (LBF): charcoal dates fit well within expected range of early Late Prehistoric period, except for Tx-2797, which is inexplicably early. Bone date, Tx-3111, consistent with major occupation of site; however, Tx-3112 thought to be more realistic date for structure as living surface is stratigraphically below latest occupation. For further details see Fredlund (1979).

Idaho

Hatwai site series

Charcoal from Hatwai site (10NP143), at confluence of Hatwai Creek and Clearwater R, ca 7km E of Lewiston, Idaho (46° 26′ 30″ N, 116° 54′ 00″ W). Coll 1978 by Green, Ames, and others and subm by J P Green and K M Ames, Dept Sociol, Anthropol, and Criminal Justice Admin, Boise State Univ, Boise, Idaho. Comments by JPG and KMA.

Tx-3081. 10NP143-77 **9320 ± 1830**

Very small samples from remnant sand layer over alluvial bar gravel, 9.6-11.8N/90-91E, alt 232.6 to 232.8cm. Early Alluvium (Qae) (Hammett, 1976). *Comment*: dates overbank sand deposition in broad meander at midpoint bar position. Stratigraphically below Tx-3082 and -3083, below.

Tx-3082. 10NP143-78 **8560 ± 520**

Truncated surface under upper gravel, 10-15N/89-90E, alt 232 to 232.6cm. Early Alluvium (Qae). *Comment*: dates upper limit for truncation of overbank chute sediments and start of period of increased stream competence. Dates same episode as WSU-1828, 6165 ± 210 (Ames, pers commun); present date in better agreement with geologic evidence. Stratigraphically above Tx-3083, below.

Tx-3083. 10NP143-17/78 **9280 ± 110**

In overbank channel, 13-15N/89-90E, alt 321.8m. Mid-point bar location. *Comment*: dates start of overbank chute deposition; dates upper limit for truncation of underlying deposits. Geologically same as WSU-1840, 7860 ± 90 (Ames, pers commun); present date in better agreement with geologic evidence. Early Alluvium (Qae). Unconformably overlies Tx-3081; underlies Tx-3082.

Tx-3084. 10NP143-87 **6240 ± 100**

Bottom of channel cut into Early Alluvium, 13-14N/259E, alt 231.85 to 231.90cm. *Comment*: dates upper limit for cut. Dates cut and fill episode represented by Overbank "A" set, chute fill. Overbank episode records vigorous Clearwater R flow in Altithermal period. Upper point bar location; correlates with units at mid and lower bar positions.

Tx-3085. 10NP143-102 **4310 ± 70**

Organic fraction of Overbank Laminae "C" set, Unit B, 12.5-13.6N/259E, alt 232.78 to 232.81m. *Comment*: dates episode of increased Clearwater R flow, roughly co-eval with Tucannon phase pit houses (Tx-3088, -3263, below). Upper point bar location, correlates with units at mid and lower bar positions. Middle Alluvium unit (Qam).

Tx-3086. 10NP143-64 **9160 ± 230**

Occupational surface in Early Alluvium (Qae) unit, 9-12N/56-60E, alt 231.9 to 232.1cm. *Comment*: laterally equivalent to Tx-3083, above; dates agree. Dates upper limit for lower point bar gravels containing Windust phase artifacts (Leonhardy and Rice, 1970).

Tx-3088. 10NP143-103 **4120 ± 110**

Small branch or house timber, lower floor House 2; 15.35-15.40N/141.18-141.40E, alt 233.25cm. *Comment*: pit house of Tucannon phase (Leonhardy and Rice, 1970); below upper floor of house, from which came Tx-3092, -3264, below.

Tx-3089. 10NP143-70A **360 ± 60**

From intrusive pit, Feature 90, dug into House 3, Tucannon phase pit house, 2.05-3.05N/59.45E, alt 234cm. *Comment*: dates trash in pit.

Tx-3090. 10NP143-4A-5 **150 ± 70**

From pit, Feature 2, 26.20-27.25S/32W, alt 234cm. *Comment*: small side-notched points assoc; latest precontact date for site use.

Tx-3091. 10NP143-37 **2270 ± 150**

Buried soil surface on upper Tucannon sediment, 18-28S/32W, alt 232.6 to 232.7cm. *Comment*: Middle Alluvium; composite sample from along contact, Qal position; correlates with paleosol developed on Qam.

Tx-3092. 10NP143-119 **3420 ± 380**

Composite sample from small area on upper floor House 2, 14-16N/141-145E, alt 233.4 to 233.5cm. *Comment*: assoc with Tx-3264, below; dates agree closely. Appropriately later than Tx-3088, above, on lower floor of same house. See Tx-3264, below, for further comments.

Tx-3158. 10NP143-217 **9850 ± 870**

Intergravel sand lens at lower point bar position; 10-12N/56-60E, alt 230.94 to 231.38cm. *Comment*: assoc with Windust phase artifacts, post-Missoula flood gravels. Stratigraphically inconsistent with Tx-3159, below; present date probably too recent.

Tx-3159. 10NP143-187 **10,820 ± 140**

Lower point bar gravel unit, 8-10N/51.3-54.0E. *Comment*: Windust phase artifacts directly assoc; first post-Missoula flood occupation. Overlies Tx-3158, above, which has more recent date; present date believed more reliable because consistent with those from Marmes Rock Shelter for initial occupation (Rice, 1972).

Tx-3160. 10NP143-216 **10,110 ± 720**

Intergravel sand lens, 14-16N/124-127E, alt 232.64 to 233.03cm. Mid-point bar position. *Comment*: dates period of high stream competence. Artifacts in overlying gravel foreset unit.

Tx-3161. 10NP143-283 **5450 ± 120**

Organic fraction of Overbank Lamina "B", from buried channel at intersection of lower point bar and creek; 0.5-1.0N/48-50E, alt 231 to 231.38cm. *Comment*: dates episode of increased stream competence. Gives median age for ashy (Mazama) fan deposits derived from Hatwai Creek.

Tx-3262. 10NP143-261 **5550 ± 220**

Composite sample from fill of large pit intrusive into fill of House 1; 10-12N/128-130E, alt 233 to 233.1cm. *Comment*: stratigraphically more recent than Tx-3263, below, and WSU-1842, 3330 ± 70; present date must be too old for age of pit.

Tx-3263. 10NP143-271 **4340 ± 90**

Composite sample from floor of House 1, 10-12N/128-130E, alt 232.9 to 233cm. *Comment*: agrees with Tx-3088, above, in dating first pit house here, and provides support in dating House 5 at Alpowai site (Brauner, 1976). Hatwai and Alpowai are thus earliest villages on Columbia Plateau.

Tx-3264. 10NP143-186 **3440 ± 110**

Composite sample from small pit assoc with upper floor of House 2; 14.7-15.4N/142.18-143.05E, alt 232.82 to 233.20cm. *Comment*: agrees closely with Tx-3092, above. These 2 dates, and dates on House 1 (WSU-1842, 3330 ± 70; WSU-1878, 3130 ± 90; Ames, pers commun) and House 4 (WSU-1892, 3240 ± 90; Ames, pers commun) date second major house construction episode at site, Tucannon phase.

Tx-3265. 10NP143-117 **8800 ± 1310**

Small composite sample on occupational surface in late glacial overbank sediment; 7-12N/51-60E, alt 231.84cm. *Comment*: assoc with early Cascade phase material. Early Alluvium (Qae). Duplicate sample of Tx-3086, above, with which it agrees.

Tx-3266. 10NP143-229 **8660 ± 1660**

Small composite sample assoc with upper gravel veneer on lower point bar, Feature 63, 6-12N/51-60E, variable alt. *Comment*: Windust phase cultural material assoc. Laterally equivalent to episode dated by Tx-3082; dates agree.

General Comment on Hatwai series: series provides first good set of dates for an open Windust phase site, establishes initiation of pit house villages on Columbia Plateau at 4300 to 4000 BP, and provides chronologic base for developing Clearwater R alluvial sequence.

Curecanti Project, Colorado

Samples from sites in Curecanti area, Blue Mesa Reservoir Basin, on Gunnison R, W of Gunnison, Colorado. Coll 1978 by R T Euler and subm by M Steiger, Midwest Archeol Center, Lincoln, Nebraska.

5GN191 series

Charcoal from Site 5GN191, extensive lithic deposit with slab-lined firepits, points including variant type of Pinto Basin; S bank of Gunnison R, ca 22.5km W of Gunnison (38° 28′ N, 107° 08′ W).

Tx-3149. #19 **8550 ± 100**

Feature 11, unlined firepit.

Tx-3152. #16 **5810 ± 120**

Feature 3, slab-lined firepit.

Tx-3155. #18 **5690 ± 170**

Feature 6, slab-lined firepit.

General Comment (MS): dates earlier than expected; all are before end of Altithermal.

5GN205 series

Charcoal from site 5GN205, in Elk Creek development area, ca 0.8km N of Blue Mesa Reservoir, ca 24km W of Gunnison (38° 28′ N, 107° 10′ W). All samples are from same stratigraphic level, 20 to 30cm below present ground surface.

Tx-3150. #420/422 **4430 ± 300**

Feature 1, circular ash stain (probable habitation structure), general fill, ca 3m diam.

Tx-3151. #443 **4560 ± 80**

From hearth on edge of *in situ* lithic concentration.

Tx-3154. #297/298 **9800 ± 830**

Same location as Tx-3151, above.

Tx-3156. #442 **7060 ± 110**

From poorly defined charcoal stain, 4m NW of Feature 1.

Tx-3157. #437 **4270 ± 90**

Sample from possible cribbing from Feature 1.

General Comment (MS): dates from Feature 1 consistent; earlier than expected.

Tx-3153. 5GN200, Catalog #1 **4520 ± 120**

Charcoal from Site 5GN200, within Elk Creek development area (see 5GN205 series, above). From possible shallow hearth in test pit. *Comment* (MS): consistent with most other dates from similar components in Curecanti area.

South America

Perijá series, Venezuela

Charcoal samples from 2 sites in Perijá Dist, state of Zulia, Venezuela. Coll 1976 and subm by E Wagner, Dept Antropol, IVIC, Caracas, Venezuela.

Tx-2608. Perijá, Caño Pescado **9140 ± 140**

From Trench A, level 0.25 to 0.5m, Caño Pescado site, on riverbank where Caño Pescado enters Rio Palmar (10° 41′ N, 72° 26′ W).

Tx-2609. Perijá, Berlin #1 **490 ± 70**

Trench V, surface to 0.25m, Berlin site, in valley between Caño Pescado and Caño Colorado, ca 1.5km from Rio Palmar (10° 38′ N, 72° 25′ W).

Tx-2610. Perijá, Berlin #2 **7710 ± 700**

Same as Tx-2609, level 0.25 to 0.5m.

Tx-2611. Perijá, Berlin #3 **8420 ± 970**

Same as Tx-2609, Level 0.5 to 1m.

General Comment (EW): assoc ceramics are similar to those at El Diluvio site (Tx-2409 to -2413; R, 1978, v 20, p 265), which were widely varied. Present dates much too old to date occupations, except Tx-2609 which is too young. Samples seem to consist partially of coal from Tertiary formations of Perijá area.

La Galgada series, Peru

Carbonized wood from pre-ceramic temples, La Galgada site, 1km S of La Galgada village on E bank of Rio Tablachaca, Prov Pallasca, Peru (8° 28′ S, 78° 9′ W). Coll 1978 and subm by T Grieder, Art Dept, Univ Texas, Austin.

Tx-3166. C1-J6 **3660 ± 80**

Fire pit in Floors 3, 5, 7, Sec C1, Sq J6.

Tx-3167. D1-D3 **3820 ± 60**

Fire pit in Floor 25, Sec D1, Sq D3.

General Comment (TG): dates provide rough time range for pre-ceramic temples.

Vegas series, Ecuador

Shell (*Anadara tuburculosa*) and human bone from Vegas culture type site midden, on low hill 1km SW Santa Elena, Santa Elena Peninsula, Prov Guayas, Ecuador (02° 13′ S, 80° 52′ W). Coll 1977 and subm by K E Stothert, Paleo-Indian Proj, Central Bank of Ecuador, 723 E Woodlawn, San Antonio, Texas.

Tx-3313. OGSE-80 #1 **7440 ± 100**

Shell, Quad G-H/8-9, 90 to 95cm level.

Tx-3314. OGSE-80 #2 **7150 ± 70**

Shell, Quad G-H/8, 95 to 100cm level.

Tx-3315. OGSE-80 #3 **8170 ± 70**

Shell, Quad G-H/8-9, 105 to 110cm level.

Tx-3316. OGSE-80 #4 **9550 ± 120**

Shell, Quad G-H/8, 140cm level.

Tx-3318. OGSE-80 Moved bones **6750 ± 150**

Bone from cemetery in midden. *Lab Comment*: date is on apatite fraction.

Tx-3413. OGSE-80, Feature 24 **8250 ± 120**

Bone from cemetery in midden. *Lab Comment*: date is on apatite fraction.

General Comment (KES): shell dates in fairly good stratigraphic order excepting Tx-3313 and -3314; dates confirm previous dates from midden (L-1042A, 8600 ± 200 BP; L-1042F, 7600 ± 100 BP; I-10,097, 8810 ± 395 BP; Stothert, pers commun). Bone dates confirm burials made while midden accumulating; Tx-3318 probably corresponds to refuse levels that have eroded from upper level of midden.

Yugoslavia

Stobi mortar, Series I, Yugoslavia

Samples of mortar ($CaCO_3$) from masonry buildings at Stobi, Hellenistic and Roman site at junction of Crna and Vardar Rivers, S of Titov Veles, Macedonia (41° 33′ N, 21° 59′ E). Previous dates from Stobi are in R, 1975, v 17, p 96-98, and 1977, v 19, p 323. Present series represents first work on application of modified technique for dating of mortar, in which aggregate is removed and only first fraction of CO_2 gas evolved from mortar is used (for details of technique see Valastro, 1975; Folk and Valastro, 1975; 1976). Tx-1431 and -1940 to -1944 coll 1973 by Davis (except as noted) and represent 1st phase of project. These dates have been reported and discussed in sources just cited (some dates are slightly different here because of being rounded to nearest 10 yr). Tx-2488 to -2494 coll 1974-5 by Davis, reported here for 1st time. Most samples split and parts prepared and counted independently. In such cases, date is average and dates of parts are given in description. "Corrected dates" are corrected for $^{13}C/^{12}C$ and dendrochronology (Damon *et al*, 1974). Subm by J R Wiseman, Dept Classical Studies, Boston Univ, Boston, Massachusetts, and E M Davis; comments by JRW and EMD.

Tx-1431. Stobi Cent Bas, Folk mortar **1870 ± 180**

Small sample for preliminary experiment in mortar dating. Floor 1, narthex of Central Basilica (formerly called Synagogue Basilica). Coll 1971 by R L Folk. *Comment*: archaeol date of building construction, AD 460 ± 30 (1490 ± 30BP), but mortar might be as much as a century later. Mortar ^{14}C date much earlier, but this preliminary experiment justified continuing work on mortar dating.

1600 ± 60

Tx-1944. Stobi, Cent Bas, Mortar 11 $\delta^{13}C = -15.8‰$

Same provenience as Tx-1431, above, 1628 ± 50, 1560 ± 90. *Comment*: corrected date, 1510 ± 60, agrees with archaeol date of building construction, 1490 ± 30BP; suggests mortar does not refer to time after building was abandoned, as had been suspected.

1730 ± 40

Tx-1941. Stobi, Theater 2X73, Mortar 4 $\delta^{13}C = -9.3‰$

Theater, foundation of analemma in E parodos, 1740 ± 60, 1720 ± 60, 1730 ± 60. *Comment*: corrected date is 1690 ± 40.

1720 ± 50

Tx-1942. Stobi, Theater 7X73, Mortar 9 $\delta^{13}C = -8.2‰$

Theater, foundation of S wall of 1st radial corridor of cavea, next to

W parodos, 1738 ± 80, 1690 ± 70, 1715 ± 70. *Comment*: corrected date is 1700 ± 50.

Tx-2488. Stobi, Theater 1X74 **1950 ± 60** $\delta^{13}C = -14.9‰$

Theater, E Porch II, from core of porch of scene building. *Comment*: corrected date is 1850 ± 75.

Tx-2489. Stobi, Theater 4X74 **1780 ± 50** $\delta^{13}C = -6.8‰$

Theater, core of W wall of center radial corridor, just N of outer circular corridor. *Comment*: corrected date is 1775 ± 70.

General Comment on Tx-1941, -1942, -2488, -2489: samples are all from same construction episode in early 2nd century AD, ca 1840 BP. Average of 4 corrected dates is 1755 ± 30. Tx-1941, -1942 agree with each other but are more recent than archaeol date. Tx-2488 agrees well with archaeol date. Tx-2489 is intermediate.

Tx-1943. Stobi, E Bas, Mortar 10 **1660 ± 50** $\delta^{13}C = -19.2‰$

Episcopal Basilica, foundation of S wall, 1680 ± 130, 1627 ± 70, 1670 ± 60, 1640 ± 70. *Comment*: corrected date is 1550 ± 50.

Tx-2490. Stobi, E Bas 45X75 **1600 ± 70** $\delta^{13}C = -10.6‰$

Episcopal Basilica, foundation of S stylobate at E end. *Comment*: corrected date is 1525 ± 85.

Tx-2491. Stobi, E Bas 46X75 **1800 ± 80** $\delta^{13}C = -18.3‰$

Episcopal Basilica, foundation of N wall near E end. *Comment*: corrected date is 1625 ± 85.

General Comment on Tx-1943, -2490, -2491: samples are all from construction Phase I, 2nd quarter or middle of 5th century AD, ca 1510 ± 20 BP. Average of 3 corrected dates is 1570 ± 40. Dates agree with one another within 1σ, and Tx-1942 and -2490 agree with archaeol date; Tx-2491 is early.

Tx-1940. Stobi, CWE 4X73, Mortar 1 **2040 ± 50** $\delta^{13}C = -16.2‰$

From horizontal layer of mortar in deposits against exterior of E wall (Wall 15) of Casa Romana, alt 131.20 to 131.44m; later than wall, 2015 ± 80, 2051 ± 60. Coll 1972 by J F Cherry. *Comment*: corrected date is 1880 ± 60, much earlier than archaeol date of 4th century AD based on pottery in strata above and below mortar layer; secondary deposition suspected. See general comment, below.

Tx-2492. Stobi, CWE 48X75 **1970 ± 80** $\delta^{13}C = -12.3‰$

Casa Romana, E (older) part of S wall (Wall 6). *Comment*: corrected date is 1915 ± 80.

Tx-2494. Stobi, CWE 50X75 **1940 ± 80** $\delta^{13}C = -12.7‰$

Casa Romana, W (younger) part of S wall (Wall 6). *Comment*: corrected date is 1865 ± 85.

General Comment on Tx-1940, -2492, -2494: age of Casa Romana not known from direct archaeol evidence. Tx-2492 and -2494 indicate 1st century AD, which is compatible with stratigraphic evidence and style of wall decoration. Structural evidence shows that Tx-2492 is earlier than -2494; dates suggest same relationship. Tx-1940, stratigraphically much later, nevertheless agrees with other 2 dates; very likely mortar of Tx-1940 originally came from Casa Romana and was redeposited. Field evidence suggested this possibility.

General Comment on Stobi mortar dates (SV, Jr & EMD): mortar dates support archaeol dates of times of construction, except in case of Theater where mortar dates vary.

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[RADIOCARBON, VOL 22, No. 4, 1980, P 1116-1124]

UNIVERSITY OF MIAMI RADIOCARBON DATES XVIII

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The following radiocarbon dates are a partial list of samples measured for a variety of projects and materials since August 1979. Chemical and counting procedures remain the same as indicated in R, v 20, p 274-282.

Calculations are based on the 5568-year Libby ^{14}C half-life. Precision is reported as one standard deviation based only on statistical counting uncertainties in the measurement of the background, NBS modern standard, and sample activities. $\delta^{13}C$ values are measured relative to PDB and reported ages are corrected for isotopic fractionation by normalizing to −25‰. An additional 400-year reservoir age correction has been applied to marine carbonates.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Western Mediterranean series

Foraminiferal mud taken by piston corer at two localities in the western Mediterranean Sea. Dated to establish planktonic foraminiferal paleoclimate curve. Coll 1975 to 1978 and subm 1979 by P Loubere, Oregon State Univ, Corvallis.

UM-1801. Core 35326: 150 to 165cm — **11,600 ± 200**, *$\delta^{13}C = -0.6‰$*

Sample coll in water depth 2480m (41° 24.8′ N, 5° 57.8′ W).

UM-1824. TR 173-16P: 92 to 107cm — **7390 ± 110**

Sample coll at water depth 1904m (36° 10.1′ N, 1° 51.4′ W).

UM-1825. Core 35326: 275 to 290cm — **16,760 ± 300**

Sample coll at water depth 2480m (41° 24.8′ N, 5° 57.8′ W).

Mediterranean Sedimentation series

Carbonate mud coll by piston corer from two sites in the W Mediterranean Sea. Samples analyzed to establish sedimentation rates for the area. Coll 1978 and subm 1979 by M Ayers, Duke Univ, Durham, North Carolina.

UM-1814. 35279: 5cm — **10,500 ± 200**

Sample coll at water depth 2595m (36° 33′ N, 0° 4.5′ W).

UM-1815. 35073: 3 to 10cm — **6110 ± 100**

Sample coll at (36° 55.9′ N, 0° 2.2′ W).

Sea Level Fluctuation series

Wood samples coll from littoral zone in several counties in Georgia for sea level fluctuation studies. Coll 1979 by R Brokaw and subm 1979 by J Howard, Skidaway Inst Oceanog, Georgia.

UM-1875. RB-5 **3020 ± 90**

Sample taken from S bank of Tybee Creek, Chatham Co (31° 32′ 32″ N, 81° 20′ 30″ W).

UM-1876. RB-8 **2810 ± 110**

Sample from Sapelo R, McIntosh Co (31° 32′ 32″ N, 81° 20′ 30″ W).

UM-1877. RB-9 **4160 ± 80**

Sample from E bank of Carr's Neck Creek, Liberty Co (31° 41′ 25″ N, 81° 17′ 30″ W).

UM-1878. RB-11 **4550 ± 90**

Sample from N bank of Little Ogeechee R, Chatham Co (31° 55′ 00″ N, 81° 08′ 20′ W).

UM-1879. RB-12 **3750 ± 70**

Sample coll from N bank of Little Ogeechee R, Chatham Co (31° 57′ 05″ N, 81° 10′ 45″ W).

Peace River series

Soil samples coll from Peace R in Bartow, Florida (27° 47′ N, 81° 48′ W). Samples dated to determine chronology sequence of soils. Coll and subm 1979 by B Volk, Univ Florida, Gainesville.

2150 ± 130

UM-1826. BA-10, 15 to 36cm, #1 $\delta^{13}C = -25.2‰$

Sample of alluvium taken from depth 15 to 36cm from submerged stream bank.

3260 ± 130

UM-1827. S BA-15, 38 to 51cm, #2 $\delta^{13}C = -26.2‰$

Sample taken from depth 38 to 51cm.

114.6% modern

UM-1828. VHS-1, A11 #3 $\delta^{13}C = -27.2‰$

Sample from soil surface which is continuously exposed.

<270

UM-1829. VHS-1, 91cm, #4 $\delta^{13}C = -27.2‰$

Sample taken immediately above water table at depth 91cm.

112.5% modern

UM-1830. 1021, 1028, 1035, #5 $\delta^{13}C = -29.2‰$

Sample taken from A1 horizon.

<370

UM-1831. 1068, 1074, 1079, #6 $\delta^{13}C = -28.4‰$

Sample coll from A1 soil horizon.

3500 ± 370

UM-1832. BA-10, 15 to 36cm, #11 $\delta^{13}C = -26.9‰$

Sample identical to UM-1826, above, but treated with NaOH.

110.9% modern
UM-1833. 1021, 1028, 1035, #15 $\delta^{13}C = -27.5‰$

Sample identical to UM-1830, above, but treated with NaOH.

Southern California series

Various species of wood taken from excavations and welling operations in S California. Dated for rate of alluviation studies. Coll 1974 and subm 1979 by D Morton, Branch chief, Western Environmental Geol, Menlo Park, California. Coordinates are unavailable and, thus, are only general. All samples are from within Los Angeles city limits (34° 03′ N, 118° 15′ W).

19,630 ± 230
UM-1816. LA Landslides $\delta^{13}C = -26.3‰$

Sample taken from excavation in Los Angeles.

11,800 ± 130
UM-1817. Burrows (61m) $\delta^{13}C = -25.2‰$

Sample taken from well at depth 61m in San Jacinto Valley.

31,440 +2210 −1730
UM-1818. Burrows (91m) $\delta^{13}C = -23.7‰$

Sample taken from same site as UM-1817, from depth 91m.

18,500 +510 −480
UM-1819. Bridge Street (160m) $\delta^{13}C = -25.1‰$

Sample taken from well in San Jacinto Valley at depth 160m.

29,850 +660 −610
UM-1820. Sanderson & San Jacinto (131m) $\delta^{13}C = -22.5‰$

Sample taken from well at intersection of Sanderson and San Jacinto R, at depth 131m.

810 ± 60
UM-1821. Temescal Canyon $\delta^{13}C = -28.0‰$

Sample coll during excavation.

33,460 +950 −850
UM-1822. DWR Long #36565 $\delta^{13}C = -25.5‰$

Sample taken from well in San Jacinto at intersection of First St and Camino Los Banos. Sample from depth 140m.

12,260 ± 210
UM-1823. West Side Bridge St $\delta^{13}C = -23.7‰$

Sample taken from well on W side of Bridge St, San Jacinto.

San Andreas Fault series

Carbonized wood fragments coll from San Andreas Fault, Dogtown trenching site, Point Reyes Natl Seashore, California (37° 56′ 56″ N, 122° 42′ 46″ W). Dated to determine recurrence interval on San Andreas fault. Coll and subm 1979 by N Hall, Foothill Coll, Los Altos Hills, California.

UM-1794. SAF-PR3-79 **2230 ± 110**
$\delta^{13}C = -24.8‰$

Sample from fluvial unit beneath clayey gravel interpreted to be paleosol.

UM-1795. SAF-PR4-79 **1410 ± 100**
$\delta^{13}C = -24.7‰$

Sample from gray sands overlying bluish gray clay.

UM-1796. SAF-PR8-79 **1250 ± 110**
$\delta^{13}C = -24.3‰$

Sample from unconsolidated fluvial sands.

UM-1797. SAF-PR9-79 **380 ± 90**
$\delta^{13}C = -27.0‰$

Sample from unconsolidated alluvium.

Alaskan River series

Samples of suspended particulate matter from the Kuparuk R and the Colville R delta, Alaska. Samples dated to establish mean ^{14}C activity of river borne particulate matter and for constructing ^{14}C baseline for coastal marine food chains.

UM-1803. 79-12 **900 ± 120**
$\delta^{13}C = -26.4‰$

Sample from Colville R delta (70° 3′ N, 150° 30′ W).

UM-1804. 79-14 **2690 ± 90**
$\delta^{13}C = -26.9‰$

Sample from Kuparuk R (70° N, 149° W).

Hatteras Slope series

Foraminiferal sand coll via piston cores and coral coll from the Florida Hatteras Slope. Samples dated to determine sedimentation rates. Coral coll 1886 by Agassiz and subm 1979 with foraminiferal sand by M Ayers.

UM-1791. 344998: 20 to 40cm $\mathbf{38{,}970\ {}^{+1940}_{-1560}}$

Foraminiferal sand coll at water depth 420m (32° 35′ N, 77° 33′ W).

UM-1792. 16154 **680 ± 70**

Coral (29° 24′ N, 79° 43′ W).

UM-1793. 34987: 25 to 40cm **$28,770^{+860}_{-780}$**

Foraminiferal sand coll at water depth 440m (32° 43′ N, 77° 21′ W).

Lost Lake series

Low grade peat and freshwater gastropods taken with an auger from a site 400m SE of Lost Lake, California (34° 16′ N, 117° 27′ W). Coll and subm 1979 by R Weldon, Caltech, Pasadena.

UM-1812. CP1 **2430 ± 110**
$\delta^{13}C = -23.7‰$

Peat coll 91cm below surface, underlain by 1.5m lake clay.

UM-1813. CP2 **5180 ± 90**
$\delta^{13}C = -10.4‰$

Freshwater gastropods coll at depth 2.4m in 1.5m sequence of lake clay.

General Comment (RW): comparing dates for these 2 samples should yield a movement rate on the San Andreas Fault through Cajon Pass.

Pamet Bog series

Peat samples coll with a piston sampler from Pamet Cranberry Bog, North Truro, Barnstable Co, Massachusetts (42° 00′ N, 70° 02′ W). Samples dated for correlation with pollen stratigraphy. Coll and subm 1979 by W Patterson, III, Univ Massachusetts, Amherst.

UM-1914. PB 105 to 110 **1910 ± 100**

Sample depth 105 to 110cm.

UM-1915. PB 400 to 405 **3700 ± 110**

Sample depth 400 to 405cm.

UM-1798. 8 La 118 **850 ± 70**
$\delta^{13}C = -26.8‰$

Sample coll from wooden post at Alexander Springs, Ocala Natl Forest, Florida (29° 05′ 06″ N, 81° 34′ 42″ W). Dating required for cultural resources management in Ocala Natl Forest. Coll and subm 1979 by A Prokopetz, US Forest Service, Tallahassee, Florida.

UM-1913. Main **860 ± 90**

Thalassia detritus coll via core taken at Crane Key in Florida Bay (25° 0.5′ N, 80° 37′ W). Sample dated for physical sedimentation studies, specifically storm events. Coll and subm 1979 by H Wanless, RSMAS, Miami, Florida.

II. ARCHAEOLOGIC SAMPLES

Alachua and Suwannee County series

Charred wood fragments coll from Alachua and Suwannee Co, Florida. Dated to establish chronology and periods of utilization of several

Indian sites in central Florida. Coll 1976 and subm 1979 by J Milanich and L Loucks, Florida State Mus, Gainesville.

UM-1781. Sample A 8-A-462 FS 11 **1680 ± 70**

Sample from aboriginal fire pit, Alachua Co, dates late Cades Pond culture.

UM-1782. Sample B 8-A-462 FS 18 **1460 ± 70**

Sample from probable storage pit, Alachua Co, dates late Cades Pond culture.

UM-1783. Sample C 8-A-462 FS 24 **1740 ± 70**

Sample from Feature 6, a probable fire pit which dates late Cades Pond period, Alachua Co (29° 32′ 12″ N, 82° 05′ 24″ W).

UM-1784. Sample D 8-A-48 FS 18 **590 ± 80**

Sample from circular fire pit from Woodward Village site, Alachua Co (29° 31′ 50″ N, 82° 19′ 37″ W). Dates single component of Hickory Pond period.

UM-1785. Sample E 8-A-48 FS 20 **520 ± 70**

Sample from fire pit, Woodward Village site, Alachua Co (29° 31′ 50″ N, 82° 19′ 37″ W). Dates single component of Hickory Pond period.

UM-1786. Sample F 8-Su-65 FS 79 **510 ± 70**

Sample from *in situ* charred post, Suwannee Co (30° 08′ 01″ N, 83° 08′ 04″ W). Dates Mission period Utina Indian.

UM-1787. Sample G 8-Su-65 FS 121 **250 ± 80**

Sample from aboriginal smudge pit, Suwannee Co (30° 08′ 01″ N, 83° 08′ 04″ W). Dates Mission period Utina Indian.

UM-1788. Sample H 8-A-463 FS 64 **1360 ± 80**

Sample on top of Burial 16, Henderson Mound, Alachua Co (29° 38′ 28″ N, 82° 23′ 47″ W). Dates early Hickory Pond period of Alachua tradition.

UM-1789. Sample I 8-A-463 FS 72 **1210 ± 70**

Sample from under skull of Burial 13, Henderson Mound, Alachua Co (29° 38′ 28″ N, 82° 23′ 47″ W). Dates early Hickory Pond period of Alachua tradition in N-central Florida.

UM-1790. Sample J 8-A-463 FS 85 **840 ± 100**

Sample from alongside Burial 15, Henderson Mound, Alachua Co (29° 38′ 28″ N, 82° 23′ 47″ W). Dates early Hickory Pond period of Alachua tradition in N-central Florida.

Useppa Island series

Shell samples coll from Useppa I., Lee Co, Florida. Dated for analysis of middens on Useppa I. Coll 1979 by J Milanich and J Chapman; subm 1979 by J Milanich, Florida State Mus, Gainesville.

UM-1835. TEST-2 Useppa (A) **5630 ± 100**

Busycon columella from buried shell midden, dates presumed Archaic period shell midden (26° 39′ 45″ N, 82° 12′ 46″ W).

UM-1836. TEST-2 Useppa (B) **4940 ± 100**

Mercenaria from same site as UM-1835.

UM-1837. TEST-3 Useppa (C) **1850 ± 90**

Crassostrea from buried shell midden (26° 39′ 52″ N, 82° 12′ 43″ W). Sample dates lower portion of shell midden, may correlate with early Caloasahatchee region coastal cultures.

UM-1838. TEST-3 Useppa (D) **2260 ± 80**

Duplicate run of UM-1837 using *Strombus*.

UM-1839. TEST-6 Useppa (E) **1360 ± 70**

Various shell fragments which date construction of ramp leading to large, steep, shell mound (26° 40′ N, 82° 12′ 44″ W).

UM-1840. TEST-6 Useppa (F) **1180 ± 80**

Busycon and *Strombus* shell samples which date upper shell midden underlying what appears to be constructed shell ramp leading to shell mound (26° 41′ N, 82° 12′ 44″ W).

UM-1841. TEST-5 Useppa (G) **1700 ± 80**

Busycon columella dates lower portion of shell midden (26° 39′ 52″ N, 82° 12′ 44″ W).

Horrs Island series

Shell samples coll from Horrs I., Collier Co, Florida. Dated for interpretation of multi-component site presumed to be late Prehistoric Calusa. Coll and subm 1979 by A McMichael, Florida State Mus, Florida.

UM-1918. #4 Md C Strat A **4460 ± 110**

Busycon shell from base of Strat A. Dates shell used in construction of small shell mound (25° 54′ 13″ N, 81° 41′ 3″ W).

UM-1919. #6 Md B Strat C **4220 ± 80**

Clam shell from densely packed shell layer with sand matrix which dates construction of mound (25° 54′ 14″ N, 81° 41′ 5″ W).

UM-1920. #8 Md B Strat C **6330 ± 90**

Duplicate run of UM-1919 using oyster shell.

UM-1921. #9 Md B Zone A **4250 ± 90**

Oyster shell from densely packed shell cap on shell and sand mound (25° 54′ 14″ N, 81° 41′ 5″ W).

UM-1922. #20 Md C Strat A **4470 ± 80**

Strombus shell from approximate center of Strat A which dates construction of small shell mound (25° 54′ 14″ N, 81° 41′ 5″ W).

UM-1923. #22 Md A Strat A **4340 ± 70**

Trachycardium shell from upper layer of conical shell and sand mound which dates construction of mound (25° 54′ 14″ N, 81° 41′ 0″ W).

UM-1924. #24 Md A Strat B **4030 ± 80**

Crassostrea shell from layer below Strat A (25° 54′ 14″ N, 81° 41′ 0″ W).

UM-1925. #26 Md A Strat A **4060 ± 80**

Crassostrea shell from densely packed shell core of Mound A (25° 54′ 14″ N, 81° 41′ 0″ W).

UM-1926. #33 TEST-9 Strat H **3900 ± 80**

Crassostrea from thin shell lens within largely shell-free stratum in a large stratified shell midden. Probably dates pre-Glades tradition (25° 54′ 15″ N, 81° 40′ 54″ W).

UM-1927. #34 TEST-9 Strat B **3900 ± 90**

Crassostrea fragments dates shell stratum 1.25 to 1.50m below surface of large stratified shell midden. Presumed to be Glades or pre-Glades tradition (25° 54′ 15″ N, 81° 40′ 54″ W).

UM-1928. #35 TEST-9 Strat A **4120 ± 90**

Crassostrea fragment dates uppermost stratum of large, stratified shell midden (25° 54′ 15″ N, 81° 40′ 54″ W).

UM-1929. #36 TEST-9 Strat D **4080 ± 80**

Crassostrea shells date shell stratum from bottom, 3.4m below surface, of test excavation in large, stratified midden (25° 54′ 15″ N, 81° 40′ 54″ W).

UM-1930. #37 TEST-9 Strat C **3980 ± 90**

Crassostrea shells date shell stratum at 2m depth in excavation of large, stratified shell midden (25° 54′ 14″ N, 81° 41′ 0″ W).

UM-1931. #38 TEST-9 Strat J **3890 ± 80**

Busycon shell from thin layer of whelk shells, 2.5m deep, within dense shell zone in large, stratified midden (25° 54′ 14″ N, 81° 41′ 0″ W).

Shiloh Mound series

Charred wood and shell samples from Mound A, Shiloh Natl Military Park, Tennessee (35° 06′ N, 88° 21′ W). Sample dated to determine time of construction and utilization of Mississippian Period mound. Coll and subm 1979 by J Ehrenhard, Southeast Archeol Center, Tallahassee, Florida.

UM-1807. T2 L2 **860 ± 70**

Charred wood from clayey moist soil.

UM-1808. T2 L9 **1190 ± 60**

Charred wood from friable, clayey soil.

UM-1809. T2 L11 **1130 ± 80**

Charred wood from friable, reddish and brown sands.

UM-1810. T2 L23 **1220 ± 50**

Charred wood from yellowish gray sand, dark sand and gravel.

UM-1811. T2 L26 **1810 ± 180**

Charred wood from friable gravelly soil.

UM-1872. T2 L26 **2280 ± 90**

Busycon used as cross-check for UM-1811.

UM-1873. T2 L26 **2360 ± 70**

Busycon sample from same shell as UM-1872 though recrystallized and bored through.

UM-1874. T2 L31 **2270 ± 80**

Busycon fragment from friable, gravelly soil.

Aqui Esta series

Marine shells (*Busycon*) coll from Aqui Esta burial mound on S side of North Fork of Alligator Creek, Charlotte Co, Florida (26° 53′ 52″ N, 82° 02′ 40″ W). Dated to establish construction of mound. Coll by R Jones 1962 and subm 1979 by G Luer, Sarasota, Florida.

UM-1805. AE26 **1180 ± 50**

UM-1806. AE 9 **1050 ± 70**

UM-1756. DM 3C - 1 - 3 **2640 ± 90**

Charcoal coll 100cm below surface of Indian burial mound in sand matrix. Sample dated to establish age of new pottery type found in mound. Coll 1977 by P Recourt from Pelates I., Duval Co, Florida (30° 25′ 30″ N, 80° 30′ 20″ W), and subm 1979 by R Goslin, Northeast Florida Anthropol Soc, Jacksonville, Florida.

References

Calvert, M, Rudolph, Kim, and Stipp, J J, 1978, University of Miami radiocarbon dates XII: Radiocarbon, v 20, p 274-282.

[RADIOCARBON, VOL 22, No. 4, 1980, P 1125-1129]

UNIVERSITY OF MIAMI RADIOCARBON DATES XIX

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The following radiocarbon dates are a partial list of samples measured for a variety of projects and materials since January 1980. Chemical and counting procedures remain the same as indicated in R, v 20, p 274-282.

Calculations are based on the 5568-year Libby ^{14}C half-life. Precision is reported as one standard deviation based only on statistical counting uncertainties in the measurement of the background, NBS modern standard, and sample activities. $\delta^{13}C$ values are measured relative to PDB and reported ages are corrected for isotopic fractionation by normalizing to −25‰.

I. GEOLOGIC SAMPLES

East Pacific Rise Series I

Carbonate sediment samples from eight cores taken on the East Pacific Rise, Clipperton Fracture Zone, and Galapagos Fracture Zone. Dated to study sedimentation rates and benthic mixing. Coll 1976 and subm 1979 by W H Berger, Scripps Inst Oceanography, La Jolla, California.

UM-1757. PLDS 77Bx#1 (1-4cm) 7530 ± 220

Galapagos Fracture Zone, water depth 4366m (1° 3.6′ N, 119° 55.8′ W).

UM-1758. PLDS 77Bx#1 (7-10cm) 6810 ± 420

Location and water depth identical to UM-1757.

UM-1759. PLDS 77Bx#1 (20-25cm) 13,040 ± 190

Location and water depth identical to UM-1757.

UM-1760. PLDS 79Bx#2 (1-4cm) 6230 ± 170

W slope East Pacific Rise, water depth 4542m (1° 4.6′ N, 122° 14.9′ W).

UM-1761. PLDS 79Bx#2 7-10cm) 5950 ± 170

Location and water depth identical to UM-1760.

UM-1762. PLDS 79Bx#2 (20-25cm) 10,690 ± 150

Location and water depth identical to UM-1760.

UM-1763. PLDS 81Bx#1 (1-4cm) 6580 ± 280

East Pacific Rise, water depth 4771m (1° 1.7′ N, 124° 37.3′ W).

UM-1764. PLDS 81Bx#1 (7-10cm) 5960 ± 190

Location and water depth identical to UM-1763.

UM-1765. PLDS 81Bx#1 (20-25cm) **12,645 ± 160**
Location and water depth identical to UM-1763.

UM-1766. PLDS 83Bx#1 (1-4cm) **5780 ± 150**
East Pacific Rise, water depth 4527m (0° 56.6′ N, 126° 37.7′ W).

UM-1767. PLDS 83Bx#1 (7-10cm) **6030 ± 210**
Location and water depth identical to UM-1766.

UM-1768. PLDS 83Bx#1 (20-25cm) **11,800 ± 120**
Location and water depth identical to UM-1766.

UM-1769. PLDS 85Bx#1 (1-4cm) **4850 ± 100**
East Pacific Rise, water depth 4385m (0° 58.3′ N, 128° 27.7′ W).

UM-1770. PLDS 85Bx#1 (7-10cm) **5620 ± 130**
Location and water depth identical to UM-1769.

UM-1771. PLDS 85Bx#1 (20-25cm) **11,580 ± 150**
Location and water depth identical to UM-1769.

UM-1772. PLDS 89Bx#1 (1-4cm) **5520 ± 220**
East Pacific Rise, water depth 4407m (0° 58.3′ N, 131° 39.4′ W).

UM-1773. PLDS 89Bx#1 (7-10cm) **5460 ± 110**
Location and water depth identical to UM-1772.

UM-1774. PLDS 89Bx#1 (20-25cm) **11,520 ± 170**
Location and water depth identical to UM-1772.

UM-1775. PLDS 90Bx#1 (1-4cm) **5680 ± 150**
East Pacific Rise, water depth 4297m (0° 59.2′ N, 135° 4.8′ W).

UM-1776. PLDS 90Bx#1 (7-10cm) **6340 ± 180**
Location and water depth identical to UM-1775.

UM-1777. PLDS 90Bx#1 (20-25cm) **13,430 ± 140**
Location and water depth identical to UM-1775.

UM-1778. PLDS 107Bx#1 (1-4cm) **13,700 +690 −640**
Clipperton Fracture Zone, water depth 4849m (6° 9.4′ N, 138° 16.6′ W).

UM-1779. PLDS 107Bx#1 (7-10cm) **17,390 ± 350**
Location and water depth identical to UM-1778.

UM-1780. PLDS 107Bx#1 (20-25cm) **31,900 +2500 −1900**

East Pacific Rise Series II

Carbonate sediment samples from seven cores taken on the East Pacific Rise, Clipperton Fracture Zone, and Galapagos Fracture Zone. Dated for mixing and sedimentation studies. Coll 1975 and subm 1979 by W H Berger.

UM-1892. ERDC 77Bx#1 (1-5cm) **6500 ± 100**
Water depth 3585m (4° 51′ N, 156° 3.5′ E).

UM-1893. ERDC 77Bx#1 (7-10cm) **7210 ± 90**
Location and water depth identical to UM-1892.

UM-1894. ERDC 77Bx#1 (20-25cm) **19,180 ± 210**
Location and water depth identical to UM-1892.

UM-1895. ERDC 83Bx#1 (1-5cm) **3700 ± 80**
Water depth 2342m (1° 24.1′ N, 157° 18.6′ E).

UM-1896. ERDC 83Bx#1 (7-10cm) **4380 ± 110**
Location and water depth identical to UM-1895.

UM-1897. ERDC 83Bx#1 (20-25cm) **8930 ± 110**
Location and water depth identical to UM-1895.

UM-1898. ERDC 108Bx#1 (1-5cm) **4680 ± 90**
Water depth 3383m (1° 44.8′ S, 160° 48.0′ E).

UM-1899. ERDC 108Bx#1 (7-10cm) **5870 ± 90**
Location and water depth identical to UM-1898.

UM-1900. ERDC 108Bx#1 (20-25cm) **11,650 ± 150**
Location and water depth identical to UM-1898.

UM-1901. ERDC 112Bx#1 (1-5cm) **4340 ± 70**
Water depth 2169m (1° 37.5′ S, 159° 14.1′ E).

UM-1902. ERDC 112Bx#1 (7-10cm) **5040 ± 80**
Water depth and location identical to UM-1901.

UM-1903. ERDC 112Bx#1 (20-25cm) **9895 ± 120**
Water depth and location identical to UM-1901.

UM-1904. ERDC 128Bx#2 (1-5cm) **4020 ± 80**
Water depth 3732m (0° 0.3′ S, 161° 25.6′ E).

UM-1905. ERDC 128Bx#2 (7-10cm) **5570 ± 90**
Water depth and location identical to UM-1904.

UM-1906. ERDC 128Bx#2 (20-25cm) **12,070 ± 150**
Water depth and location identical to UM-1904.

UM-1907. ERDC 136Bx#2 (1-5cm) **4250 ± 100**
Water depth 3848m (1° 6′ N, 161° 36.3′ E).

UM-1908. ERDC 136Bx#2 (7-10cm) **5920 ± 100**
Water depth and location identical to UM-1907.

UM-1909. ERDC 136Bx#2 (20-25cm) **13,740 ± 130**
Water depth and location identical to UM-1907.

UM-1910. PLDS 92Bx#1 (1-5cm) **9410 ± 90**
Water depth 4515m (3° 57.7′ N, 135° 58.6′ W).

UM-1911. PLDS 92Bx#1 (7-10cm) **14,130 ± 140**
Water depth and location identical to UM-1910.

UM-1912. PLDS 92Bx#1 (20-25cm) **27,630 ± 350**
Water depth and location identical to UM-1910.

Clipperton Fracture Zone series

Carbonate sediment samples from a core taken along the Clipperton Fracture Zone (2° 47.1′ N, 156° 13.8′ E) at depth 2767m. Samples were dated for sedimentation and paleo-oceanographic studies. Coll 1975 and subm 1979 by W H Berger.

UM-1842.	ERDC 79Bx#2 (0-2cm)	4090 ± 70
UM-1843.	ERDC 79Bx#2 (2-4cm)	4400 ± 100
UM-1844.	ERDC 79Bx#2 (4-6cm)	4710 ± 110
UM-1845.	ERDC 79Bx#2 (6-8cm)	4400 ± 80
UM-1846.	ERDC 79Bx#2 (8-10cm)	5210 ± 100
UM-1847.	ERDC 79Bx#2 (10-12cm)	6800 ± 100
UM-1848.	ERDC 79Bx#2 (12-14cm)	6820 ± 100
UM-1849.	ERDC 79Bx#2 (14-16cm)	7330 ± 90
UM-1850.	ERDC 79Bx#2 (16-18cm)	7880 ± 100
UM-1851.	ERDC 79Bx#2 (18-20cm)	7800 ± 160
UM-1852.	ERDC 79Bx#2 (20-22cm)	9250 ± 110
UM-1853.	ERDC 79Bx#2 (22-24cm)	11,820 ± 120
UM-1854.	ERDC 79Bx#2 (24-26cm)	12,590 ± 120
UM-1855.	ERDC 79Bx#2 (26-28cm)	15,130 ± 160
UM-1856.	ERDC 79Bx#2 (28-30cm)	16,930 ± 220
UM-1857.	ERDC 79Bx#2 (30-32cm)	17,320 ± 220
UM-1858.	ERDC 79Bx#2 (32-34cm)	20,330 ± 220
UM-1859.	ERDC 79Bx#2 (34-36cm)	22,890 ± 430
UM-1860.	ERDC 79Bx#2 (36-38cm)	23,700 ± 310
UM-1861.	ERDC 79Bx#2 (38-40cm)	24,290 ± 240

San Jacinto Valley series

Wood and bark samples coll from well at depth 49m in San Jacinto Valley, California (33° 48′ 25″ N, 116° 55′ 30″ W). Samples dated to study Quaternary history of San Jacinto Valley fill. Samples coll 1974 and subm 1980 by D Morton, Western Environmental Geology, Menlo Park, California.

UM-1984. San Jacinto Valley wood **27,280 ± 350**
$\delta^{13}C = -21.3‰$

UM-1985. San Jacinto Valley bark $\mathbf{31{,}000^{+1400}_{-1200}}$
$\delta^{13}C = -22.0‰$

Bogue Banks series

Various shell and organic samples coll using auger drill from Bogue Banks, North Carolina. Samples dated for barrier in stratigraphic research. Samples coll Aug 1979 and subm Nov 1979 by A Steel, Duke Univ, Durham, North Carolina.

UM-1941. RC#1 **5460 ± 170**

Oyster shell (possibly *Crassostrea virginica*) taken at 6.4m below msl in unconsolidated sediments (34° 41′ 51″ N, 76° 49′ 24″ W).

UM-1942. RC#2 **7080 ± 70**

Oyster shells (*Crassostrea ?*) taken at 8.8m to 9.1m below msl (34° 40′ 18″ N, 77° 1′ 30″ W).

UM-1943. RC#3 **7820 ± 80**

Oyster shells taken at 13.7m below msl (34° 40′ 40″, 76° 58′ 38″ W).

UM-1944. RC#4 **4700 ± 80**

Oyster shells taken at 5.2m below msl (34° 39′ 52″ N, 77° 3′ 32″ W).

UM-1945. RC#5 **9330 ± 110**

Wood fragments coll at depth of 11.9m to 13.1m below msl (34° 41′ 22″ N, 76° 51′ 43″ W).

UM-1946. RC#6 **26,440 ± 240**

Basal peat coll from shelly unconsolidated sediment 18.3m to 18.9m below msl (34° 42′ 4″ N, 76° 44′ 47″ W).

UM-1947. RC#7 **1380 ± 100**

Organic bound sand coll from depth of 2.1m to 2.4m below msl (34° 40′ 0″ N, 76° 49′ 49″ W).

Reference

Calvert, M, Rudolph, Kim, and Stipp, J J, 1978, University of Miami radiocarbon dates XII: Radiocarbon, v 20, p 274-282.

[RADIOCARBON, VOL 22, No. 4, 1980, P 1130-1140]

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INDEX

Volume 22, Nos. 1 to 4, 1980

All samples published in Volume 22, 1980 are listed here in index form. This is a new type of index, organized in chronologic order according to sample type and geographic distribution. The editors consider this index a pilot project requiring the full cooperation of our laboratories. Instructions for submitting copy for the index have been mailed and further suggestions will be considered.

ARCHAEOLOGIC SAMPLES

AFRICA

Date	Culture or Period	Sample No.	No.	Page
> 49,500	Middle Stone	KN-I-619	1	74
> 49,500	"	-620	"	73
> 49,500	"	-621	"	"
> 49,000	"	-615	"	"
> 48,500	"	-623	"	"
> 48,500	"	-618	"	"
> 48,500	"	-617	"	"
> 48,000	"	-616	"	"
> 47,500	"	-622	"	"
46,400 +3500 −2500	"	-847	"	"
> 39,000	"	-626	"	75
36,000±1150	"	-629	"	74
33,500 ± 750	"	-628	"	"
33,370 ± 550	"	-869	"	73
32,700 ± 860	"	KN -2115	"	"
29,900±1600	"	KN-I-627	"	74
28,400 ± 450	"	KN- 2056	"	72
26,700 ± 650	"	KN-I-813	"	"
19,760 ± 175	Early Later Stone	-812	"	"
19,320 ± 320	"	-625	"	74
18,660 ± 210	"	KN -2057	"	72
14,550 ± 60	"	KN-I-613	"	"
13,690 ± 120	"	-612	"	"
13,470 ± 125	"	-811	"	"
13,030 ± 100	"	-614	"	"
10,420 ± 80	Later Stone	-611	"	"
9430 ± 90	"	-610	"	"
8230 ± 70	"	KN -2143	"	76
7560 ± 75	"	-2142	"	"
7200 ± 75	"	KN-I-867	"	72
6910 ± 45	"	-624	"	74
6200 ± 65	"	-609	"	72
5960 ± 60	"	KN-I-632	"	77
3450 ± 40	"	KN-I-468	"	80
3330 ± 55	"	-633	"	77
2940 ± 45	"	-460	"	78
2910 ± 45	"	-461	"	"
2840 ± 55	"	-730	"	79
2820 ± 55	"	-638	"	"
2190 ± 40	"	-732	"	78
2150 ± 60	"	-731	"	"
2090 ± 45	"	-639	"	79
2070 ± 90	"	-637	"	"
1930 ± 50	"	-465	"	77
1670 ± 55	"	-870	"	69
1460 ± 55	"	-846	"	"
910 ± 55	"	-635	"	80
860 ± 55	"	-636	"	79
490 ± 50	"	-631	"	77
490 ± 45	Proto-Historic	-608	"	69
420 ± 60	Later Stone	-467	"	77
370 ± 50	"	-469	"	80
250 ± 70	Proto-Historic	KN -2141	"	75
230 ± 50	Later Stone	KN-I-729	"	78
110 ± 60	Proto-Historic	-630B	"	75
40 ± 50	"	-728	"	"
40 ± 50	"	-634	"	76
60 ± 50	"	-630A	"	75

AUSTRIA

Date	Culture or Period	Sample No.	No.	Page
7000±130	Hallstatt	VRI-603	1	113
5140 ± 90	"	-577	"	"
2330 ± 80	"	-598	"	114
1740 ± 90	"	-596	"	113
1450 ± 70	"	-578	"	"
1430 ± 90	"	-579	"	"
< 200	"	-583	"	"

DENMARK

Date	Culture or Period	Sample No.	No.	Page
780±50	Historic	Lu-1607	4	1062

ECUADOR

Date	Culture or Period	Sample No.	No.	Page
9550±120	Vegas	TX-3316	4	1111
8250±120	"	-3413	"	"
8170± 70	"	-3315	"	"
7440±100	"	-3313	"	"
7150± 70	"	-3314	"	"
6750±150	"	-3318	"	

EGYPT

Date	Culture or Period	Sample No.	No.	Page
3480±55		LU-1504	4	1063
3460±55		-1505	"	"
2410±55		-1503	"	"

FRANCE

Date	Culture or Period	Sample No.	No.	Page
2190±270	Early Roman	NY-557	4	1065
2150±180	"	-671	"	"
1920±180	"	-672	"	"
1820± 80	"	-556	"	"
1760± 80	Historic	-552	"	1066
1690± 80	Early Roman	-555	"	1065
1320± 90	Historic	-646	"	1066
1030± 90	"	-696	"	1065
980± 80	"	-635	"	1066
970± 80	"	-634	"	1065
840±110	"	-693	"	"
730±100	"	-695	"	"
730±120	Early Roman	-557	"	"
710± 80	Historic	-669	"	1064
570± 80	"	-547	"	"
340±110	"	-547	"	1065
320± 80	"	-548	"	1064

GREECE

Date	Culture or Period	Sample No.	No.	Page
7490±150	Sesklo	LJ-4449	4	1040

HUNGARY

Date	Culture or Period	Sample No.	No.	Page
3260±140	15th-18th C BC	LJ-4376	4	1037
3040±140	15th-17th C BC	-4377	"	"
3030±110	12th-16th C BC	-4379	"	1038
3030±110	"	-4382	"	"
1980±100	1st C AD-4th C BC	-4378	"	"
840±130	13th-10th C AD	-4380	"	"
700±130	15th-11th C AD	-4381	"	"

INDIA

Date	Culture or Period	Sample No.	No.	Page
740,000		BS-79	1	59
34,670±710	Upper Paleolithic	-78	"	58
3355±105	Early Jorwe	-103	"	59
3255±120	Neolithic	-98	"	58
2495±105	Megalithic	-94	"	"
2455±100	"	-92	"	"
2210±100	Historic	-119	"	"
2130±105	N.Black Polished Ware	-70	"	57
2065±120	"	-66	"	"
2045± 90	Megalithic	-97	"	58
1975±110	N.Black Polished Ware	-69	"	57
1965± 90	Historic	-117	"	58
1940±110	"	-68	"	"
1920±110	"	-67	"	57
1910± 95	"	-118	"	58
1350± 95	"	-113	"	59

IRAN

Date	Culture or Period	Sample No.	No.	Page
2920±20	Iron	VRI-479	1	114
2640±80	"	-480	"	"

IRAQ

Date	Culture or Period	Sample No.	No.	Page
< 200		VRI-632	1	114

IRELAND

Date	Culture or Period	Sample No.	No.	Page
2960±110	Bronze	D-132	4	1028
2860±110	Late Bronze	-134	"	"
2810±110	"	-133	"	"
2490±120	Bronze	-135	"	"

ITALY

Date	Culture or Period	Sample No.	No.	Page
> 41,000		NY -524	4	1066
> 41,000		-525	"	"
30,580 ± 1000		-522	"	"
22,570 ± 1000		-526	"	"
7110 ± 140	Late 70th C BC	LJ-4548	"	1040
6900 ± 150	Early 60th-Late 70th C BC	-4551	"	"
6870 ± 100	"	-4143	"	1039
6780 ± 100	Early 60th C BC	-4549	"	1040
6530 ± 150	Mid 60th C BC	-4550	"	"
6490 ± 100	"	-4144	"	1039
6230 ± 90	Late-Mid-60th C BC	-4139	"	"
6220 ± 100	"	-4140	"	"
6090 ± 90	50th-54th C BC	-4140	"	"
6070 ± 90	"	-4142	"	"
5940 ± 100	48th-52nd C BC	-4138	"	1038
5940 ± 80	"	-4136	"	"
5770 ± 100		Ny -411.5	"	1066
5730 ± 100		-411.1	"	"

ARCHAEOLOGIC SAMPLES

ITALY (cont)

Date	Culture or Period	Sample No.	No.	Page
5720±100		NY -411.2	4	1066
5720±100		-411.3	"	"
5710±100		-411.4	4	1066
5700 ± 90	45th-48th C BC	LJ -4137	"	1038
4710 ± 80	34th-36th C BC	-4545	"	1039
4680 ± 60	34th-37th C BC	-4544	"	"
4580 ± 80	34th-36th C BC	-4546	"	1040
4440 ± 70	31st-45th C BC	-4547	"	"
4350 ± 90		NY - 519	"	1067
4350 ± 80		- 518	"	"
2450 ± 80		- 517	"	"
1820±100		- 516	"	"
540 ± 80		- 483	"	"
370 ± 80		- 484	"	"
Modern		- 535	"	"

PERU

Date	Culture or Period	Sample No.	No.	Page
3820±60	Pre Ceramic	Tx -3167	4	1111
3660±80	"	-3166	"	"

POLAND

Date	Culture or Period	Sample No.	No.	Page
2450±180		Gd-448	1	64
2400±170		-447	"	"
2020±155		-436	"	"
1970±150		-427	"	65
1940±150		-437	"	64
1895±160	Roman (?)	-432	"	65
1790±150		-431	"	"
1760± 70	Roman	-489	"	64
1730±140		-428	"	65
1720± 70	Roman	-488	"	64

SWEDEN

Date	Culture or Period	Sample No.	No.	Page
8830±110		Lu-1566	4	1059
8180± 80		-1567	"	"
7580±115		-1573	"	1060
7280± 75		-1558	"	1058
7070± 75		-1578	"	1060
6860± 70	Early Ertebølle	-1623	"	1062
6680± 70	"	-1622	"	"
6660± 80	"	-1617	"	"
6160± 70		-1562	"	1059
5570± 65		-1572	"	1060
5270± 90		-1570	"	1059
5080± 65		-1636	"	1058
5010± 65		-1633	"	"
4700± 60		-1563	"	1059
4440± 80		-1569	"	"
4120± 60		-1574	"	1060
3590±100		-1577	"	"
2860± 60	Late Bronze	-1674	"	1062
2830± 55		-1615	"	1061
2800± 55	Late Bronze	-1673	"	"
2760± 55	"	-1635	"	1058
2710± 55	"	-1652	"	1061
2660± 60	"	-1616	"	"
2550± 75	"	-1576	"	1060
2460± 55	"	-1565	"	1059
2310± 55	"	-1579	"	1060
2120± 50	"	-1568	"	1059
1520± 50	"	-1561	"	"
1380± 50	"	-1560	"	1058
1370± 50	"	-1564	"	1059
1280± 50	"	-1575	"	1060
1100± 50	Historic	-1614	"	1062
1100± 50	"	-1559	"	1058
1070± 50	"	-1544	"	1057
1060± 50	"	-1545	"	"
1060± 50	"	-1543	"	"
1040± 50	"	-1549	"	"
1010± 50	"	-1548	"	"
1010± 50	"	-1542	"	"
970± 50	"	-1550	"	"
960± 50	"	-1551	"	1058
960± 50	"	-1547	"	1057
450± 55	"	-1571	"	1060
< 150	"	-1677	"	1061

VENEZUELA

Date	Culture or Period	Sample No.	No.	Page
24,400 ± 650	Early Corozal	QC-275A	4	1081
24,700±1250	"	-272B	"	"
24,700 ± 200	"	-275B	"	"
23,900 ± 650	"	-272A	"	"
23,080 +910 -820	Early Camoruco - Late Corozal	-335(1)	"	1082
22,420 +820 -740	"	-335(2)	"	"
9140 ± 140		Tx-2608	"	1110
8420 ± 970		-2611	"	1111
7710 ± 700		-2610	"	"
3720 ± 270	Early Camoruco - Late Corozal	QC- 335(3)	"	1082
2810 ± 130	Early Corozal	-271B	"	1081
2650 ± 80	"	-271A	"	"
1740 ± 100	Middle Corozal	-323	"	1082
1450 ± 70	Ronquin	-311B	"	1081
1300 ± 90		-327	"	"
1200 ± 90	Early Camoruco - Late Corozal	-326	"	1082
1170 ± 100	Ronquin	-311A	"	1081
1170 ± 90	Middle-Late Corozal	-313AA	"	1083
900 ± 90	"	-312AB	"	"
860 ± 70	Late Corozal	-309	"	1081
830 ± 90	Early Camoruco - Late Corozal	-325	"	1082
820 ± 90	Late Corozal	-322	"	"
760 ± 100	Middle-Late Corozal	-313AB	"	1083
720 ± 80	"	-319	"	1082
540 ± 80	Middle Corozal	-310A2	"	"
510 ± 70	"	-310A1	"	"
490 ± 70		Tx-2609	"	1110
460 ± 80	Early-Middle Camoruco	QC-324A	"	1082
410 ± 90	Early Camoruco	QC-321	"	"
410 ± 80	Middle Camoruco	-310B1	"	"
340 ± 90	"	-310B2	"	"
340 ± 80	Middle-Late Corozal	-312AA	"	1083
260 ± 80	Middle Corozal	-320	"	1082

YUGOSLAVIA

Date	Culture or Period	Sample No.	No.	Page
2035±50	1st C AD	TX-1940	4	1113
1970±80	"	-2492	"	"
1950±60	Early 2nd C AD	-2494	"	1114
1870±180		-1431	"	1112
1800±80	Mid 5th C AD	-2491	"	1113
1780±50	Early 2nd C AD	-2489	"	"
1730±40	"	-1921	"	1112
1720±50	"	-1942	"	"
1660±45	Mid 5th C AD	-1943	"	1113
1600±70	"	-2490	"	"
1600±60		-1944	"	1112

UNITED STATES

ARKANSAS

Date	Culture or Period	Sample No.	No.	Page
790 50	Bartholomew phase Plaquemine	TX-2885	4	1103
750 80	"	-2887	"	"
690 60	"	-2886	"	"
440 70	Late Caddoan	-2859	"	1102
230 50		-2858	"	"

CALIFORNIA

Date	Culture or Period	Sample No.	No.	Page
36,000±4000		LJ-4535	4	1037
8180 ± 110		-4130	"	1036
7440 ± 110		-4134	"	1035
7120 ± 150		-4133	"	"
7060 ± 110		-4135	"	"
6300 ± 90		-4168	"	1036
5810 ± 90		-4131	"	"
5650 ± 90		-4132	"	"
4950 ± 90		-4169	"	"
3810 ± 70	23rd, 24th, 25th C BC	-4216	"	1035
3310 ± 70		-4173	"	1036
3110 ± 120	14th, 15th, 16th C BC	-4170	"	"
1400 ± 100	7th, 6th, 5th C AD	-4533	"	1037
910 ± 50	12th, 11th, 10th C AD	-4532	"	"
430 ± 70		-4219	"	1036
410 ± 70		-4534	"	1037
350 ± 70	Late Historic (?)	-4224	"	"
330 ± 70		-4255	"	1035
<250		-4217	"	"
230 ± 70		-4254	"	"
230 ± 60		-4535	"	1037

ARCHAEOLOGIC SAMPLES

UNITED STATES (cont)

COLORADO

Date	Culture or Period	Sample No.	No.	Page
9800±830		TX-3154	4	1110
8550±100		-3149	"	1109
7060±110		-3156	"	1110
5810±120		-3152	"	"
5690±170		-3155	"	"
4560± 80		-3151	"	"
4520±120		-3153	"	"
4430±300		-3150	"	"
4270±90		-3157	"	"

CONNECTICUT

Date	Culture or Period	Sample No.	No.	Page
3510±140		QC -301	4	1080
2290± 90		-217	"	1079
1050± 80		-332	"	"
750± 90		-298	"	"
610±350		-318	"	"
130± 90		-231	"	"
80± 50		-273	"	"

FLORIDA

Date	Culture or Period	Sample No.	No.	Page
6330 ± 90	Late Prehistoric Calusa	UM-1920	4	1122
5630±100	Archaic	-1835	"	"
4940±100	"	-1836	"	"
4470 ± 80	Late Prehistoric Calusa	-1922	"	"
4460±110	"	-1918	"	"
4340 ± 70	"	-1923	"	1123
4250 ± 90	"	-1921	"	1122
4220 ± 80	"	-1919	"	"
4120 ± 90	"	-1928	"	1123
4080 ± 80	"	-1929	"	"
4060 ± 80	"	-1925	"	"
4030 ± 80	"	-1924	"	"
3980 ± 90	"	-1930	"	"
3950 ± 90	"	-1726	1	107
3900 ± 90	"	-1927	4	1123
3900 ± 80	"	-1926	"	"
3890 ± 80	"	-1931	"	"
3770 ± 80	Pre-Occupation	-1723	1	107
2640 ± 90	Mississippian	-1756	4	1124
2440 ± 70	"	-1720	1	106
2360 ± 70	"	-1873	4	1124
2280 ± 90	"	-1872	"	"
2270 ± 80		-1874	"	"
2260 ± 80		-1838	"	1122
2210 ± 80		-1722	1	107
2000 ± 70		-1721	"	106
1960 ± 70		-1727	"	107
1930 ± 75		-1672	"	106
1890 $^{+120}_{-110}$		-1725	"	107
1850 ± 90		-1837	4	1122
1810±180	Mississippian	-1811	"	1124
1770 ± 70		-1642	1	104
1740 ± 70	Late Cades Pond	-1783	"	1121
1700 ± 80		-1841	"	1122
1690 ± 90		-1644	"	104
1680 ± 70	Late Cades Pond	-1781	4	1121
1530 ± 80		-1645	1	104
1520 ± 70		-1646	"	105
1460 $^{+190}_{-180}$		-1724	"	107
1460 ± 70	Late Cades Pond	-1782	4	1121
1450 ± 90		-1643	1	104
1440±140		-1674	"	106
1360 ± 80	Early Hickory Pond	-1788	4	1121
1360 ± 70		-1839	"	1122
1350 ± 80		-1665	1	105
1230 ± 80		-1669	"	106
1220 ± 50		-1671	"	"
1220 ± 50	Mississippian	-1810	4	1124
1210 ± 70	Early Hickory Pond	-1789	"	1121
1190 ± 60	Mississippian	-1808	"	1124
1180 ± 80		-1840	"	1122
1180 ± 50		-1805	"	1124
1160 ± 50		-1663	1	105
1130 ± 80	Mississippian	-1809	4	1124
1090 ± 70		-1666	1	106
1080 ± 50		-1660	"	105
1050 ± 70		-1806	4	1124
1030 ± 50		-1664	1	105
1020 ± 70		-1662	"	105
1020 ± 50		-1670	"	106

FLORIDA (cont.)

Date	Culture or Period	Sample No.	No.	Page
940 ± 60		UM-1742	1	106
890 ± 60		-1668	"	"
860 ± 70	Mississippian	-1807	4	1123
840±100	Early Hickory Pond	-1790	"	1121
590 ± 80	"	-1784	"	"
530 ± 60		-1661	1	105
520 ± 70	Early Hickory Pond	-1785	4	1121
510 ± 70	Mission	-1786	"	"
490±110		-1667	1	106
250 ± 80	Mission	-1787	4	1121

GEORGIA

Date	Culture or Period	Sample No.	No.	Page
2430±70	Woodland	UM-1676	1	105
1420±80	"	-1677	"	"
980±100	Early Mississippian	-1675	"	"

IDAHO

Date	Culture or Period	Sample No.	No.	Page
10,820 ± 140	Windust	Tx-3159	4	1108
10,110 ± 720		-3160	"	"
9850 ± 870	Windust	-3158	"	"
9320±1830		-3081	"	1107
9280 ± 110		-3083	"	"
9160 ± 230	Windust	-3086	"	"
8800±1310	Early Cascade	-3265	"	1109
8660±1660	Windust	-3266	"	"
8560 ± 520		-3082	"	1107
6240 ± 100		-3084	"	"
5550 ± 220		-3262	"	1109
5450 ± 120		-3161	"	1108
4340 ± 90		-2263	"	1109
4310 ± 70	Tucannon	-3085	"	1107
4120 ± 110	"	-3088	"	1108
3440 ± 110	"	-3264	"	1109
3420 ± 380	"	-3092	"	1108
2270 ± 150	"	-3091	"	"
360 ± 60	"	-3089	"	"
150 ± 70		-3090	"	"

MARYLAND

Date	Culture or Period	Sample No.	No.	Page
1040 ± 120	Montgomery	QC-157/8	4	1080

MASSACHUSETTS

Date	Culture or Period	Sample No.	No.	Page
1790 ± 120		QC-222(1)	4	1080
1760 ± 80		-222(2)		"

MONTANA

Date	Culture or Period	Sample No.	No.	Page
4230 ± 50	Early Late Prehistoric	Tx-2797	4	1106
1790 ± 50		-3066	"	"
1770 ± 200	Early Late Prehistoric	-3112	"	"
1510 ± 60	"	-2796	"	"
1140 ± 50	"	-2798	"	"
1000 ± 90	"	-3111	"	"
940 ± 60	"	-2795	"	"

NEW YORK

Date	Culture or Period	Sample No.	No.	Page
4940 ± 100		QC-240	4	1078
4700 ± 90		-270(2)	"	"
4600 ± 80		-270(1)	"	"
4490 ± 90		-243	"	"
4400 ± 100		-224	"	"
4370 ± 90		-239	"	"
3370 ± 170		-225	"	"
2850 ± 220		-307/8	"	1079
2480 ± 340		-241	"	1078
700 ± 120		-112	"	"

NEVADA

Date	Culture or Period	Sample No.	No.	Page
7080 ± 680		QC-291	4	1080
5410 ± 270		-294	"	1081
5390 ± 150		-293	"	"
5290 ± 180		-289	"	1080
5100 ± 100		-293	"	1081
4850 ± 100		-290	"	1080
4140 ± 130		-292	"	1081
3140 ± 90		-288	"	1080
3130 ± 90		-287(2)	"	"
2900 ± 90		-287(1)	"	"

ARCHAEOLOGIC SAMPLES

Date	Culture or Period	Sample No.	No.	Page
NORTH CAROLINA				
1340 ± 60	Late Woodland	Tx-2819	4	1104
970 ± 80		-2818	"	"
120 ± 260		-2820	"	"
NORTH DAKOTA				
470 ± 75	Early Plains Woodland	WIS-1016	1	115
265 ± 70	"	-1021	"	"
PENNSYLVANIA				
1990 ± 80		QC-250	1	1080
1610 ± 100		-259	"	"
OHIO				
2990 ± 80	Early Woodland	Tx-2347	4	1105
2290 ± 50	Early Adena	-2462	"	"
2160 ± 60	Late Adena-Early Hopwell	-2375	"	"
1650 ± 60	Late Hopewell	-2373	"	"
680 ± 50	Philo	-2345	"	"
660 ± 60	"	-2344	"	"
660 ± 50	Late Woodland	-2374	"	1104
600 ± 70	Philo Phase	-2346	"	1105
OKLAHOMA				
1920 ± 60		Tx-3284	4	1104
1270 ± 60	Plains Woodland	-3248	"	1103
1010 ± 50	Early Caddo	-3280	"	"
1000 ± 50	"	-3281	"	"
530 ± 50		-3283	"	1104
500 ± 40		-3282	"	"
SOUTH DAKOTA				
610 55	Initial Coalescent	WIS-1074	1	116
TEXAS				
3080 ± 160	Late San Pedro Cochise	Tx-3173	4	1100
1190 ± 80	Early Caddo	-3312	"	1102
1170 ± 100	"	-3309	"	1101
1140 ± 160	"	-3311	"	1102
1040 ± 230	"	-3268	"	1100
1020 ± 60		-3400	"	1102
1010 ± 70	San Pedro Cochise	-3169	"	1100
990 ± 60		-3399	"	1102
950 ± 80	Early Caddo	-3273	"	1101
910 ± 90	"	-3275	"	"
880 ± 110	"	-3307	"	"
800 ± 40		-3401	"	1102
790 ± 80	Early Caddo	-3271	"	1101
780 ± 100	"	-3272	"	"
780 ± 70	Late San Pedro Cochise	-3168	"	1100
770 ± 70	Early Caddo	-3270	"	1101
740 ± 70	"	-3269	"	"
620 ± 100	"	-3308	"	"
610 ± 100	"	-3310	"	"
560 ± 60	"	-3267	"	1100
550 ± 60	"	-3276	"	1101
440 ± 90	"	-3274	"	"
WASHINGTON				
2500 ± 70	7th,8th,9th C BC	LJ-4218	4	1034
2400 ± 110		Tx-3304	"	1105

GEOCHEMICAL SAMPLES

% of Modern △ Value or Date	Depth	Sample No.	No.	Page
		ANTARCTICA		
-73±7‰	20m below ice	LJ-4256	4	1043
		BRAZIL		
		LJ-4099-4102	4	1044
		-4303-4308	"	"
		-4450-4455	"	"
0.7±0.5	277 m	FZ-44	"	1032
2.5±0.8		-53	"	"
4.1±05	240 m	-43	"	"
4.9±03	210 m	-37	"	"
5.7±1.1		-45	"	"
9.7±0.4	77 m	-38	"	"
10.6±0.8	141 m	-41	"	"
11.7±0.3		-64	"	"
19.1±0.7	32 m	-67	"	1033
23.1±0.7		-34	"	1031
23.9±0.7	164 m	-35	"	"
25.6±0.7	36 m	-77	"	1033
27.1±0.7	120 m	-40	"	1032
32.8±0.6		-66	"	1033
37.1±0.7	130 m	-14	"	1031
37.8±0.8	89.5 m	-36	"	1032
40.0±0.6	142 m	-78	"	1033
53.9±0.7	60 m	-71	"	"
55.4±0.6		-69	"	"
71.5±0.9		-72	"	"
72.1±1.0		-73	"	"
77.2 ± .1	110 m	-79	"	"
79.9±0.8	68 m	-68	"	"
83.6±1.4		-70	"	"
88.0±0.9		-65	"	1032
		CANADA		
14,540±300	+ 150 m	MGU-334	1	90
11,280±160	+ 84 m	-330	"	"
8570±120	+ 98 m	-331	"	"
7590±100	+ 62 m	-333	"	"
6336±160	+ 44.5 m	-332	"	"
		CUBA		
29,780±500	1.4 m	MGU-465	1	88
27,160±150	3-4 m	-363	"	"
20,000±260		-416	"	89
16,430±200	6-7 m	-415	"	"
15,020±300	310-330 cm	-547	"	"
7680±150	275-295 cm	-551	"	90
7590±250	340-360 cm	-550	"	"
7480±800	420-440 cm	-548	"	89
7360±290	380-435 cm	-368	"	"
5480±140	340-380 cm	-367	"	"
4055±120	10-45 cm	-369	"	"
3370± 80	400-455 cm	-552	"	90
2150± 90		-417	"	89
1900±120	1 m	-419	"	"
1610±130		-414	"	"
1310± 80	20-30 cm	-371	"	"
1170±130	1 m	-418	"	"
		INDIA		
2875±100		BS-59	1	59
2755±105		-61	"	"
2455±100		-64	"	60
2215±100		-63	"	"
595±105		-62	"	59
475 ± 75		-58	"	"
180 ± 95		-65	"	60

% of Modern △ Value or Date	Depth	Sample No.	No.	Page
		PACIFIC ISLANDS		
>41,000	+ 50 m	MGU-164	1	84
31,930±1300	+ 34 m	-634	"	87
31,600 ± 500	+ 60 m	-165	"	85
29,880 ± 300	+ 29 m	-173	"	84
29,780±1000	+100 m	-163	"	"
29,590 ± 600	+3.5 m	-184-2	"	86
28,968±1020	+ 65 m	-625	"	88
27,480 ± 330	+ 20 m	-622	"	"
26,870 ± 350	+166 cm	-592	"	87
26,290 ± 450	+3.5 m	-184-1	"	86
25,160 ± 500	+ 24 m	-187	"	"
25,100 ± 780	+ 60 m	-181	"	85
23,894 ± 430	+1.3 m	-631	"	87
22,897 ± 352	+ 1 m	-628	"	"
22,500 ± 180	+ 5 m	-593	"	86
22,400 ± 100	+ 70 m	-175	"	83
21,920 ± 360	+ 80 m	-162	"	84
21,400 ± 270	+ 14 m	-176	"	"
20,000 ± 220	+ 2 m	-179	"	86
19,580 ± 460	+ 3 m	-590	"	88
15,220 ± 300	+ 15 m	-172	"	84
12,316 ± 210	+1.5 m	-633	"	86
6478 ± 116	185 cm	-630	"	87
4100 ± 84	- 55 cm	-618	"	"
3960 ± 150	+ 8 m	-170-1	"	83
3780 ± 150		-170-3	"	"
3740 ± 250		-170-2	"	"
3623 ± 116		-632	"	88
3190 ± 170	+ 20 cm	-629	"	86
3180 ± 170	+0.3 m	-591	"	87
2954 ± 170		-589	"	88
2890 ± 500	1.5 m	-174	"	83
2615 ± 84		-627	"	81
2500 ± 190		-177	"	84
2467 ± 84	+0.8 m	-624	"	87
2385 ± 120	+1.5 m	-171	"	84
2230 ± 150	98-104 cm	-239	"	86
1823 ± 100		-191	"	85
1666 ± 70	+1.5 m	-178	"	84
1435 ± 80		-185	"	85
1197 ± 170	+2.5 m	-626	"	88
830 ± 50	+5-10 m	-190	"	85
725 ± 180		-180	"	86
530 ± 60	340-350 cm	-237	"	85
440 ± 90	196-202 cm	-236	"	"
Recent	0-10 cm	-238	"	"
"	40m 0-10 cm	-235	"	"
"	+0.5 m	-623	"	88
		POLAND		
149.7±1.4		Gd-494	1	66
134.9±1.6		-480	"	"
103.0±0.8		-493	"	"
100.3±1.7		-288	"	"
85.3±1.6		-289	"	"
74.8±1.6		-290	"	"
69.5±1.5		-483	"	"
66.3±1.4	Surface	-417	"	65
62.0±1.3		-292	"	66
61.9±1.3	ca 400 m	-467	"	65
59.8±1.7	Surface	-433	"	"
59.5±1.7	ca 400 m	-457	"	"
59.1±1.1		-291	"	66
55.8±1.2		-434	"	"
52 3±1.2	ca 600 m	-466	"	65
48.8±1 1		-481	"	66
43.2±1 1	ca 600 m	-456	"	65
41 7±1.0	ca 600 m	-462	"	"
25 3±0.9	ca 380 m	-412	"	
24.9±1.1	ca 600 m	-411	"	
21.5±1 2	ca 380 m	-434	"	
20.6±1 1	ca 600 m	-426	"	
		*SWEDEN		
13,110±115		Lu-1675	4	1050
13 080±115		1676		

GEOLOGIC SAMPLES

% of Modern or Date	Depth	Sample No.	No.	Page
AUSTRIA				
28,300±700		VRI-618	1	118
26,300±600		-619	"	"
25,630±660		-570	"	111
11,560±170		-464	"	109
9680±210		-594	"	"
7830±130		-582	"	111
6980±130	214-216 cm	-533	"	110
6490±90	285-300 cm	-501	"	"
6270±100	188-189 cm	-534	"	"
6130±120		-634	"	109
6000±100	150-160 cm	-500	"	110
5420±100	134-144 cm	-535	"	"
5690±110	350-355 cm	-532	"	"
4920±140	113-115 cm	-536	"	"
4420±100	13.2 cm	-631	"	109
3490±80	303-307 cm	-531	"	110
3150±80	279-285 cm	-530	"	"
2280±100	60 cm	-633	"	109
750±70	1.5 m	-587	"	108
590±70	14-24 cm	-588	"	"
<250	-4.5 m	-630	"	109
BULGARIA				
2625 65	182-185 cm	WIS-1014	1	129
1810 60	146-150 cm	-1010	"	"
CANADA				
10,260±100	505-515 cm	WIS-987	1	125
10,040±95	500-505 cm	-985	"	"
9840±100	490-500 cm	-983	"	"
8940±90	270-280 cm	-1067	"	"
8900±90	385-375 cm	-1053	"	126
8740±90	450-465 cm	-992	"	127
8340±90	946 cm	-1062	"	"
8310±80	362-352 cm	-1061	"	126
7870±85	390-400 cm	-991	"	127
7265±85	390-400 cm	-982	"	125
6920±85	185-195 cm	-1066	"	"
6920±80	430-440 cm	-1055	"	127
5625±75	300-290 cm	-1054	"	126
5210±70	280-370 cm	-1060	"	"
4520±80	310-320 cm	-1056	"	127
4510±75	290-300 cm	-981	"	125
4040±80	90-100 cm	-1064	"	126
3860±70	240-250 cm	-1057	"	127
3350±70	200-190 cm	-1047	"	126
3330±70	855 cm	-1063	"	127
3230±120		Gd-473	"	63
2850±65	190-200 cm	-980	"	125
2835±75	160-150 cm	-1059	"	126
2675±60	290-300 cm	-990	"	127
2355±55	190-200 cm	-989	"	"
1840±60	90-100 cm	-986	"	"
1135±60	90-100 cm	-979	"	127
620±70	50-60 cm	-1058	"	126
FRANCE				
19,510±620		NY-543.2	4	1071
19,400±560		-543.1	"	"
6830±100		-474	"	"
4260±90	180-185 cm	-495	"	1070
4180±90	154-160 cm	-494	"	"
4120±90		-523	"	"
4100±90		-544	"	"
4000±80		-496	"	"
3770±90	125-131 cm	-493	"	"
3570±80		-546.1	"	1071
3490±90		-546.2	"	"
3480±90	119-125 cm	-492	"	1070
3390±80		-546.3	"	1071
3390±80	75-180 cm	-611	"	1068
3340±90		-545	"	1071
3230±85		LU-1606	4	1056
2930±100	120-130 cm	NY-507	"	1069
2810±70	60-65 cm	-610	"	1068
2510±100		-506	"	1069
2510±80		-633	"	1071
2440±70	65-70 cm	-614	"	1068
2380±70	60-65 cm	-612	"	"
2280±80		-476	"	1070
2120±80		-475.1	"	"
FRANCE (cont)				
2110±80	45-49 cm	Ny-491	4	1070
2070±80		-475.2	"	1071
2000±70	55-60 cm	-613	"	1068
1890±100	30-37 cm	-502	"	1069
1820±100	77-85 cm	-503	"	"
1750±90	40-55 cm	-504	"	"
1660±90	100-110 cm	-505	"	"
1440±80	50-55 cm	-609	"	1068
1220±70	40-45 cm	-615	"	"
770±80	30-35 cm	-616	"	"
770±80	40-45 cm	-617	"	"
460±100	75-85 cm	-509	"	1069
320±100	65-75 cm	-508	"	"
210±50	40-55 cm	-501	"	1068
160±90	63-70 cm	-512	"	1069
50±90	30-40 cm	-510	"	1068
Modern	33-45 cm	-511	"	1069
Modern	70-75 cm	-514	"	"
ICELAND				
8990±155	386-393 cm	Lu-1682	4	1053
7660±115	338-343 cm	-1683	"	"
6570±65	309-316 cm	-1684	"	"
6040±100	267-272 cm	-1685	"	"
4470±95	228-234 cm	-1724	"	"
2710±70	176-182 cm	-1725	"	"
2330±55	760-765 cm	-1641	"	1052
1850±60	660-665 cm	-1643	"	"
1830±55	710-715 cm	-1642	"	"
1700±50	610-615 cm	-1644	"	"
1590±60	297-302 cm	-1650	"	1053
1530±50	560-565 cm	-1645	"	1052
1450±55	360-365 cm	-1649	"	1053
1390±60	247-252 cm	-1651	"	"
1380±50	410-415 cm	-1648	"	1052
1330±55	460-465 cm	-1647	"	"
1320±55	510-515 cm	-1646	"	"
INDIA				
38,270±2480	3.4 m	BS-83	1	57
28,310±3070	43-73 cm	-73	"	54
24,030±580	179-220 cm	-74	"	"
19,310±360	120-150 cm	-122	"	56
10,620±160	70-100 cm	-120	"	"
7985±110	40-44 cm	-87	"	55
7840±300	2.3-2.4 m	-81	"	56
7210±160	260-267 cm	-996	"	"
5210±145	0.3 m	-88	"	57
4005±90	20-50 cm	-106	"	56
1975±110	17 cm	-86	"	54
1920±100	30 cm	-75	"	56
1345±110		-71b	"	55
1220±350	127-132 cm	-84	"	"
870±110		-71a	"	"
825±120		-77b	"	56
425±90		-77a	"	"
330±140	3.15 m	-96	"	57
330±70	3.3 m	-100	"	"
245±90	1.2 m	-102	"	"
280±100	0.-5 cm	-76	"	55
160±95	0.9 m	-95	"	57
Modern	15 cm	-82	"	55
Modern	5-8 cm	-89	"	"
Modern	38 cm	-99a	"	"
Modern	3.0 m	-101	"	57
Modern	5-7 cm	-85	"	54
Modern	26-43 cm	-55	"	55
IRELAND				
10,010±170		I-136F	4	1029
4030±120		-119	"	"
0.7±0.2	Bottom 1 cm	-144	"	1030
40.2±0.9	Upper 1 cm	-137	"	1029
44.9±0.4		-149	"	1030
53.5±0.9	Central 2 cm	-141	"	1029
72.8±1.1	Outer 2 cm	-142	"	"
85.8±1.2		-139	"	"
114.1±2.6		-147	"	1030
142.6±1.4		-148	"	"

GEOLOGIC SAMPLES

% of Modern or Date	Depth	Sample No.	No.	Page
		ITALY		
10,020±190	450-472.5 cm	VRI-539	1	112
9370±150	375-383 cm	-553	"	"
8920±130	385-405 cm	-548	"	"
8900±130	110-120 cm	-499	"	111
7870±140	330-340 cm	-549	"	112
		MEXICO		
14,540 ± 90		TX-1913	4	1094
14,450±100		-1914	"	"
13,180±290		-1784	"	"
		NEPAL		
36,000		VRI-607	1	112
29,200±1100		-608	"	"
		NORWAY		
9420 ± 85		Lu-1581A	4	1051
9220±100	109-114 cm	-1621	"	"
8320 ± 80	+ 1220 m	-1693	"	1052
8240 ± 80	+ 1030 m	-1692	"	1051
7330 ± 75		-1580A	"	"
7180 ± 75	69-74 cm	-1620	"	1050
4890 ± 65	+ 1000 m	-995	"	1051
3600 ± 55		-1583A	"	"
2860 ± 55		-1582A	"	"
		PERU		
10,050±100	895-902 cm		1	128
5670 ± 80	728-736 cm		"	"
1100 ± 70	225-235 cm		"	"
455 ± 60	118-123 cm		"	"
		POLAND		
36,400 +1200 -1000	520-550 cm	Lu-1632A	4	1056
35,100 +1000 - 900	520-550 cm	-1632	"	1055
11,840 ± 110	197-201 cm	-1678	"	"
11,380 ± 100	186-190 cm	-1679	"	"
11,100 ± 105	178-182 cm	-1680	"	"
11,000 ± 100	165-170 cm	-1681	"	"
9940 ± 210	440-460 cm	Gd-449	1	62
9870 ± 90	790-803 cm	Lu-1531	4	1054
9740 ± 300	330-350 cm	Gd-438	1	62
9610 ± 210	445-455 cm	-445	"	"
9470 ± 270	335-355 cm	-439	"	61
9360 ± 300	325-355 cm	-446	"	"
9280 ± 90	775-780 cm	Lu-1532	4	1054
8830 ± 85	750-755 cm	-1533	"	"
8670 ± 220	555-565 cm	Gd-458	1	62
8350 ± 80	725-730 cm	Lu-1534	4	1054
8120 ± 80	675-680 cm	-1535	"	"
7770 ± 220	495-505 cm	Gd-460	1	62
7430 ± 190	145-155 cm	-454	"	61
7160 ± 75	625-630 cm	Lu-1536	4	1054
6930 ± 240		Gd-420	1	63
6620 ± 180	135-165 cm	-442A	"	61
6600 ± 250		-442B	"	"
6590 ± 70	575-580 cm	Lu-1469	4	1054
6220 ± 120	345-355 cm	Gd-476	1	62
5950 ± 65	525-530 cm	Lu-1537	4	1054
5430 ± 65	475-480 cm	-1538	"	"
5130 ± 60	445-450 cm	-1539	"	"
4870 ± 150	340-360 cm	Gd-452	1	62
4810 ± 60	425-430 cm	Lu-1470	4	1054
4230 ± 60	390-395 cm	-1608	"	1055
3740 ± 55	340-345 cm	-1609	"	"
3320 ± 55	290-295 cm	-1610	"	"
3270 ± 160	140-160 cm	Gd-475	1	62
3150 ± 130	435-465 cm	-472	"	"
2850 ± 170	140-160 cm	-451	"	"
2740 ± 150	440-460 cm	-464	"	"
2700 ± 130	435-440 cm	-470	"	"
2650 ± 55	240-245 cm	Lu-1611	4	1055
2370 ± 150	160-180 cm	Gd-459	1	63
2250 ± 50	195-200 cm	Lu-1612	4	1055
2150 ± 100		Gd-474	1	64
1850 ± 120	215-235 cm	-471	"	62
1790 ± 80	Ca50 cm	-490	"	63
1790 ± 50	140-145 cm	Lu-1613	4	1055
1640 ± 140	215-235 cm	Gd-461	1	62
		POLAND (cont)		
1220 ± 50	75-80 cm	Lu-1540	4	1054
830±110	45-70 cm	Gd-492	1	63
810 ± 50		Lu-1637	4	1055
780 ± 50	25-30 cm	-1541	"	1054
		SAUDI ARABIA		
32,200 +1800 -1500		VRI-600	1	112
4330 ± 100		-599	"	"
1.8 ± 0.4%		-601	"	113
		SWEDEN		
12,890±190	532-538 cm	Lu-1599	4	1049
12,090±145	525-530 cm	-1600	"	"
11,970±105	249-253 cm	-1588	"	1048
11,810±190	1015+1018 cm	-1597	"	1049
11,700±105	838-840 cm	-1618	"	1050
11,260±100	613-615 cm	-1589	"	1047
11,040±150	995-998 cm	-1598	"	1049
10,890 ± 90	598-600 cm	-1590	"	1047
10,830±100	582-584 cm	-1591	"	"
10,760±100	507-511 cm	-1601	"	1049
10,560±100	502-507 cm	-1602	"	"
10,740±105	498-502 cm	-1603	"	"
10,500±100	768-770 cm	-1619	"	1050
10,450±100	574-576 cm	-1592	"	1047
10,260 ± 95	491-495 cm	-1604	"	1049
10,220 ± 95	563-565 cm	-1593	"	1047
9840 ± 95	551-553 cm	-1594	"	"
9760 ± 90	482-485 cm	-1605	"	1049
9560 ± 90	537-539 cm	-1595	"	1048
7280 ± 75	228-230 cm	-1517	"	1046
6830 ± 90	125-130 cm	-1653	"	1047
6640 ± 75	218-220 cm	-1518	"	1046
4490 ± 75	94-98 cm	-1654	"	1047
3810 ± 60	208-210 cm	-1587	"	1046
3480 ± 70	72-76 cm	-1655	"	1047
3470 ± 60	194-196 cm	-1519	"	1046
3180 ± 70	168-170 cm	-1520	"	"
2570 ± 55	100-105 cm	-1672	"	"
2500 ± 55	415-420 cm	-1639	"	1048
2300 ± 50	130-134 cm	-1521	"	1046
2050 ± 50	75-80 cm	-1671	"	"
1970 ± 70	23-27 cm	-1656	"	1047
1850 ± 50	122-126 cm	-1522	"	1046
1710 ± 50	395-400 cm	-1640	"	1048
1610 ± 65	375-380 cm	-1638	"	"
1580 ± 50	50-55 cm	-1670	"	1046
1540 ± 55	100-104 cm	-1523	"	"
900 ± 50	32.5-37.5 cm	-1669	"	"
580 ± 50	75-77.5 cm	-1686	"	1050
		SWITZERLAND		
5140±120		Lu-1696	4	1056
5090 ± 65		-1697	"	"
		UNITED STATES		
ALASKA				
6960±100		QC-245	4	1077
6660 ± 90		-208	"	"
5110±200		-206B	"	"
4460±180		-244	"	"
3830±110		-204A	"	1076
3770±100		-205	"	"
3630±130		-162	"	1075
3040±370		-207	"	1077
2770 ± 90		-161	"	1075
2690 ± 90		UM-1804	"	1119
900±120		-1803	"	"
650 ± 80		QC-160	"	1075
107.1%		UM-1739	1	102
105 %		-1738	"	"
104.4%		-1740	"	"
103.7%		-1741	"	103

GEOLOGIC SAMPLES

UNITED STATES (cont.)

CALIFORNIA

% of Modern or Date	Depth	Sample No.	No.	Page
$38,380^{+730}_{-670}$		UM-1631	1	102
$33,460^{+950}_{-850}$	140 m	-1822	4	1118
$31,440^{+2210}_{-1730}$	91 m	-1818	"	"
$31,000^{+1400}_{-1200}$	49 m	-1985	"	1129
$29,850^{+660}_{-610}$	131 m	-1820	"	1118
$29,040^{+610}_{-570}$		-1632	1	102
27,280±350	49 m	-1984	4	1129
19,630±230		-1816	"	118
$18,500^{+510}_{-480}$	160 m	-1819	"	"
12,260±210		-1823	"	"
18,800±130	61 m	-1817	"	"
5180 ± 90	2.4 m	-1813	"	1120
3530 ± 80		LJ-4366	"	1041
2430±110	91 cm	UM-1812	"	1120
2230±110		-1794	"	1119
1410±100		-1795	"	"
1250±110		-1796	"	"
850 ± 90		LJ-4391	"	1041
810 ± 60		UM-1821	"	1118
700 ± 50		LJ-4383	"	1041
670 ± 70		-4388	"	"
560 ± 50		-4385	"	"
410 ± 70		-4384	"	"
390 ± 60		-4392	"	"
380 ± 90		UM-1797	"	1119
360 ± 50		LJ-4365	"	1041
340 ± 60		-4387	"	"
330 ± 60		-4386	"	"
240 ± 60		-4389	"	"
110 ± 30		-4390	"	"

FLORIDA

% of Modern or Date	Depth	Sample No.	No.	Page
$38,970^{+1940}_{-1560}$	20-40 cm	UM-1791	4	1119
$28,770^{+860}_{-730}$	25-40 cm	-1793	"	1120
3500 ± 130	15-36 cm	-1832	"	1117
3260 ± 130	38-51 cm	-1827	"	"
2150 ± 130	15-36 cm	-1826	"	"
860 ± 90		-1913	"	1120
850 ± 70		-1798	"	"
680 ± 70		-1792	"	1119
370		-1831	"	1117
270	910 m	-1829	"	"
180 ± 80	3 m	-1692	1	104
Modern		UM-1828	4	1117
Modern		-1830	"	"
Modern		-1833	"	1118

GEORGIA

% of Modern or Date	Depth	Sample No.	No.	Page
4550±90		UM-1878	4	1117
4160±80		-1877	"	"
3750±70		-1879	"	"
3020±90		-1875	"	"
2810±110		-1876	"	"

IDAHO

% of Modern or Date	Depth	Sample No.	No.	Page
9510±190	920-923 cm	Tx-2108	4	1096
9110±110	913-416 cm	-2103	"	"
8280±120	904-908 cm	-2110	"	"
7960±310	805-810 cm	-2674	"	"
7680± 40	760-771 cm	-2673	"	"
6980±480	643-645 cm	-2104	"	"
6630± 80	600-605 cm	-2116	"	"
6390±230	500-505 cm	-2121	"	"
4310±990	395-399 cm	-2119	"	"
3030±110	339-343 cm	-2105	"	"
2940± 80	279-283 cm	-2113	"	"
2670±100	161-166 cm	-2115	"	"

KANSAS

% of Modern or Date	Depth	Sample No.	No.	Page
2395 ± 65	12 m	WIS-1030	1	116

MAINE

% of Modern or Date	Depth	Sample No.	No.	Page
$24,750^{+1560}_{-1300}$	550-570 cm	UM-1693	1	104

UNITED STATES (cont.)

MASSACHUSETTS

% of Modern or Date	Depth	Sample No.	No.	Page
10,300±370	1205-1230 cm	TX-2946	1	1099
8520±200	902-927 cm	-2945	"	"
3700±110	400-405 cm	UM-1915	"	1120
3020±380	305-310 cm	TX-2948	"	1099
1910±100	105-110 cm	UM-1914	"	1120

MINNESOTA

% of Modern or Date	Depth	Sample No.	No.	Page
12,060±125	1770-1778 cm	WIS-1034	1	119
7550 ± 90	947-952 cm	-1029	"	117
6165 ± 80	787-792 cm	-1026	"	"
5640 ± 70	13.4-13.5 cm	-1008	"	119
4650 ± 75	607-612 cm	-1027	"	117
4030 ± 75	11.30-11.40 cm	-1007	"	119
3950 ± 80		-1037	"	"
3785 ± 70	1150-1160 cm	-1013	"	118
3705 ± 70	487-492 cm	-1024	"	117
3705 ± 60	10.6-10.7 m	-1006	"	119
2790 ± 65	9.7-9.8 m	-1005	"	118
2615 ± 65	945-955 cm	-1009	"	"
2290 ± 65	347-352 cm	-1028	"	117
1950 ± 65	150- 55 cm	-1035	"	119
920 ± 60	7.8-7.9 m	-1003	"	118
910 ± 70	207-217 cm	1025	"	116
810 ± 60	720-730 cm		"	118
800 ± 60	7.45-7.55		"	119
630 ± 55	7.1 - ...	-1[illegible]	"	118
390 ± 60	60-70 cm	-1[illegible]	"	"

NEVADA

% of Modern or Date	Depth	Sample No.	No.	Page
40,000	34 m	TX-2561	4	1094

NEW JERSEY

% of Modern or Date	Depth	Sample No.	No.	Page
12,820±200		QC-297	4	1075
12,130±210	1.8 m	-296	"	"
6340±100	1.4 m	-142	"	"
5220±120	1.4 m	-141	"	"
5080 ± 60	1.2 m	-144	"	"

NEW YORK

% of Modern or Date	Depth	Sample No.	No.	Page
$25,450^{+6680}_{-3600}$	+ 60 cm	QC-238	4	1076
10,830±220	3 m	-232	"	"
10,360±100	997-1023 cm	WIS-1050	"	120
7950±100	4.5 m	QC-263	"	1076
7880±100	231-249 m	WIS-1051	"	120
6270±340	4.5 m	QC-233	"	1076
5900±300	9.45 m	-189	"	1073
5150±210	7.5 m	-221A	"	"
5060±120	10.1 m	-314	"	1074
4610±120	8.54 m	-261	"	"
4570±120	6.8 m	-221B	"	1073
4500±100	7 m	-264	"	"
4230±120	7.7 m	-227	"	1074
4110±100	6.15 m	-276	"	"
3940±140	10.75 m	-186	"	"
3800±160	4.75 m	-187	"	"
3610±120	4.6 m	-274	"	"
3460±100	5.05 m	-262	"	"
3245 ± 65	231-249 m	WIS-1052	1	120
2326±100	3.9 m	QC-226	4	1074
2300±160	3 m	-211	"	"
1870 ± 90	2.7 m	-228	"	1073
1800 ± 90	2.25 m	-295	"	1074
1020±100	1.12 m	-315	"	"
300 ± 90	0.27 m	-316	"	"

NORTH CAROLINA

% of Modern or Date	Depth	Sample No.	No.	Page
>32,000	475-483 cm	UM-1651	1	100
$32,540^{+680}_{-630}$	335-427 cm	-1707	"	"
$28,940^{+500}_{-470}$	457-518 cm	-1717	"	"
26,400±240	18.3-18.9 m	-1946	4	1129
$25,050^{+480}_{-450}$	457-483 cm	-1652	1	100
$23,060^{+625}_{-580}$	1524-1585 cm	-1718	"	"
15,440±280	257-262 cm	-1650	"	"
12,550±300	0-10 cm	-1715	"	101

GEOLOGIC SAMPLES

UNITED STATES (cont.)

NORTH CAROLINA (cont.)

% of Modern or Date	Depth	Sample No.	No.	Page
9330±110	11.9-13.1 m	UM-1965	4	1129
9090^{+380}_{-360}	241-246 m/msl	-1716	1	101
7820 ± 80	-13.7m/msl	-1943	4	1129
7080 ± 70	-8.8-9.1 m/msl	-1942	"	"
5460±170	-6.4 m/msl	-1941	"	"
4800±100	56-64 cm	-1919	1	101
4700 ± 80	5.2 m/msl	-1944	4	1129
4300 ± 90	188-191 cm	-1647	1	100
3780±140	76 cm	-1714	"	101
3580±110	91 cm	-1712	"	"
3190±150	287-295 cm	-1709	"	100
3080 ± 90	213 cm	-1648	"	"
2940±150	76 cm	-1710	"	"
2720±135	10-20 cm	-1711	"	"
2710±150	183-188 cm	-1713	"	101
1520 ± 70	208-218 cm	-1649	"	100
1380±100	2.1-2.4 m/msl	-1947	4	1129
1050±140	112-142 cm	-1708	1	100

VIRGINIA

% of Modern or Date	Depth	Sample No.	No.	Page
10,800±190	351 cm	UM-1706	1	102
8540±100	219 cm	-1705	"	"
8240±210	104 cm	-1703	"	101
6870±150	357 cm	-1704	"	"

VIRGIN ISLANDS

% of Modern or Date	Depth	Sample No.	No.	Page
22,370±280		UM-1733	1	99
7600±100		-1734	"	"
5940 ± 85		-1732	"	"
3660 ± 80		-1731	"	"
2890 ± 90		-1730	"	"
2020 ± 80		-1729	"	"
1750 ± 90		-1728	"	"

WASHINGTON

% of Modern or Date	Depth	Sample No.	No.	Page
$43{,}200^{+3200}_{-2280}$		UM-1753	1	104
41,500		-1749	"	103
39,600		-1750	"	"
$39{,}210^{+1730}_{-1420}$		-1747	"	"
$36{,}990^{+1200}_{-1040}$		-1754	"	104
$30{,}470^{+1650}_{-1370}$		-1751	"	103
$29{,}330^{+550}_{-520}$		-1746	"	"
$28{,}910^{+690}_{-630}$		-1745	"	"
$29{,}130^{+570}_{-530}$		-1748	"	"
23,600 ± 280		-1752	"	"
11,950 ± 200	830-850 cm	Tx-2663	4	1098
11,500 ± 560	458-466 cm	-2690	"	"
11,300 ± 560	424-466 cm	-2689	"	"
10,460 ± 320	607 cm	-2226	"	"
10,010 ± 220	848 cm	-2233	"	1097
10,000 ± 220	572-577 cm	-2685	"	1099
10,000 ± 150	840-845 cm	-2222	"	1097
9980 ± 160	660-684 cm	-2662	"	1098
9880 ± 150	570-590 cm	-2661	"	"
9560 ± 110	730-735 cm	-2470	"	1097
9440 ± 120	355-360 cm	-2688	"	1098
9270 ± 280	710 cm	-2418	"	1097
9130 ± 320	581 cm	-2417	"	"
9000 ± 420	525-530 cm	-2684	"	1099
8910 ± 80	563 cm	-2073	"	1097
8840 ± 940	326-332 cm	-2687	"	1098
8480 ± 260	440-456 cm	-2660	"	"
8300 ± 80	492-497 cm	-2884	"	1099
8030 ± 150	254-260 cm	-2686	"	1098
7910 ± 100	315-330 cm	-2659	"	"
6930 ± 110	468-473 cm	-2883	"	1099
6870 ± 110	435-439 cm	-2881	"	"
6810 ± 190	415-421 cm	-2882	"	"
6790 ± 130	410-415 cm	-2683	"	"
6750 ± 190	350-355 cm	-2682	"	"
6250 ± 100	275-294 cm	-2658	"	1098
5850 ± 240	632-635 cm	-2220	"	1097
4790 ± 230	526-529 cm	-2219	"	"

UNITED STATES (cont.)

WASHINGTON (cont.)

% of Modern or Date	Depth	Sample No.	No.	Page
4780±240	305-310 cm	Tx-2681	4	1099
4380±240	477-480 cm	-2218	"	1097
4210±110	363 cm	-2415	"	"
4120±170	411-414 cm	-2217	"	"
3530 ± 80	125-135 cm	-2637	"	1098
3390±100	307 cm	-2414	"	1097
3340 ± 90	245-250 cm	-2680	"	1099
3260±100	340-344 cm	-2216	"	1097
3050 ± 70	253 cm	-2416	"	"
2630±160	264-268 cm	-2215	"	1096
2570 ± 70	190-195 cm	-2679	"	1099
2480±130	149 cm	-2295	"	1097
2440±100	150-155 cm	-2678	"	1099
2170±220	115-119 cm	-2677	"	"
1970±160	225-228 cm	-2214	"	1096
1480 ± 60	55-60 cm	-2076	"	1099
1170±100	76 cm	-2203	"	1097

WISCONSIN

% of Modern or Date	Depth	Sample No.	No.	Page
12,880±125	599-603 cm	WIS-1004	4	122
12,520±160	6 m	-1075	"	"
12,260±115	6 m	-1073	"	"
10,620±105	541-547 cm	-1001	"	"
10,570±110	10.10-10.30 m	-1019	"	124
10,140±105	7.95-8.10 m	-1017	"	"
10,080±100	514-518 cm	-1000	"	122
9520 ± 95	180-190 cm	-1023	"	"
9060 ± 95	2.5 m	-1018	"	123
8640 ± 85	455-459 cm	- 999	"	122
8640 ± 90	6.15-6.3 m	-1015	"	124
8070±100	990-1000 cm	-1045	"	121
7810 ± 95	2.5 m	-1046	"	123
6920 ± 75	395-399 cm	- 998	"	121
6840 ± 90	1.55 m	-1041	"	120
6350 ± 70	4.6-4.7 m	-1048	"	124
5245 ± 65	334-338 cm	- 997	"	121
5145 ± 65	2.3 m	-1071	"	123
4540 ± 70	2.2 m	-1044	"	"
4410 ± 75	2.1 m	-1022	"	"
4185 ± 70	2.95-3.05 m	-1049	"	124
4105 ± 65	263-267 cm	- 996	"	121
3215 ± 55	1.55 m	-1040	"	120
2430 ± 65	164-169 cm	- 995	"	121
2055 ± 65	138-144 cm	- 994	"	"
1770 ± 70	100-110 cm	-1078	"	124
1760 ± 70	76-81 cm	-1043	"	121
1615 ± 65	1.45 m	-1038	"	120
1505 ± 65	1.25 m	-1039	"	"
1370 ± 70	95-110 cm	-1081	"	124
620 ± 65	1.05 m	-1036	"	120
380 ± 50	.140 cm	-1072	"	122
245 ± 55	16-21 cm	- 993	"	121
<150	10-15 cm	-1042	"	"
<150	180 cm	-1029	"	122

USSR

BYELORUSSIAN SSR

% of Modern or Date	Depth	Sample No.	No.	Page
$35{,}700^{+1100}_{-1000}$		Tln-322	1	93
$34{,}850^{+2350}_{-1850}$		-326	"	"
24,550±300	300 m	-327	"	"
17,470±210	375 cm	-309	"	92
17,150±150		-329	"	93
10,650±160	480 cm	-325	"	"
5300 ± 80	720 cm	-310	"	92
5050 ± 70	670 cm	-308	"	"

CSSR

% of Modern or Date	Depth	Sample No.	No.	Page
6800±110	92-100 cm	VRI-547	1	111
4240 ± 70	62-70 cm	-546	"	"

ARKHANGELSK DISTRICT

% of Modern or Date	Depth	Sample No.	No.	Page
$>55{,}550$		Tln-335	1	96
$>54{,}550$	450 cm	-312	"	94
$>52{,}750$		-344	"	95
$>51{,}600$		-315	"	"

GEOLOGIC SAMPLES

% of Modern or Date	Depth	Sample No.	No.	Page
		USSR (cont.)		
ARKHANGELSK DISTRICT				
51,600		Tln-350	1	96
51 200		-336	"	"
$46\ 900^{+2300}_{-1750}$	+550-590 cm	-338	"	95
46 400		-349	"	96
46,300		-314	"	95
44 600		-351	"	"
$40\ 100^{+5200}_{-3600}$		-313	"	"
$38,600^{+900}_{-750}$		-324	"	"
35,300 500		-323	"	"
ESTONIA				
$41,000^{+700}_{-2100}$	350 cm	Tln-328	1	92
12,050±120	360-370 cm	-687	4	1089
12,040±100	530-540 cm	-688	"	1088
9360 ± 80	630-640 cm	-704	"	1085
9190 ± 80	468-475 cm	-342	1	92
9140 ± 80	620-630 cm	-703	4	1085
8990 ± 90	380-390 cm	-685	"	1089
8730 ± 90	590-600 cm	-300	"	1085
8710 ± 80	580-590 cm	-702	"	"
8570 ± 70	570-580 cm	-315	"	"
8530 ± 80	780-790 cm	-679	"	1089
8500 ± 70	530-540 cm	-314	"	1085
8490 ± 70	520-530 cm	-299	"	"
8300 ± 90	570-580 cm	-691	"	1088
7720 ± 70	510-520 cm	-294	"	1085
7580 ± 70	280-290 cm	-261	1	91
7350 ± 70	220-230 cm	-254	"	"
7165 ± 70	200-220 cm	-253	"	"
6980 ± 70	550-560 cm	-701	4	1085
6910±100	565-575 cm	-346	1	92
6660 ± 90	1160-1170 cm	-650	4	1089
6620 ± 80	155-165 cm	-340	1	92
6570 ± 70	420-430 cm	-298	4	1084
6510 ± 70	215-225 cm	-343	1	92
6390 ± 90	340-350 cm	-282	"	91
6330 ± 70	440-450 cm	TA-700	4	1085
5800 ± 90	340-350 cm	-291	"	1084
5330 ± 80	370-380 cm	-690	"	1088
5330 ± 80	410-420 cm	-689	"	"
4680 ± 70	270-280 cm	-297	"	1084
4590 ± 80	930-940 cm	-651	"	1089
4520 ± 70	220-230 cm	-296	"	1084
4390 ± 70	200-210 cm	-313	"	"
4260 ± 70	180-190 cm	-295	"	"
4080 ± 60	90-100 cm	-686	"	1089
3920 ± 50	120-130 cm	-312	"	1084
3830 ± 70	360-370 cm	-699	"	1085
3610 ± 70	175-185 cm	Tln-348	1	91
3480 ± 60	190-200 cm	-281	"	"
3340 ± 60	165-173 cm	-347	"	"
3210 ± 70	570-580 cm	TA-678	4	1089
3190 ± 60	125-135 cm	Tln-345	1	92
2940 ± 60	60-70 cm	TA-293	4	1084
2680 ± 80	450-460 cm	-677	"	1089
2470 ± 60	60-70 cm	-292	"	1084
2370 ± 70	270-280 cm	-697	"	1085
2170 ± 70	10-20 cm	-290	"	1084
1540 ± 80	500-510 cm	-652	"	1089
1330 ± 60	170-180 cm	-684	"	"
860 ± 60	70-80 cm	-683	"	"
240 ± 60	190-200 cm	-690	"	1085
MURMERISK DISTRICT				
> 53,000	800-1000 cm	Tln-305	1	94
8130±65	150-165 cm	-333	"	"
7410±95	70 cm	-260	"	93
7400±100	300 cm	-306	"	94
7300±60	135-145 cm	-332	"	"
7200±200	400 cm	-307	"	"
7100±60	150-160 cm	-331	"	"
6670±80		-267	"	93
5470±70		-339	"	94
4665±90	170-180 cm	-256	"	93
4285±115	160-170 cm	-255	"	"
3455±65		-259	"	"
3180±100	300 cm	-293	"	94
120±70	35 cm	-302	"	"
100±70	150 cm	-301	"	"

% of Modern or Date	Depth	Sample No.	No.	Page
		USSR (cont.)		
SIBERIA				
8900±90	480-500 cm	TA-934	4	1087
8610±90	300-340 cm	-667	"	"
8400±70		-1036B	"	1086
8300±70	185-195 cm	-1036A	"	"
8140±80	580-600 cm	-933	"	1087
8000±80	600-625 cm	-1038	"	"
7740±70	410-430 cm	-506	"	1086
7490±80	400-450 cm	-668	"	1087
7260±90	550-570 cm	-666	"	1086
7080±90	350-380 cm	-669	"	1087
6680±70	280-300 cm	-144	"	1086
6330±80	200 cm	-1037	"	1087
6120±80	210-220 cm	-618	"	1086
5810±70	320-330 cm	-752	"	"
5660±80	480-500 cm	-911	"	1087
5610±70	300 cm	-746	"	1086
4350±70	300-310 cm	-596	"	1088
4260±80	0-10 cm	-1037	"	1086
4180±70	260-280 cm	-901	"	1087
3710±60	275-285 cm	-507	"	1086
3610±60	250-260 cm	-508	"	"
3580±70	900-920 cm	-902	"	1087
3380±80	415-425 cm	-907	"	1088
3220±60	225-235 cm	-509	"	1086
3050±70	190-210 cm	-908	"	1088
2870±60	140-145 cm	-743	"	1085
2610±70	265-275 cm	-906	"	1088
2390±70	10-20 cm	-617	"	1086
2140±80	125-135 cm	-597	"	1088
1930±60	130-150 cm	-910	"	1087
1640±70	180-200 cm	-905	"	1088
1580±80	100-120 cm	-909	"	1087
750±60	65-75 cm	-745	"	1086
440±80	20-40 cm	-904	"	1088
190±50	90-100 cm	-510	"	1086
Modern	30-50 cm	-903	"	1088
WEST SPITSBERGEN				
41,700±1200		Tln-279	1	97
33,250 ± 500		-298	"	98
23,300 ± 500	+5-7 m	-292	"	"
10,360 ± 260	170-175 cm	-270	"	96
9480 ± 120	12-13 m	-275	"	97
9450 ± 120	Surface	-276	"	"
9370 ± 110	"	-274	"	"
9330 ± 120	"	-277	"	"
9330 ± 70	"	-334	"	98
9300 ± 130		-273	"	97
9250 ± 300		-321	"	"
9220 ± 140	Surface	-278	"	"
9150 ± 110	1-1.5 m	-272	"	"
8700 ± 90	Surface	-271	"	"
8670 ± 60		-362	"	"
8260 ± 80	90-100 cm	-269	"	96
7965 ± 80	5-15 cm	-268	"	"
6900 ± 100		-320	"	97
6590 ± 100	+ 80 m	-319	"	98
5350 ± 80	+ 6 m	-280	"	97
2990 ± 50	Surface	-353	"	98
2080 ± 50	+ 3.1 m	-352	"	"
1010 ± 60		-300	"	"
830 ± 50	Surface	-295	"	"
620 ± 60		-266	"	96
150 ± 70		-299	"	98
		VENEZUELA		
4500±80		Tx-2326	4	1095
4480±50		-2275	"	1094
3620±90		-2327	"	1095
3430±70		-2329	"	"
3380±50		-2328	"	"
3260±50		-2181	"	"
2840±80		-2280	"	"
1860±60		-2282	"	"
1500±50		-2283	"	"
1310±60		-2332	"	"
1170±80		-2274	"	1094
1040±60		-2278	"	1095
1020±60		-2276	"	1094
990±50		-2330	"	1095
970±70		-2277	"	"
620±70		-2331	"	"
310±100		-2325	"	"
Modern		-2279	"	"

OCEANOGRAPHIC SAMPLES

Date	Depth	Sample No.	No.	Page
ARABIAN OCEAN				
9435±145		BS-109	1	59
8395±145		-107	"	"
8380±140		-110	"	"
8300±135		-111	"	"
7845±130		-108	"	"
7470±135		-112	"	"
ATLANTIC OCEAN				
$31,400^{+1650}_{-1450}$	55 cm	QC-249	4	1077
$29,500^{+1900}_{-1600}$	50 cm	-248	"	"
$27,200^{+1300}_{-1200}$	40 cm	-247	"	"
18,300 660	46.8 cm	-317	"	"
10,850 280	25 cm	-246	"	"
	GEOSECS	ML&QL	1	1-24
BAHAMAS				
35,800±2200	99-101 cm	TX-2999	4	1090
30,600±2400	59-61 cm	-3004	"	1091
26,250 ± 680	140 cm	-3030	"	1092
26,500±1000	79-81 cm	-2998	"	1090
22,670 ± 290	110 cm	-3028	"	1092
21,260 ± 490	88 cm	-3031	"	"
20,880 ± 490	140 cm	-3032	"	"
17,210 ± 310	88 cm	-3029	"	"
13,880 ± 150	80 cm	-3034	"	"
12,260 ± 160	59-61 cm	-3003	"	1091
9970 ± 90	200 m	-3035	"	1092
8380 ± 110	295 m	-3033	"	"
8230 ± 260	424-427 cm	-3231	"	1093
6940 ± 80	420-422 cm	-3233	"	"
6550 ± 90	59-61 cm	-3003	"	1091
6510 ± 90	376-378 cm	-3234	"	1093
5840 ± 80	489-493 cm	-3229	"	"
4650 ± 70	405 m	-3027	"	1092
4410 ± 100	415-417 cm	-3230	"	1093
4120 ± 100	245-247 cm	-3232	"	"
4010 ± 60	39-41 cm	-2997	"	1090
3920 ± 90	310-313 cm	-3236	"	1093
3870 ± 60	88 cm	-3005	"	1091
3860 ± 60	19-21 cm	-3002	"	"
3800 ± 100	410-413 cm	-3235	"	1093
2610 ± 60	18.5-21.5 cm	-3000	"	1090
2040 ± 140	200-202 cm	-3240	"	1093
1970 ± 60	6-8 cm	-3001	"	1091
1940 ± 70	210-213 cm	-3242	"	1093
1790 ± 60	45-50 cm	-3006	"	1091
1640 ± 50	110-113 cm	-3238	"	1093
1190 ± 80	69-73 cm	-3237	"	"
1110 ± 70.	100-102 cm	-3241	"	"
1060 ± 50	10-13 cm	-3239	"	"
80 ± 40		-3008	"	1091
Ultra Modern		-3009	"	"
MEDITERRANEAN SEA				
16,760±300	275-290 cm	UM-1825	4	1116
11,600±200	150-165 cm	-1801	"	"
10,500±200	5 cm	-1814	"	"
7390±110	92-107 cm	-1824	"	"
6110±100	3-10 cm	-1815	"	"
PACIFIC OCEAN				
$31,900^{+2500}_{-1900}$	20-25 cm	UM-1780	4	1126
27,630 ± 350	20-25 cm	-1912	"	1128
24,290 ± 240	38-40 cm	-1861	"	"
23,700	19-21 cm	LJ-4301	"	1042
23,700 ± 310	36-38 cm	UM-1860	"	1128
22,890 ± 430	34-36 cm	-1859	"	"
20,330 ± 220	32-34 cm	-1858	"	"
20,300±2200	11-13 cm	LJ-4222	"	1042
19,180 ± 210	20-25 cm	UM-1894	"	1127
18,500±1900	7-9 cm	LJ-4221	"	1042
17,390 ± 350	7-10 cm	UM-1779	"	1126
17,320 ± 220	30-32 cm	-1857	"	1128
16,930 ± 220	28-30 cm	-1856	"	"
PACIFIC OCEAN (cont.)				
15,130 ± 160	26-28 cm	UM-1855	4	1128
14,130 ± 140	7-10 cm	-1911	"	"
14,000±1000	190-210 cm	LJ-4175	"	1042
13,740 ± 130	20-25 cm	UM-1909	"	1128
$13,700^{+690}_{-640}$	1-4 cm	-1778	"	1126
13,450 ± 140	20-25 cm	-1777	"	"
13,040 ± 190	20-25 cm	-1759	"	1125
12,645 ± 160	20-25 cm	-1765	"	1126
12,590 ± 120	24-26 cm	-1854	"	1128
12,500 ± 180	34-36 cm	LJ-4521	"	1042
12,070 ± 150	20-25 cm	UM-1906	"	1127
11,820 ± 120	22-24 cm	-1853	"	1128
11,800 ± 120	20-25 cm	-1768	"	1126
11,650 ± 150	20-25 cm	-1900	"	1127
11,580 ± 150	20-25 cm	-1771	"	1126
11,520 ± 170	20-25 cm	-1774	"	"
10,700 ± 600	5-7 cm	LJ-4223	"	1042
10,690 ± 150	20-25 cm	UM-1762	"	1125
9895 ± 120	20-25 cm	-1903	"	1127
9410 ± 90	1-5 cm	-1910	"	1128
9250 ± 110	20-22 cm	-1852	"	"
8930 ± 110	20-25 cm	-1897	"	1127
7800 ± 160	18-20 cm	-1851	"	1128
7880 ± 100	16-18 cm	-1850	"	"
7530 ± 220	1-4 cm	-1757	"	1125
7330 ± 90	14-16 cm	-1849	"	1128
7210 ± 90	7-10 cm	-1893	"	1127
6820 ± 100	12-14 cm	-1848	"	1128
6810 ± 420	7-10 cm	UM-1758	"	1125
6810 ± 70	18-20 cm	LJ-4520	"	1042
6800 ± 100	10-12 cm	-1847	"	1128
6580 ± 280	1-4 cm	-1763	"	1125
6500 ± 100	1-5 cm	-1892	"	1127
6340 ± 180	7-10 cm	-1776	"	1126
6320 ± 170	1-4 cm	-1760	"	1125
6030 ± 210	7-10 cm	-1767	"	1126
5960 ± 190	7-10 cm	-1764	"	1125
5950 ± 170	7-10 cm	-1761	"	"
5920 ± 100	7-10 cm	-1908	"	1128
5870 ± 90	7-10 cm	-1899	"	1127
5780 ± 150	1-4 cm	-1766	"	1126
5680 ± 150	20-25 cm	-1775	"	"
5620 ± 130	7-10 cm	-1770	"	"
5570 ± 90	7-10 cm	-1905	"	1127
5520 ± 220	1-4 cm	-1772	"	1126
5460 ± 110	7-10 cm	-1773	"	"
5210 ± 100	8-10 cm	-1846	"	1128
5040 ± 80	7-10 cm	-1902	"	1127
4850 ± 100	1-4 cm	-1769	"	1126
4710 ± 110	4-6 cm	-1844	"	1128
4680 ± 90	1-5 cm	-1898	"	1127
4400 ± 100	2-4 cm	-1843	"	1128
4400 ± 80	6-8 cm	-1845	"	"
4380 ± 110	7-10 cm	-1896	"	1127
4340 ± 70	1-5 cm	-1901	"	"
4250 ± 100	1-5 cm	-1907	"	1128
4200 ± 100	3-5 cm	LJ-4519	"	1042
4090 ± 70	0-2 cm	UM-1892	"	1128
4020 ± 80	1-5 cm	-1904	"	1127
3980 ± 70	0-3 cm	LJ-4518	"	1042
3700 ± 80	1-5 cm	UM-1895	"	1127
+45 ± 12‰	3800 m	LJ-4737	"	1043
+37 ± 8‰	3800 m	-4339	"	"
+27 ± 7‰	3800 m	-4338	"	"
	GEOSECS	ML&QL	1	25-53

NOTICE TO READERS

Half life of ^{14}C. In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, **all dates published in this volume (as in previous volumes) are based on the Libby value, 5570 ± 30 yr,** for the half life. This decision was reaffirmed at the 9th International Conference on Radiocarbon Dating, Los Angeles/La Jolla, 1976. Because of various uncertainties, when ^{14}C measurements are expressed as dates in years BP the accuracy of the dates is limited, and refinements that take some but not all uncertainties into account may be misleading. The mean of three recent determinations of the half life, 5730 ± 40 yr, (**Nature,** v 195, no. 4845, p 984, 1962), is regarded as the best value presently available. Published dates in years BP, can be converted to this basis by multiplying them by 1.03.

AD/BC Dates. In accordance with the decision of the Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, the designation of AD/BC, obtained by subtracting AD 1950 from conventional BP determinations is discontinued in Radiocarbon. Authors or submitters may include calendar estimates as a comment, and report these estimates as AD/BC, citing the specific calibration curve used to obtain the estimate.

Meaning of $\delta^{14}C$. In Volume 3, 1961, we endorsed the notation Δ (Lamont VIII, 1961) for geochemical measurements of ^{14}C activity, corrected for isotopic fractionation in samples and in the NBS oxalic-acid standard. The value of $\delta^{14}C$ that entered the calculation of Δ was defined by reference to Lamont VI, 1959, and **was corrected for age.** This fact has been lost sight of, by editors as well as by authors, and recent papers have used $\delta^{14}C$ as the **observed** deviation from the standard. At the New Zealand Radiocarbon Dating Conference it was recommended to use $\delta^{14}C$ only for age-corrected samples. Without an age correction, the value should then be reported as percent of modern relative to 0.95 NBS oxalic acid. (Proceedings 8th Conference on Radiocarbon Dating, Wellington, New Zealand, 1972). The Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, recommended that the reference standard, 0.95 times NBS oxalic acid activity, be normalized to $\delta^{13}C = -19‰$.

In several fields, however, age corrections are not possible. $\delta^{14}C$ and Δ, uncorrected for age, have been used extensively in oceanography, and are an integral part of models and theories. For the present, therefore, we continue the editorial policy of using Δ notations for samples not corrected for age.

Citations. A number of radiocarbon dates appear in publications without laboratory citation or reference to published date lists. We ask that laboratories remind submitters and users of radiocarbon dates to include proper citation (laboratory number and date-list citation) in all publications in which radiocarbon dates appear.

Radiocarbon Measurements: Comprehensive Index, 1950 1965. This index, covering all published ^{14}C measurements through Volume 7 of RADIOCARBON, and incorporating revisions made by all laboratories is available to all subscribers to RADIOCARBON at $10.00 US per copy.

Publication schedule. Beginning with Volume 15, RADIOCARBON has been published in three issues: Winter, Spring, and Summer. Contributors who meet our deadlines will be given priority but publication is not guaranteed in the following issue.

List of laboratories. The comprehensive list of laboratories at the end of each volume now appears in the third number of each volume. For Volume 22, the list of laboratories will appear at the end of No. 4.

Index. All dates appear in index form at the end of the third number of each volume. Starting with Volume 22, RADIOCARBON is publishing a new type of index which will be organized in chronologic order, according to sample type, and by geographic distribution. The editors of RADIOCARBON believe that this practice will serve a more useful function. Our readers are encouraged to make further suggestions.

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