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Carbon-14 Dating, Tree-Ring Dating And Speed of Light Decay (A Preliminary Model)

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CARBON-14 AND SPEED OF LIGHT DECAY

It is desirable to examine in some detail the effect of the decay in the speed of light (denoted by c) on carbon-14 (denoted by C-14) which is used for the dating of historical objects. From the c decay curve it is apparent that the half-life of C-14 was shorter in the past by progressively greater amounts as we go back further in historical time. It is the degree of the effect that concerns us here. What is required from the c decay curve is the total apparent elapsed time as measured by the C-14 decay rate. Fortunately, this turns out to be a simple expression: the total elapsed time, as measured by ANY radioactive decay prior to 1960, is given by

$$T = 3846.5 \cot kt \qquad (1)$$

where $k = 0.0148957299$ (2)

and t is the number of years after 4082 BC.

For equation (1) a table can be drawn up of the actual time before the present (BP) compared with the radiometric time BP and the difference between these two measures of time. This is done in Table 1. From that table two graphs can be drawn of actual time against radiometric time, and actual time against the difference between the two times (see Fig. 1).

SHORT-TERM CHECK AGAINST TREE-RING DATES

From Table 1 and the graphs in Figure 1 we are in a position to check the agreement between theory and data. E.H. Willis et al. have analysed samples of wood from a giant sequoia that has been dated more or less accurately from its annual growth rings.[1] They made the statement that there were **"minor but real fluctuations"** that indicated **"definite small changes in the rate of C-14 production in the past".** This is to be expected. However, the other significant aspect of their comment was that the dates agreed only **"to within 100 years back to AD 650"** beyond which that particular tree gave no further record. This generalized statement is of interest as we can apply a test. AD 650 is just 4732 years after 4082 BC and this gives us the value of t in equation (1). Accordingly, we discover that T, the radiometric elapsed time BP, is equal to 1363 years up to 1960 AD, from which the radiometric 'date' becomes 597 AD. This means that the radiometric 'date' will be in error by 53 years to an absolute chronology. This is well within the limits of the 100 years mentioned above, and it would seem that the C-14 production rate coupled with variation in the annual ring production accounts for the remainder of the discrepancy.

However, it is possible to determine the agreement or otherwise between theory and the data more accurately than the above example. In 1975 McKerrell outlined the known results between 1800 AD and 0 AD and summarized them in Figure 1 and Figure 16 of his article.[2] From this we can draw up Table 2, the comparison between the C-14 and tree-ring dates and the difference At between them and then a cross-check made with the expected At from c decay theory. Since the difference indicated by theory only becomes significant around 1000 AD and earlier, that has been chosen as the point of commencement of Table 2. From Table 2 and the accompanying Figure 2 (which combines two of McKerrell's results) it can be clearly seen that At in practice agrees closely with theory from 1000 AD down to about 400 AD, with the C-14 dates registering systematically "old". Before 400 BC they

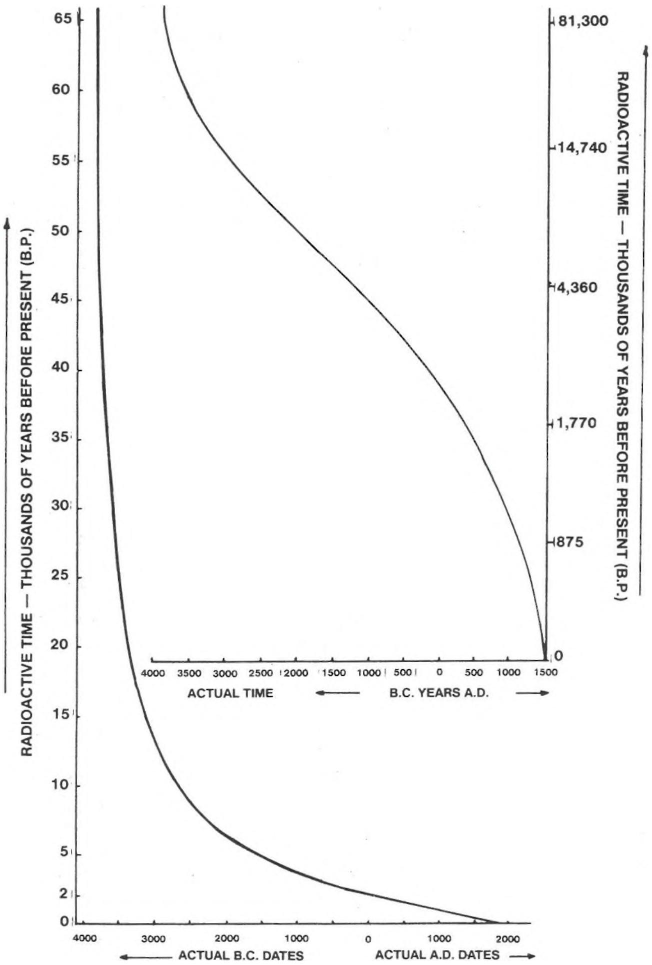

Figure 1 *c decay results for radiometric dating.*

are still recorded as being too "old" but by a smaller factor than the theory would indicate. One important point that may be involved with this change in trend is the rate of C-14 production which will be examined in more detail shortly, with the result that this suspicion is confirmed. In the meantime it can be stated that in general the results of tree-ring and C-14 comparisons back to about 2000 years ago do not contradict, and generally are in agreement with the predictions of c decay theory.

LONG TERM CHECK AGAINST TREE-RING DATES

Theoretically, there should be a good possibility of an accurate cross-check on the longer term data, that prior to 0 AD. The majority of work in this area has been done on the bristlecone pine dendrochronology by C.W. Ferguson.[3] By this method it is claimed that a dendrochronology sequence covering a period of 7000 years or more can be built up. The results when compared with C-14 dating have caused problems: the C-14 dates are all registering systematically "young" when compared to the dendro-dates. A bristlecone pine dating as 1000 BC on rings will radiocarbon date as 800 BC. At a dendro-date of 5000 BC the C-14 date is only about 4000 BC and so on.[3] The question then arises as to whether the dendro-dates are reliable back then anyway and we turn our attention to this briefly.

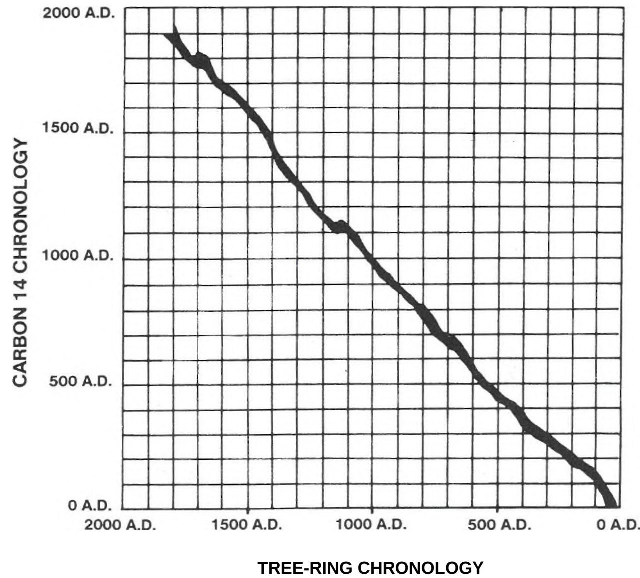

Figure 2 *Tree-ring dates with carbon-14 comparison. Results are averaged over 50-year intervals. (After McKerrell, Figure 1 with results of Fig. 16 as modifications.)*

DENDROCHRONOLOGY (TREE-RING DATING)

It is apparent that a 7000-year chronology is NOT established from the rings of a single tree, but rather from the composite ring systems of a large number of trees, both dead and alive. The formation of the composite pattern is the key factor in the exercise. It is possible because the pattern of ring widths may be distinctive. If the same pattern is found in two trees, it is presumed that those sections grew at the same time. If one specimen has rings older than the common pattern while another has rings younger than the common pattern, the overlap of the common pattern will then extend the dendrochronology either side of the common pattern to form a composite. The addition of a third specimen may extend the composite further — and so on[4] using trees long since dead, as well as alive.[5]

There are a number of problems in the method so outlined. Firstly, there is a problem with ring formation itself. If several wet and dry seasons follow in a single year, then the tree will usually form several rings. There are known cases where 30% of the rings are extras, and instances where 10% are 'missing' due to dry conditions.[6] A second problem is that the rings in the bristlecone pines are not really distinctive — they are 'complacent' to use the technical term. In addition the rings are very thin, with as many as 100 to the centimetre. However, there are two final points which make the exercise completely sterile. The cross-matching of rings can be a massive task dependent upon visual inspection to a large degree. The situation is one in which a specimen with a few hundred rings is brought up to the composite standard of several THOUSAND rings for comparison. Where do you begin? Incredibly enough Ferguson has admitted that they begin **BY FIRST CARBON DATING THE SPECIMEN** to obtain its approximate position in the chronology.[7] Under these conditions it is impossible to obtain a true dendro-date from the bristlecone pines that will give an independent cross-check on the C-14 date. It is primarily for this reason that there is no comparison

Table 1

Date A.D.	Radioactive Time B.P.	Actual Time B.P.	B.P. Time Diff. At	Log_{10} At
1960	0	0	0	
1700	260.400	260	0.4	
1500	462.210	460	2.2	0.342
1300	666.562	660	6.56	0.816
1100	874.633	860	14.63	1.17
900	1087.687	1060	27.69	1.44
700	1307.105	1260	47.11	1.67
500	1534.42	1460	74.42	1.87
300	1771.38	1660	111.38	2.05
100	2019.98	1860	159.98	2.20
1	2149.4	1960	189.4	2.28
-100	2282.5	2060	222.5	2.35
- 300	2561.8	2260	301.8	2.48
- 500	2861	2460	401	2.60
- 700	3185	2660	525	2.72
- 900	3537	2860	677	2.83
-1100	3925	3060	865	2.94
- 1300	4357	3260	1097	3.04
- 1500	4843	3460	1383	3.14
- 1700	5396	3660	1736	3.24
- 1900	6037	3860	2177	3.34
-2100	6792	4060	2732	3.44
- 2300	7700	4260	3440	3.54
- 2500	8819	4460	4359	3.64
- 2700	10,241	4660	5581	3.75
- 2900	12,120	4860	7260	3.86
- 3100	14,738	5060	9678	3.99
- 3300	18,659	5260	13,399	4.13
- 3500	25,227	5460	19,767	4.30
- 3700	38,604	5660	32,944	4.52
- 3900	81,233	5860	75,373	4.88
- 4000	180,404	5960	174,444	5.24
- 4050	462,345	6010	456,335	5.66
- 4080	7.4×10^6	6040	7.39×10^6	6.87
- 4081	1.5×10^7	6041	1.5×10^7	7.18
- 4081.5	3.0×10^7	6041.5	3.0×10^7	7.48
- 4081.95	3.0×10^8	6041.95	3.0×10^8	8.48
- 4081.99	1.5×10^9	6041.99	1.5×10^9	9.18

This Table is based on the measure of the total elapsed time for any radioactive decay prior to 1960 given by the expression T = Radioactive time BP = 3846.5 cot kt where k = 0.0148957299 and t is the number of years after 4082 B.C.

between the dendro-date/C-14 difference relationship and that predicted by c decay theory. The whole thing is rendered all the more suspect when it is realized that the entire chronology is the work of one laboratory whose director has refused to allow critical study of the raw data.[8]

The other problem arises from the C-14 end because of its production rate variations. If the physical conditions allowed MORE C-14 to be produced than at present then the objects being dated from the past would read systematically ‘young’ while if the conditions permitted LESS C-14 to be produced they would read systematically ‘old’. Furthermore, in order to see whether the C-14/C-12 ratio has been substantially constant we also need a check on the historical dates being used, as it is customary to promote ‘long’ chronologies. Let us check this point first and then check with the data from C-14.

Table 2. Δt — Comparison between carbon — 14 and tree-ring dates

Tree-Ring Date A.D.	Carbon 14 Date A.D.	At	Δt from C Decay
1000	975	25	20.5
900	870	30	27.7
800	765*	35*	36.5
700	657*	43*	47.1
600	542	58	59.7
500	425*	75*	74.4
400	330	70	91.6
350	290*	60*	100
300	255*	45*	111.4
200	175	25	134.1
100	100	0	159.9
65	0-	65*	169.8

Results taken from “Radiocarbon Calibration & Prehistory” article by McKerrell ‘Correction Procedures’. Values marked as * from his Fig. 16; unstarred values from his Fig. 1. A combined result appears below.

LIMITING DATES

According to Scripture there was an origin of all things in the recent past. The decay in the speed of light indicates that this origin can be placed around 4100 BC. This is in accord with the short chronology of Scripture which indicates an origin of all things about 4000 BC. The work of Eugene Faulstich with computer dates and matching suggests strongly that this date should be 4001 BC. Alternatively, the theoretical derivation of the c decay equation suggests the origin date as 4008 BC. The work of the late Government Astronomer for South Australia, G. F. Dodwell, indicates a date of 4001 BC in agreement with Faulstich.

This origin date is not the basic issue in this exercise, however, as the onset of the Flood of Noah erased all pre-existing structures to produce the majority of the geological column as we have it today. Accordingly, the only records of human development should post-date that event. According to Scripture we have an exact record of the time from Creation to the Flood in Genesis 5 and 7:11 as 1656 years. This gives the year of the Flood as 2345 BC on the Dodwell/Faulstich material, which may be extended out to about 2400 BC on the speed of light approach. These dates then give us the limit for human, animal and vegetable records of existence on an absolute time scale.

There is one further consideration which is particularly relevant for records of human development. The Scriptures indicate that the pioneer expansion of the post-Flood population did not begin until after the Tower of Babel incident. It was only following that event that the post-Flood population began to move out to the various parts of the globe to start anew, some in caves, some using metal tools as they became more settled, and other building colonies and cities. Thus it would seem that the Babel incident date would mark the boundary for human records that would be left for dating by the C-14 process. Animal and vegetable limits would be as above.

We are thus left to determine the date of the Babel dispersion as the limit for records of human activity outside the Iran/Iraq area where Babel was situated. From the genealogies given in Genesis 10 and 11 it would seem that this particular incident occurred about 150 years after the Flood. This gives a date of 2195 BC on Dodwell/Faulstich chronologies which may be extended to about 2250 BC on c decay data. Bearing in mind that the incident may have occurred a greater number of years after the Flood than given here (though it is a good average), then it would seem reasonable to assume that a good average date for Babel is 2200 BC and that records of human activity should start to appear sometime after that.

A CHECK WITH THE DATA

We now turn to the actually recorded data as published, mainly in “Radiocarbon Dating” by Libby, but elsewhere as well. In Table 3 is a list of the oldest obtained radiocarbon dates of a variety of objects around the world. The page numbers refer to Libby’s book from which the data was obtained. The BC dates are those obtained on the basis of equation (1) where T is the C-14 age as given by the data from Libby and others. It must be emphasized that the c decay BC dates in Tables 3 and 4 are uncorrected for the changing C-14/C-12 ratio and so they only approximate roughly to the actual date.

What has been recorded in Table 3a are the C-14 ‘dates’ from sites of obvious human habitation. It will be noted that the oldest human occupation dates come from the Mid East and Africa, the total average

Table 3A. Earliest Human Occurrences

C-14 AVERAGE DATE 10,077 B.P.				AGE CORRECTED FOR C DECAY 2680 B.C.	
PAGE or REFERENCE	SAMPLE NO.	COUNTRY/STATE	DESCRIPTION	C-14 AGE B.P.	C DECAY AGE B.C.
84	C-815	AFGHANISTAN	Pre-historic charcoal	4,580	1395
127	C-560	ALASKA	Charcoal from 80 cm depth in cave	5.993	1887
128	C-793	ALASKA	Charcoal and flint — earliest occurrence	4,658	1427
R.2	W-169	AUSTRALIA (Vic)	Keilor Skull — once thought oldest man	8.500	2447
134	C-485	CHILE	Burned animal bones and human artifacts	8,639	2470
86, 87	C-432-435	DENMARK	Charcoal and nuts etc in 'house'	7,583-9,931	2276-2661
77	C-550-551	EGYPT	Earliest wheat and grain samples	6,391	1998
77	C-457	EGYPT	Neolithic wheat and barley	6,095	1917
78	C-810-811	EGYPT	Pre-dynastic hair	5,619-5,744	1773-1812
79	C-814	EGYPT	Pre-dynastic human skin	5,577	1760
88	C-343	ENGLAND	Neolithic peat	6,044	1902
88	C-353	ENGLAND	Wooden platform from Mesolithic site	9,488	2601
88	C-340	ENGLAND	Early Post-glacial peat	8,275	2408
85	C-406	FRANCE	Charcoal from cave with drawings	15,516	3147
85	C-577	FRANCE	Burned bone from hearth (Magdalenian)	11,109	2800
86	C-337	GERMANY	Allerod peat with birch and pollen	11,044	2793
R.14	GRO.422, 423	HOLLAND	Neolithic material	5,790-6,200	1827-1946
89	C-627	HOLLAND	Charcoal from Mesolithic site	7,965	2351
89	C-749	ICELAND	Post-glacial peat under lava	5,300	1667
83	C-492	IRAN	Lowest soil with Mesolithic artifacts	8,004	2359
84	C-524	IRAN	Mesolithic — Neolithic transition	10,560	2738
84	C-574	IRAN	Upper Mesolithic artifacts	8,545	2455
84	C-494-495	IRAN	Flint blades from Neolithic	8,085	2374
R.13	L-182	IRAN	'Hotu Man' charcoal from hearth skeleton	9,500	2602
79	C-113	IRAQ	Land snail shells from earliest 'village'	6,707	2079
79,80	C-742-743	IRAQ	Jarmo excavation — charcoal	5,266-6,695	1655-2076
R.5	GrN — 1495	IRAQ	Neanderthal skeleton	50,600	3790
87	C-358	IRELAND	Irish Neolithic peat	5,824	1837
84	C-919	ISRAEL	Charcoal from lowest 'Chalcolithic'	7,420	2242
R.14	F.30,39,43	ISRAEL	Jericho — oldest Neolithic	8,690-8,895	2479-2512
135	C-548	JAPAN	Charcoal from earliest occupation level	4,546	1380
85	C-819	LEBANON	Wood from first structure (Predynastic)	5,317	1673
R.5	GrN-2022	LIBYA	Neanderthal mandible	40,700	3720
129	C-205	MEXICO	Becerra peat from Armenta horizon	11,003	2788
129	C-198	MEXICO	Charcoal from 'Chalco culture'	6,390	1998
R.10	NY-73	MOROCCO	Neanderthal bones	32,000	3622
137	C-663	Nth. RHODESIA	Stone Age charcoal	6,310	1976
138	C-697	Nth. RHODESIA	Charcoal in pit 12' deep	6,098	1917
132	C-316	PERU	Wood-bottom of Huaca Prieta mound	4,380	1310
133	C-598	PERU	Charcoal from lowest level on bedrock	4,298	1274
R.7	UCLA-630	RHODESIA	'Broken Hill Man' with animal bones	9,000	2528
139, R.12	C-850. Y-103	Sth. AFRICA	'Florisbad Man' skull, fossils	35,000-41,000	3661-3722
139	C-851	Sth. AFRICA	Florisbad peat 47" above skull peat	9,104	2544
140	C-924-927	Sth. AFRICA	Ash from stone age hearths	11,600-16,811	2850-3217
78	C-753-754	SUDAN	Neolithic charcoal and shells	5,060-5,446	1582-1717
R.14	F.17,K.121	SWITZERLAND	Neolithic material	4,650-4,720	1423-1452
79	C-183	TURKEY	Chalcolithic wood	4,519	1370
R.2	A-30-33	U.S.A.	Lehner Mammoth, with implements	6,877-8,330	2120-2418
105	C-755-756	USA. Alabama	Archaic man shell mound	4,764	1469
112	C-216	USA. Arizona	Charcoal from Cochise Culture	7,756	2311
101-103	C-899	USA. Illinois	Earliest Indian site, flint	5,268-11,200	1656-2810
94	C-180	USA. Kentucky	Archaic period shell mound	7,374	2233
107	C-470	USA. Nebraska	Charcoal from lowest occupation zone	10,493	2731
110	C-824	USA. Nebraska	Charcoal from hearth — Pleistocene	8,862	2508
121	C-914	USA. Nevada	Suspected occupation site (charcoal)	23,800	3466
118	C-281	USA. Nevada	Rock shelter with artifacts and burned guano	8,660	2474
116	C-823	USA. New Mex	Cave charcoal from Mankato ice phase	7,432	2245
119	C-428	USA. Oregon	Woven rope sandals	9,053	2537
126	C-454	USA. Sth. Dak.	Charcoal	7,715	2303
119	C-611	USA.Utah	Charcoal from lowest level in cave	9,789	2642
121	C-827	USA. Washing.	Ancient occupation — stone artifacts	8,700	2481
126	C-839	USA. Wisconsin	Charred wood, old copper culture	7,510	2261
125	C-795	USA. Wyoming	Charcoal from hearth with bison	6,920	2131
R.10	GIN-93	USSR (Siberia)	Mammoth in Cro-Magnon burial site	11,000	2788
135	C-580	W. AFRICA (Angola)	Carbonised wood with stone age blade	11,189	2808
135	C-581	W. AFRICA	Carbonised wood 15 cm below C-580	14,503	3085

Table 3B. First Animal Occurrences

PAGE or REFERENCE	SAMPLE NO.	COUNTRY/STATE	DESCRIPTION	C-14 AGE B.P.	C DECAY AGE B.C.
128	C-301	ALASKA	Wood and mammal bones	12,622	2944
R.12	L-137	ALASKA	Wood under Pleistocene fauna	8,800-10,200	2497-2695
R.6	Sa-100	ALGERIA	Fossil bank — hippo, bovines	5,140	1611
R.8	Gak-643	ANTARCTICA	Penguin bones	6,100	1918
R.5	NZ-206-381	AUSTRALIA, SA	Diprotodon jaw and molar	6,700-11,000	2077-2788
R.7	GX-105	AUSTRALIA	Jawbone of Nototherium	14,000	3050
R.10	S-246	CANADA, Sask.	Mammoth bone in fossiliferous sand	12,000	2889
R.10	GSC-611-614	CANADA, Ont.	Mastodon bones	8,910-11,380	2514-2828
134	C-484	CHILE	Dung of giant sloth	10,832	2769.5
R.6	Sa-49	CHILE	Mylodon manure	10,200	2695
R.11	UCLA-1319	ETHIOPIA	Mammal bones near Australopithecus	15,500	3146
R.11	Gif-774	FRANCE	Molar of Elephus	14,000	3050
R.13	H-145	GERMANY	Mammoth bone	3,370	807
R.11	GaK-1042	JAPAN	Bone of Metacurvulus	18,800	2497
R.11	UCLA-1321	KENYA	Mammal bones near Zinjanthropus	10,100	2682
129	C-204	MEXICO	Wood associated with mammoth and horse	16,000	3175
R.7	NZ-1	NEW ZEALAND	Molar of Diprotodon	11,100	2799
R.4	Trond.	NORWAY	Fossil shells	7,250-11,200	2206-2810
134	C-378	PERU (Chincha)	Guano beneath island sand	19,000	3314
R.9	A-195-536	USA. Ariz. & NM.	Mammoth vertebrae and ribs	6,370-8,980	1992-2525
R.7	UCLA — 705	USA. Calif.	Ilium of dwarf mammoth	8,000	2358
R.11	UCLA — 1325	USA. Calif.	Fossil wood with Pleistocene animals	8,550	2456
R.2	LJ-55	USA. Calif. (LA)	Wood with animal bones (Pleistocene)	14,400	3078
R.8	I-622	USA. Col. & Wyo.	Mammoth bones and tusks	11,200	2810
R.12	W-418	USA. Ind.	Wood with bison, tapir, Megalonyx	9,400	2588
R.9	UCLA — 1069	USA. Idaho	Sloth dung	10,455	2726
R.10	M-1739-1783	USA. Mich.	Mastodon ulna and tusk	9,250-9,910	2566-2658
R.7	M-1254	USA. Mich.	Mastodon bones	10,700	2755
117	C-221	USA. Nev.	Dung of giant sloth	10,455	2726
118	C-599	USA. Nev.	Bat guano above Pleistocene	11,199	2809
117	C-898	USA. N.M.	Guano in Carlsbad caverns	17,800	3263
R.11	Y-1163	USA. N.M.	Skin of Nothroterium	9,840	2649
R.7	OWU-126	USA. Ohio	Mastodon bones	10,654	2749
R.11	OWU-190	USA. Ohio	Spruce wood beneath mastodon skeleton	15,315	3136
119	C-609	USA. Utah	Sheep-dung	11,453	2836
R.6	A-372	USA. Wyo.	Mammoth fossil vertebra	9,600	2616
R.10	GIN-7	USSR (Ukraine)	Fossil bones in clay	10,590	2742
R.10	TA-121	USSR	Pleistocene mammoth bones	18,320	3286
R.4	M-1068	VENEZUELA	Fossil bones of 27 extinct species	14,300	3071

C-14 AVERAGE 11,132 B.P.
AGE CORRECTED FOR C DECAY 2802 B.C.

References in Tables 3 and 4

Page Numbers: "Radiocarbon Dating", W. Libby, 1955
R.2 — 'Radiocarbon', vol.2, 1960 and vol.1, 1959
R.4 — 'Radiocarbon', vol.3, 1961 and vol.4, 1962
R.5 — 'Radiocarbon', vol.5, 1963
R.6 — 'Radiocarbon', vol.6, 1964
R.7 — 'Radiocarbon', vol.7, 1965
R.8 — 'Radiocarbon', vol.8, 1966
R.9 — 'Radiocarbon', vol.9, 1967
R.10 — 'Radiocarbon', vol. 10, 1968
R.11 —'Radiocarbon', vol.11, 1969
R.12 — 'Science', 1957 and 1958
R.13, 'Science', 1951 to 1957
R.14 — "Dating the Past", F.E. Zeuner, p.344–345 (Chapter 10 — Table)

C-14 age being 10,077 years BP which translates on a c decay model to 2680 BC. On the other hand, the first sign of animal occupation (from Table 3b) is given by the average date of 11,132 years BP which becomes on the basis of equation (1) 2802 BC. (Note that in some cases in Tables 3a and 3b it is the wood that was dated and not the bones, so this may represent some debris from before the Flood which would give an 'older' date.) These dates are obviously of the right order of magnitude when compared with the predicted radiometric dates from c decay.

It is interesting to observe that if the twenty-nine countries represented in Table 3a each have their dates totalled together and the average taken, the mean date for the commencement of human occupation around the world is 2680 BC. This compares reasonably with the expected date of 2200 BC for the dispersion from Babel and 2400 BC (about) for the Flood. It is apparent, however, once the c decay effect is taken into account, that the results obtained are registering slightly 'old' when compared to the Scriptures, even though they are of substantially the same value. The cause for this may be traced to a somewhat lower concentration of C-14 immediately after the Flood which later built up to a higher value. The suggestion is that either the Flood process lowered the concentration of C-14 temporarily, or that, due to the canopy in the pre-Flood atmosphere, the concentration of C-14 was systematically lower throughout that epoch. Let us examine this proposal in a little more detail.

THE C-14 CONCENTRATION

There is a way of calculating the difference in concentration in the early post-Flood atmosphere. We should also notice in passing that nuclear tests and monitoring have shown that atmospheric mixing is rapid and that any irregularities in C-14 composition are smoothed out after a few years (C. Renfrew, op. cit. p.69). Accordingly the model assumes that the atmospheric C-14 is virtually homogeneous at all times.

If we take the Babel incident as occurring about 2200 BC we obtain from (1) a C-14 'date' of 7224 years BP. But the earliest human occupation dates from 10,077 BP (which then becomes 2680 BC). This is a difference in radiometric 'age' of 2853 years. If this difference is due to the lesser amount of C-14 in the immediate post-Flood atmosphere we can do a calculation. At today's standard for the half-life of C-14 of 5580 years used by Libby in his calculations, this difference of 2853 years corresponds to (2853/5580) = 0.511 of a half-life. This is the information that we need since, to take another example, if the level of C-14 in the atmosphere were 1/500th of its present level, then the number of half-lives involved is given by x in the equation.[9]

$$2^{x} = 500 \text{ and therefore } x = 8.97 \qquad (3)$$

Accordingly, the C-14 level at 2200 BC is given by

$$2^{0.511} = 1.425 \qquad (4)$$

and so the level is

$$1/1.425 = 0.70 \text{ or } 70\% \qquad (5)$$

In other words, at the time of the Babel crisis, the atmosphere had about 70% of its current C-14 concentration on this approach. This result was obtained on the basis of an average date from around the world which would date a little later than the Babel incident. This figure then probably represents somewhat less than the maximum depletion to be expected under the circumstances.

C-14 CONCENTRATION AT THE FLOOD

Table 4a lists the radiometric 'ages' of material trapped by the 'last ice-age'. (This 'ice-age' may be taken as representing the final phases of the Flood, even though the ice retreat and associated debris in some places would definitely have post-dated the Flood itself, which in turn indicates that the earliest dates will be more diagnostic than the later.) From Table 4 we discover that the 'age' range is from 10,494 - 560 years BP to about 24,000 BP. These 'ages' convert to 2730 BC and 3470 BC respectively on the formula given by (1). The average 'age' is about 16,000 years BP which then becomes 3206 BC on the c decay formula.

However, these figures represent samples that were trapped at the close of the Flood when the ice-age began, and from the above discussion this occurred about 2345 BC on the Dodwell/Faulstich model or about 2400 BC on the c decay model. If we nominate a date of 2400 BC as that of the Flood for the purposes of this exercise (remembering that equation (1) is geared for 2426 BC) then we should obtain the right result to a first approximation. Note that 2400 BC becomes 8228 BP from (1).

If we take the average 'age' of 16,000 years BP, the difference in radiometric 'age' compared with that from c decay is 8372 'years'. This is (8372/5580) = 1.50 half-lives and accordingly the C-14 level is given by the inverse of

$$2^{1.50} = 2.829 \qquad (6)$$

Table 4A. Ice-Age Material

PAGE or REFERENCE	SAMPLE NO.	COUNTRY/ STATE	DESCRIPTION	C-14 AGE B.P.	c DECAY AGE B.C.
127	C-299	ALASKA	Wood from 100' depth in frozen muck	20,000	3351
88	C-444	ENGLAND	Lake mud, pollen Zone II last glacial phase	10,851	2772
88	C-479	ENGLAND	Plant debris from glacial stage and mammoth	20,000	3351
88	C-480	ENGLAND	Oak debris — middle of last interglacial	17,000	3226
86	C-588	FRANCE	Interglacial wood	21,000	3385
87	C-355	IRELAND	Mud — late glacial, pollen Zone II	11,310	2821
87	C-356	IRELAND	Lake mud — early post glacial, Zone IV	11,787	2869
116	C-894	USA. Calif.	Lake mud — end of ice age sequence	10,494	2731
113, 117	C-615, 895, 896	USA. Calif.	Lake mud — middle of ice age sequence	15,089-18,000	3122-3272
117	C-897	USA. Calif.	Lake mud — beginning of ice age	23,923	3469
105	C-475	USA. Carolina	Sediments from mid Mankato/Cary substage	.20,000	3351
R.10	UCLA 1292	USA. Cal. (LA)	Pleistocene fossils	28,000	3557
95	C-535	USA. Illinois	Wood from Tazewell phase of glaciation	13,842	3039
95	C-466	USA. Illinois	Wood found in glacial till	17,000	3226
95	C-575	USA. Illinois	Wood overlain by periglacial silt	17,000	3226
96	C-509	USA. Illinois	Wood below Farmdale loess	19,000	3314
96	C-510	USA. Illinois	Wood under loess — earliest glacial phase	20,000	3351
104	C-935	USA. Illinois	Wood from 70' depth in glacial deposits	21,600	3404
105	C-937	USA. Illinois	Wood from ice age at 110' depth	24,000	3470
99	C-801	USA. Indiana	Wood from near surface — Glenwood glacials	10,972	2785
100	C-871	USA. Indiana	Wood from 12' depth — Glenwood glacials	18,500	3293
100	C-872	USA. Indiana	Lagoon deposit from 15' depth Glenwood glacials	21,000	3385
97	C-596, 653	USA. Iowa	Glacial wood (Cary II) 25' depth	11,952-12,200	2884-2907
97	C-664	USA. Iowa	Glacial wood — between tills 28' depth	14,042	3054
103	C-912-913	USA, Iowa	Mankato (?) wood — oxidised/unoxidised	12,120-13,300	2900-2999
96	C-481	USA. Iowa	Wood from under Mankato glacial till	17,000	3226
121	C-946	USA. Minn.	Pre-glacial wood at 88' depth	19,000	3314
96	C-508	USA. Ohio	Wood from Camden glacial moraine	17,000	3226
96	C-438	USA. Penn.	Peat beneath 17' of Cary alluvial	16,000	3175
122	C-537	USA. Wisc.	Wood from last advance of ice sheet	11,404	2831
123	C-630	USA. Wisc.	Wood buried by last retreat of ice sheet	10,676	2752
126	C-800	USA. Wisc.	Pleistocene wood in glacial till	10,856	2772

Table 4B. Fossils and unusual dates

PAGE or REFERENCE	SAMPLE NO.	COUNTRY/ STATE	DESCRIPTION	C-14 AGE B.P.	c DECAY AGE B.C.
R.13	L-127	ALASKA	Extinct superbison tissue	28,000	3557
R.4	L-601	ALASKA	Skin of baby elephant	21,000	3385
R.8	N-141-143	JAPAN	Rich mammalian fossil formation	29,300-37,000	3580-3684
R.9	ANU-9	NEW ZEALAND	Fossil wood beneath tuff and lava	31,000	3607
R.6	Sa-170	Nth. AFRICA	Cores 400 cm below ocean — early life	30,000	3591
R.6	UCLA-285	PHILIPPINES	Fossil bones — human and animal	21,000	3385
R.8	I-1149	USA. Alabama	Natural gas in Cretaceous strata	34,000	3649
114	C-631	USA. Calif.	Crude oil 1100' deep — Pliocene	24,000	3470
114	C-632	USA. Calif.	Crude oil from Upper/Middle Pliocene	27,780	3553
R.8	I-1150	USA. Miss.	Natural gas from Eocene strata	30,000	3591
R.13	0-235	USA. Texas.	20' of charcoal with animal bones	37,000	3684
R.12	L-228	USA. Wash.	Fossil wood in Miocene sandstone and conglomerate	27,000	3538
R.4	T-172	USSR	Wooly rhinoceros skin	38,000	3694

and so

1/2.829 = 0.353 or 35.3% (7)

Thus the level on these figures was about 35% of the present value.

If we take the earliest dates of around 24,000 BP which are more likely to reflect the true situation radiometrically, then the difference in radiometric age is 15,772 'years'. This becomes 2.827 half-lives and by the above procedure this in turn translates into a C-14 level of 14.09% of the present value. It would so appear that this gives an idea of the limit of the carbon-14 content in the atmosphere immediately prior to the Flood, the low value being partly due to the vapour canopy that was precipitated by the Flood process and probably also partly due to the greater strength of the magnetic field in the pre-Flood age. As a result of both of these factors being affected by the Flood process, we might expect a rapid rise in the C-14/C-12 ratio after the Flood aided by an additional factor which will be mentioned shortly.

In the following discussion it is possible to have two models for the pre-Flood C-14 level. Model I is based upon a gradual build-up to the 14% level from virtually zero at the time of Creation, approximately 1600 or 2000 years earlier according to the Dodwell/Faulstich chronology or the c decay approach respectively. Model II, however, takes into account the possibility that the C-14 level was about constant throughout the whole pre-Flood era. There is a marginal difference in the results of these two approaches (see Fig. 3 and Fig. 4), Model I giving older radiometric 'ages' at any given date.

PRE-FLOOD C-14 QUANTITIES

It has been estimated that today C-14 is produced in the upper atmosphere at the rate of 8.2 ± 1.5 kg/yr on the average.[10] If we take the amount of time from Creation to the Flood as being approximately 2000 years and make an assumption that the current rate of production held during the pre-Flood age, we can then calculate the amount of radiocarbon in the ecosystem compared with today and so cross-check our figures. We must first find approximately the total radiocarbon content today. It has been estimated that the C-14/C-12 ratio in the deep ocean averages about 84% of that in air[11] and from the figure quoted for the oceans[12] R.H. Brown points out that the total amount of C-14 in the biosphere and deep ocean is 46,000 kg. Now taking the present rate of production as holding over the pre-Flood period of 2000 years we find that there would have been a total of

8.2 x 2000 = 16,400 kg (8)

in the biosphere by the time of the Flood. However, today there is about 46,000 kg in the ecosystem. Thus the percentage of C-14 in the system at the time of the Flood compared to today from (8) is given by

(16,400/46,000) x 100 = 35.6% (9)

This compares very closely with the result of the other calculation in (7) where from c decay theory the estimate was made of 35.3%. In both of these cases it is apparent that this is the maximum upper limit, particularly because the assumption made for this latter calculation is that the C-14 production rate pre-Flood was the same as it is now. This may not have been the case due to the probably stronger magnetic field[13] pre-Flood and the presence of the water canopy that is strongly suspected. It will certainly not be the case due to the additional factor hinted at earlier. If it is assumed that the magnetic field, the canopy and the other factor cut back the production rate to about 40% of what it is today so that instead of 8.2 kg/yr being formed there was only 3.28 kg/yr of C-14 forming, then we have the total of

3.28 x 2000 = 6560 kg (10)

in the system at the time of the Flood. The percentage of C-14 compared to now becomes

(6560/46,000) x 100 = 14.3% (11)

which is very close to the 14.09% estimated from the probable limit adopted from the data and c decay. If the production rate pre-Flood was just half that of now due to the above factors, that translates into a total of 8,200 kg in the system at the Flood which is just 17.8% of the C-14 concentration now. These values are very reasonable estimates and indicate that the choice, of the earlier radiometric dates for the Flood being more diagnostic than the average date, was justified.

THE GEOMAGNETIC FIELD STRENGTH

The question arises, however, whether or not the magnetic field would influence the production rate to this extent. It has been estimated that if the geomagnetic field were to completely disappear, then the C-14 production rate would double due to the increase in the activity of cosmic rays in our atmosphere.[14] On the other hand, a 100-fold increase in the field would reduce the production rate of C-14 to virtually zero.[15] The paleomagnetic data indicate that the upper maximum possible is an eleven-fold increase on the present value[16] which imposes constraints on the discussion. Certainly the evidence from the decay of the magnetic field indicates that about 2400 BC the field was, at a maximum, about 10 times higher than now if the field decay is taken as being exponential.[17] If the decay in the magnetic field is taken as linear at roughly 5.5% per century,[18] which is the current condition, then the field would have been 2.5 times its present value around 2400 BC and about 3.5 times the present intensity around 4000 BC, the approximate Creation date on the Dodwell/Faulstich model. On these estimates it seems likely that as a conservative estimate the geomagnetic field roughly averaged 4 or 5 times its present value during the pre-Flood era. Professor T.G. Barnes estimates that with the geomagnetic field four times as strong, the neutron intensity from cosmic rays would be reduced by about 10% from the present level.[19]

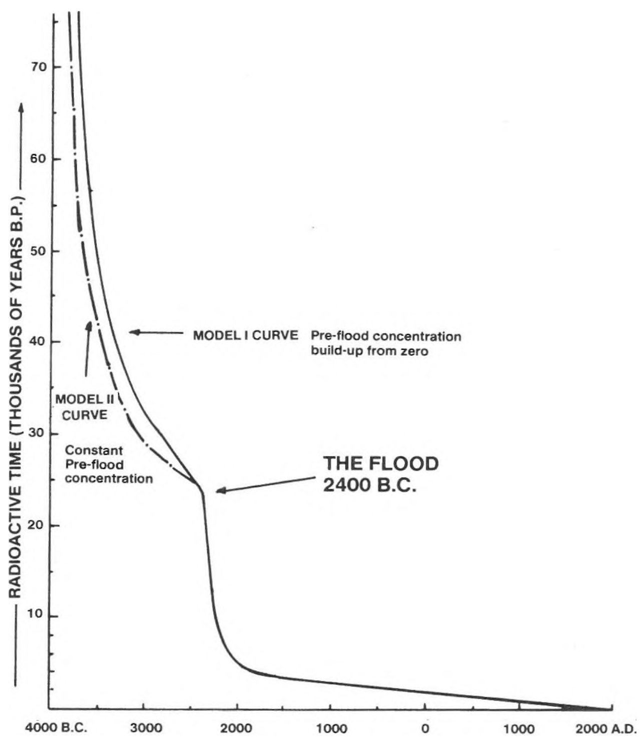

Figure 3 *C-14 concentration (given by the C-14/C-12 ratio as a percentage of today's value of 1/(848 x 10^9)).*

From these figures, if a four-fold increase in the field reduces the C-14 production by 10% and a 100-fold increase is required to reduce it to virtually zero, a very rough estimate can be made of the field strength required to reduce the C-14 production rate down to 40% of its present value, that is, a 60% reduction. The estimate can only be rough, as Professor Barnes admits that the total process is quite complex. If the effect is assumed to be roughly linear over the range, then a 60% reduction would be achieved by a 57-fold increase in the strength of the field. An exponential-type behaviour between the above limiting values would give a 60% reduction with a 42-fold increase in the field strength. Thus a field strength of say 40 to 60 times the present value would seem to be indicated. But is the decay in the magnetic field the only way in which it was acting more strongly in the past? The answer would seem to be 'no' as there is another mechanism which should be considered, one which is accomplished through c decay.

COSMIC RAYS AND C DECAY

Primary cosmic rays consist of high-speed positively charged atomic nuclei. The earth is constantly bombarded from all directions with these charged particles. These cosmic rays collide with atmospheric atoms to produce neutrons, which in turn change the nitrogen atoms in our atmosphere into carbon-14. With a lesser number of cosmic rays striking the atmosphere per second then there results a lower rate of C-14 production. The earth's magnetic field bends the path of these cosmic rays away from the earth, resulting in fewer striking the atmosphere. The magnetic force F with which this happens is a function of the velocity of the charged particles, the formula for the magnetic force being[20]

$$F = qvB \sin \theta \qquad (12)$$

where q is the electronic charge, v is the velocity of the particle and the force F is dependent upon the angle θ between the velocity direction and the magnetic flux density B. Now the velocity of the cosmic rays is proportional to the speed of light c due to conservation of energy. This arises since the rest-mass of atomic particles is proportional to $1/c^2$ and the kinetic energy of the rays is given by $0.5mv^2$. So it would seem initially that the force in (12) might be proportional to c. However, the magnetic flux density B is also c dependent as

$$B = \mu H \qquad ....(13)$$

and

$$H = m^* / (\mu r^2) \qquad ....(14)$$

where H is the magnetic fieldstrength of unit pole m* and μ is the permeability of free space such that

$$\mu \approx 1/c^2 \text{ and } m^* \approx 1/c \qquad ....(15)$$

Therefore

$$H \approx c \text{ and } B \approx 1/c \qquad ....(16)$$

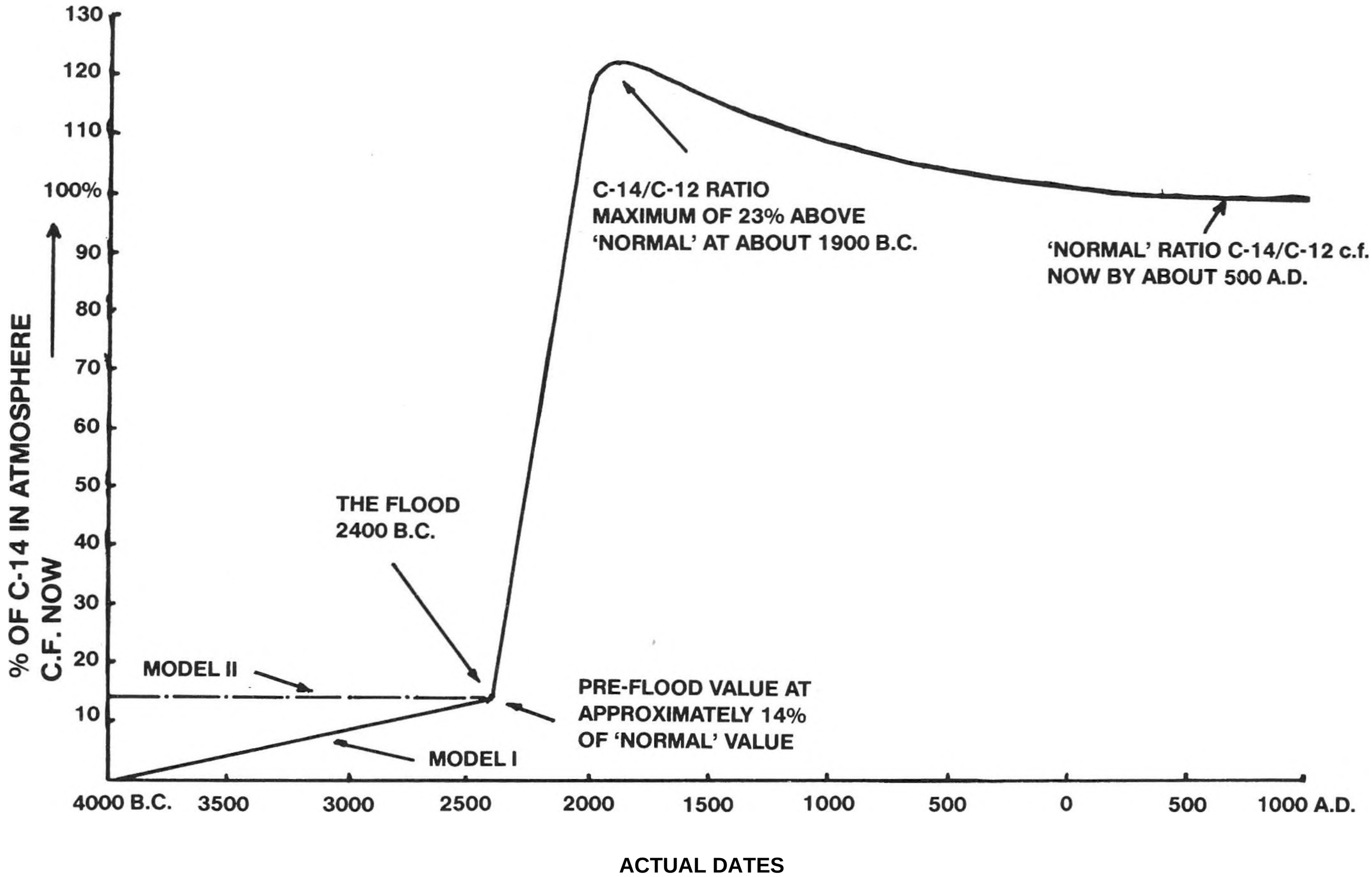

Figure 4 *Final C-14 dating curve (c decay plus C-14 concentration).*

In other words, due to the higher velocity of the cosmic rays with higher c, the nett result is that the magnetic force will remain constant.

But that is not the end of the story. The mass of those cosmic rays is proportional to $1/c^2$ and consequently, back in the past with higher c, the same magnetic force was acting on a lower rest-mass. It follows that this same force is therefore going to repel, deflect and deviate this lower mass more strongly at the same position in the magnetic field by a factor of c^2. The analogy of two sets of magnets all of fixed strength is relevant here. If one pair of light magnets is brought towards each other with their like poles approaching they are repelled at a further distance apart than the pair of heavy magnets by a factor that is proportional to their mass. So in the case of the cosmic rays, there is a c^2 repulsion. This will be offset by the fact that the flux of particles will be proportional to c, leaving us with a nett repulsion factor of c, the same effect as if the magnetic force F were proportional to c, or the magnetic field were increased proportional to c.

It is now possible to estimate the effect of this magnetic field interaction with the cosmic rays. Remembering that for C-14 production to average only 40% of that pertaining now throughout the pre-Flood era of about 2000 years in order to give a total C-14 content in the biosphere at the time of Flood of 14% of the present level, the magnetic field strength must have been the equivalent of roughly 40 to 60 times its present value over the pre-Flood period.

What are the results? The difference between the integrals given by (1), divided by the total time between 3950 BC and 2400 BC, gives the average of how much faster c was during that time. For these figures it is about 66 times faster. For 3930 BC to 2400 BC it averages 58.2 times faster. For the period 3900 BC to 2400 BC it was 48.7 times faster. By 3860 BC the average had dropped to 40 times faster. Clearly, then, these figures do suggest strongly that the effective magnetic field operating on the cosmic rays was roughly 40 to 60 times greater on the average during the pre-Flood epoch, resulting in a C-14 production rate that was about 40% of present rate during that time and which would thus give a total C-14 inventory of about 14% of the present value by the time of the Flood itself. This process operating on the cosmic rays would also have had an influence on the longevity of the pre-Flood population as damaging radiation levels would have been

Table 5.

Date (actual)	Years BP (c decay)	Years BP (C-14)	BP_c —BP_{C-14}	x	2*	1/2x	C-14/C-12 % of ratio now
2400 BC*	8228	24,000	- 15,772	2.827	7.094	0.1409	-85.91%
2200 BC*	7224	10,560	- 3,336	0.511	1.425	0.7017	-29.83%
2000 BC*	6398	4,883	+ 1,515	0.272	1.207	0.8285	+ 17.15%
1500 BC	4842.5	3,460	+ 1,382.5	0.248	1.187	0.8422	+ 15.78%
1000 BC	3726	2,960	+ 760	0.136	1.099	0.9099	+ 9.01%
500 BC	2861	2,460	+ 401	0.072	1.051	0.9514	+ 4.86%
330 BC*	2605	2,190	+ 415	0.074	1.053	0.9498	+ 5.02%
0 AD	2149	1,960	+ 189	0.034	1.024	0.9768	+ 2.32%
200 AD*	1894	1,785	+ 109	0.019	1.014	0.9866	+ 1.34%

minimised.

THE POST-FLOOD RESULTS

In equations (4) and (5) the C-14 concentration at the time of the Babel incident was approximately determined. Using the mathematical process outlined in those equations it is possible to construct a table listing the C-14 concentrations at various dates compared to the present concentration. Table 5 gives those figures.

The values marked with an asterisk are actual measurements by C-14 dating of objects of known age. The 2200 BC and 2400 BC values have been discussed above and the 200 AD value is from Table 2 and Figure 2. The 330 BC value is from the wood of a Ptolemaic coffin of that decade, and the C-14 date is as given. The reported result is interesting as the age was given as 2190 ± 450 years BP. This uncertainty in the C-14 measurement more than covers the 315 ‘years’ extra that decay induces in the measurement. In other words, even as early as 300 BC the radiocarbon dating procedure does NOT GIVE DATES AT VARIANCE WITH C DECAY THEORY. This result is taken from “Radiocarbon Dating” page 77. The 2000 BC result is taken from the same source. However, in this case it was from the wood in the roof beam of the tomb of Egyptian Vizier Hemaka who ruled in the days of King Udimu of the 1st Dynasty. From the king lists it is at once apparent that Udimu reigned about 200 years or so after the 1st Dynasty commenced, and if we make the assumption that they commenced about the time of Babel in 2200 BC, then we have a radiocarbon result that should be centering around 2000 BC actual dating as a reasonable estimate.

From Table 5 it is possible to obtain a fair idea of the variation of the radiocarbon content in our atmosphere with time. This is expressed graphically in Figure 3. It should be pointed out that the values in Table 5 which are not marked by asterisks are those for which the C-14 value is reading HISTORICALLY TRUE, as there is the suggestion[21] that the C-14 date is accurate to within 200 years up until about 1500 BC. Even there the trend is for the median date within the error to read slightly young, which suggests that the procedure being adopted above is probably a conservative one, if other factors are equal.

THE C-14 CONCENTRATION CURVE

Figures 3 and 4 show three distinct regions in relation to the C-14 concentration and consequent dating of objects. Firstly, there is the pre-Flood region where, on Model I there would be a gradual build-up of the C-14 concentration from zero up to about 14% of the ‘normal’ value (that is 86% below the present value as shown in Table 5). The reason for this has been outlined above.

Secondly, there is the rapid, post-Flood rise over a period of about 500 years to a level of C-14 that was about 23% above the ‘normal’ value holding today. Thirdly, there is the region that tapers off from this 1900 BC ‘high’ to the ‘normal’ value around about 500 AD. It is this tapering off activity that has been picked up in the figures in the latter part of Table 2, where the agreement between the c decay data and the C-14 compared to tree-ring data begin to diverge. The reason for the rapid rise to above present values followed by the tapering off procedure now occupies our attention. To do this it is necessary to look at each of the four factors that will influence the C-14 content of the biosphere. These are the geomagnetic field intensity, the cosmic ray intensity, the water content of the atmosphere and the total carbon quantity in equilibrium in the biosphere. What follows is some initial modelling which will be refined at a later date.

1. The Geomagnetic Field and Cosmic Ray Intensity Post-Flood

As we have seen above, the cosmic ray intensity is influenced by the value of the speed of light on its behaviour in the magnetic field of the earth. During the period under consideration, from the Flood at about 2400 BC to 1900 BC, a span of about 500 years, the difference between the integrals given by (1) (2191 'years') divided by the total actual time span (500 years) gives the average of how much faster c was during that era, a value of 4.382 times its speed now. We have seen from above that this would have resulted in the equivalent of a magnetic field about 4.4 times stronger than now. We have also noted above that on the linear increase model for the geomagnetic field of roughly 5.5% per century, the field would have been about 2 times its present value in 1900 BC and about 2.5 times its current strength in 2400 BC. If we take the average of these figures as the mean conservative estimate for the entire period it is 2.25 times now. To this must be added the effect of c decay, which was a further 4.4 times its effect now, making a total nett field strength effectively operating on the cosmic rays of 6.6 times the current value. Now Professor Barnes states that a 4-fold increase will result in a 10% reduction in the neutron intensity and hence C-14 production.[22] From this, using the procedure adopted between equations (11) and (12) above, we can estimate that the 6.6-fold increase in the effective field would have resulted in an approximate 12% reduction in the neutron intensity producing C-14.

It should be noted that in the pre-Flood epoch the geomagnetic field strength increase would have been so minor in comparison to the effects from c decay that the addition of the two effects was not necessary, being more than covered by the indicated range.

Now if the current value as quoted above is 8.2 kg/year of C-14 being produced by the cosmic ray neutrons, then a 12% reduction means that there would have been an average of only 7.2 kg/year being produced during the 500 years under immediate consideration. That is to say that a total of only

$$500 \times 7.2 = 3600 \text{ kg} \qquad (17)$$

of C-14 would have been produced by the cosmic ray neutrons in that 500-year period from the Flood (about 2400 BC) until 1900 BC.

2. Atmospheric Water and C-14 Post-Flood

At sea level with a 100% relative humidity, one molecule out of every 29 in the atmosphere is water.[23] In this atmospheric composition 95% of the neutrons generated by the incoming cosmic rays will still produce C-14, the hydrogen in the water molecules capturing 0.8%. Accordingly, in the high stratosphere where little water is present today, it is known that 96% of the cosmic ray neutrons produce C-14. Thus even saturation conditions in the atmosphere only reduce the C-14 production marginally. However, we note in passing that it is 96% of the cosmic ray generated neutrons in the atmosphere that produce the C-14 that holds our interest.[24] Accordingly, the total quantity from (17) must be modified to 96% of that figure since in this post-Flood atmosphere C-14 quantities are obviously going to be small and account must be accurately made. Hence we can state that by 1900 BC in the 500 years since the Flood there will have been produced in the atmosphere an amount of C-14 totalling

$$3600 \times (96/100) = 3456 \text{ kg} \qquad (18)$$

The water saturated atmospheric conditions during the pre-Flood epoch need not be taken into account, since the other conditions completely override this effect.

3. The Carbon Inventory

One of the most important factors to be considered in the Post-Flood era is the amount of C-12, ordinary carbon, with which the C-14 is in equilibrium as the C-14 time-scale is based on the relative quantities of the radioactive C-14 to the stable isotope C-12. Carbon-14 has been compared with the red colouring used to turn white cake into pink; the larger the initial amount of cake mix into which a given amount of colouring is added, the less pink will be the cake. The present ratio of C-14/C-12 in the contemporary biosphere[25] is $1/(848 \times 10^9)$, and so with Brown's figure of 46,000 kg of C-14 quoted above we have a total carbon inventory today for C-12 of

$$(848 \times 10^9) \times (46{,}000) = 3.9 \times 10^{16} \text{kg} \qquad (19)$$

This total is made up by C-12 in a number of environments which are important to consider separately. Let us take the primary data[26] in Table 6.

These figures now need to be applied in each of the three cases in hand for the C-14 concentration curve — first the pre-Flood era, then the immediate result post-Flood, and finally around 1900 BC 500 years after the Flood.

Table 6. Present day C-12 inventory

Source of C-12	Amount (X 10^{12} tonnes)	% of Total
Atmosphere	0.670	1.71%
Freshwater	0.330	0.84%
Living land organisms	0.833	2.13%
Dead organic material on land	0.700	1.79%
Dead organic material in ocean	1.000	2.56%
Dissolved in upper ocean	0.500	1.28%
Dissolved in deep ocean	35.000	89.70%
TOTAL FOR BIOSPHERE	39.0	100.00%
Coal and oil (currently available only)	10.0	
Sedimentary carbonates	13,180	

A. Pre-Flood Inventory

The first thing to recognise is that in the pre-Flood age the oceans were very much shallower than we have today. As a result of the Flood process, the water canopy in the atmosphere came down and the water that had been building up under the crust[27] burst forth in a mighty torrent. If we assume that the oceanic content of C-12 that was in equilibrium with C-14 was roughly equivalent to that in the upper ocean today, then we have a basis on which to work, namely, 1.28% of the total. Furthermore, it is reasonable to assume that the amount of fresh water and dead organic matter in equilibrium was about the same percentage as now. This would be so since the amount of dead organic material on land then under the luxuriant conditions would make up for the deficit in the deep ocean's dead organic content compared with today. Accordingly, these total 5.19% as today. Making the same assumption that the living organisms on land approximately made up for the C-12 content missing because of the lack of the deep ocean we can then place that figure in the pre-Flood age as being 89.7%. This is an expression of the luxuriant conditions pertaining then with living land organisms being (89.7/2.13) = 42 times more prolific and prevalent than today. When it is remembered that there are vast stretches of desert today on all continents that in the pre-Flood age would have been abundantly verdant, this figure is easy to accept. It is quantified to some extent by the amount of coal and oil currently available. These fossil fuels result from the pre-Flood living organisms and so represent an estimate of what was there then. If we reckon that there are roughly one third of the total reserves of coal and oil that have been used since the industrial revolution (and that which is yet to be discovered) currently available, then this represents a 36-fold increase on the living land organisms today. The available reserves ALONE represent a 12-fold increase on today's conditions. That the 42-fold factor is reasonable becomes obvious when from other figures the estimate can be made that the pre-Flood land organisms were 176 times more prolific than today.[28] The pre-Flood list is given in Table 7.

The only item left unaccounted for is the atmosphere. There is the suggestion that the pre-Flood atmosphere had a significantly higher concentration of carbon dioxide.[29] This would seem to be verified by the above figures. From Table 7 the only item left is the atmosphere, and as all other C-12 sources total 96.17%, the logical inference is that it contained

$$100\% - 96.17\% = 3.83\% \text{ of C-12} \quad (20)$$

This compares with today's value of 1.71% of the C-12 in the atmosphere with the carbon dioxide content. Thus the amount by which this gas was enhanced in the antediluvian atmosphere is given by

$$3.83/1.71 = 2.24 \text{ times higher } CO_2 \text{ content} \quad (21)$$

We are thus in a position to calculate the amount of C-14 in the pre-Flood atmosphere since (20) gives the percentage total as 3.83%. Now from (10) and (11) we note that there were 6560 kg of C-14 in the antediluvian biosphere according to this model at the time of the Flood. Of this total quantity the atmosphere had 3.83%. Thus just before the Flood there were

$$6560 \times (3.83/100) = 251.25 \text{ kg C-14 in atmosphere} \quad (22)$$

Now the Flood process fluxed (1.71/3.83) = 0.446 or 44.6% of the carbon out of the atmosphere thus leaving

$$251.25 \times 0.446 = 112.2 \text{ kg C-14 in immediate post-Flood atmosphere} \quad (23)$$

Table 7. Pre-Flood C-12 **inventory**

Source of C-12	**Percentage of Total**
Ocean	1.28% (equivalent to upper ocean today)
Freshwater & dead organic	5.19% (same as today including deep ocean)
Living organisms	89.7 % (42 fold increase — some suggest 176)
Atmosphere	?????

Table 8. Immediate post-Flood C-12 inventory

Source of C-12	**Percentage of Total**
Atmosphere	1.71% (same as today)
Freshwater	0.84% (same as today)
Dead organic material	4.35% (equal to land & ocean now)
Oceans	93.10% (non equilibrating)

This leads us on to consider the immediate post-Flood results.

B. Immediate Post-Flood Inventory

Picture the situation. The atmosphere has had the canopy removed and with it came down almost half the carbon dioxide leaving just 112.2 kg of C-14 remaining. The oceans have been greatly enlarged and charged with carbon dioxide from the internal sources of the earth such as volcanism, etc., that also gave rise to the immense quantities of sedimentary carbonates listed in Table 6. The amounts that were in the pre-Flood ocean and atmosphere were virtually zero in comparison to those added during the cataclysm from internal sources, the latter becoming largely locked up in limestones and other rocks. With oceanic temperatures being quite cool due to the semi ice-age conditions immediately post-Flood, all the carbon dioxide injected into the oceans would remain in solution with very little if any coming into equilibrium with the C-14 from the atmosphere. This latter would be the case since the dissolving power of the oceans is quite small, and if the dissolved $C0_2$ was in an almost saturated solution, very little equilibration with the atmosphere would occur as far as transfer of atmospheric C-14 to the ocean was concerned. It would only be later as the oceans warmed up that the C-12 would begin to mobilise[30] and the C-14 equilibrate.

Immediately post-Flood then the ocean content can be disregarded for the purposes of C-14 equilibrium and so all that is left to count is the upper biosphere. There were virtually no plants or animals initially post-Flood, but there would be masses of dead organic material in the oceans and probably a lot of it near the surface. This might be assessed on a conservative estimate as the same total dead organic matter as today, that is 4.35% of the total. The only other factors left are the freshwater supply, assumed to be the same at today as 0.84%, and the atmosphere, which contains 1.71% of the C-12 inventory. It may be tabulated as in Table 8.

There is thus a total of 6.9% of the available C-12 equilibrating in the immediate post-Flood environment, the upper biosphere. Assuming that the total C-12 has been relatively unchanged since the Flood, then we can do a calculation. The total amount of C-12 is 3.9×10^{16} kg from (19). Of this total only 6.9% is operative, which gives us

$$(6.9/100) \times 3.9 \times 10^{16} = 2.691 \times 10^{15} \text{ kg of C-12} \quad (24)$$

which is the amount of C-12 equilibrating with the C-14 in the environment.

Now the C-14 content must be added up. Firstly there is from (23) just 112.2 kg of C-14 in the atmosphere. In addition the dead organic material will have been in equilibrium before the Flood process (which lasted a year) and so this 4.35% will contain from the pre-Flood quantity of 6560 kg

$$(4.35/100) \times 6560 = 285.36 \text{ kg of C-14} \quad (25)$$

The freshwater balance is a little more difficult to determine. Certainly some of it will have come from pre-Flood sources that were in equilibrium. If we assume that all of the fresh water was so derived we can make a calculation that gives the maximum possible effect. Thus the freshwater contains

$$(0.84/100) \times 6560 = 55.1 \text{ kg of C-14} \quad (26)$$

Thus the total amount of C-14 in equilibrium is given by adding the results of (23), (25) and (26), which results in

$$112.2 + 285.36 + 55.1 = 452.66 \text{ kg total C-14} \quad (27)$$

which is in equilibrium with the C-12 from (24). The C-14/C-12 ratio thus becomes

$$452.66/(2.691 \times 10^{15}) = 1/(5.9449 \times 10^{12}) \quad (28)$$

But the ratio today is given as $1/(848 \times 10^9)$ so compared with today's standard we have the ratio of C-14 to C-12 as

$$1/(5.9449 \times 10^{12}) = z/(848 \times 10^9) \quad (29)$$

Therefore

$$z = 0.14264 = 1/7.0104 \quad (30)$$

and z thus gives us the level of C-14 in the atmosphere when compared with the present standard. Now using the process adopted in equations (3) to (5), we can calculate the effect this will have on the dating of objects from that time through the number of half-lives affected.

The level of C-14 is thus 1/7.0104 that of now. Therefore we have

$$2^x = 7.0104 \quad (31)$$

Therefore

$$x = (\log 7.0104) / (\log 2) = 2.8095 \quad (32)$$

Thus the objects will read systematically 'old' by a factor of 2.8095 half-lives, which is

$$2.8095 \times 5580 = 15{,}677 \text{ 'years'} \quad (33)$$

To this total must be added the effects of c decay immediately after the Flood in 2400 BC, which is, from Table 5, 8228 'years'. Therefore the sample will read as being

$$8228 + 15{,}677 = 23{,}905 \text{ years BP} \quad (34)$$

This compares quite favourably with the 24,000 BP that was predicted from the description of samples radiometrically dated from the close of the 'last ice-age'.

C. The Carbon Inventory About 1900 BC

The only basic change in the inventory about 500 years after the Flood is the situation regarding the oceans and the influx of cosmic ray generated C-14. This latter quantity is already worked out in equation (18) as an additional 3456 kg of C-14.

With regard to the oceans it is apparent that they would take some time to equilibrate. Even now they have not reached total equilibrium. It is stated that the upper ocean has equilibrated to a 95% extent, that is to say that the C-14/C-12 ratio for these upper layers is about 95% that of air[31] while the deep ocean has only 84%. There is a transfer of C-14 from the upper ocean layers to the deep ocean by a mixing process which will obviously take time.

Now if the upper ocean is only equilibrating to the extent of 95% after the (2400 + 1960) = 4360 years since the Flood, then in the 500 years to 1900 BC the equilibration would only be to the extent of

$$(500/4360) \times 95\% = 10.89\% \quad (35)$$

It will be taken that this value also marks approximately the limit before which the deep ocean starts to come into equilibrium and so does not enter these calculations.

We have already noted that the upper ocean was in equilibrium before the Flood and that it had 1.28% of the carbon reservoir. By 500 years after the Flood there was only 10.89% of this reservoir in equilibrium that we must take account of. This gives a result for the upper oceans of

$$(10.89/100) \times 1.28\% = 0.1394\% \quad (36)$$

Therefore for the C-14 there is an additional amount that we must take account of as coming into equilibrium that has carried over from the Flood in this proportion of the ocean. That is equal to

$$(0.1394/100) \times 6560 = 9.144 \text{ kg} \quad (37)$$

The quantity of C-12 there that is equilibrating is given by 0.1394% of today's total

$$(0.1394/100) \times 3.9 \times 10^{16} = 5.4366 \times 10^{13} \text{ kg} \quad (38)$$

This is then added to the total that was available immediately after the Flood to give (from equation (24)) a grand total for C-12 of

$$(2.691 \times 10^{15}) + (5.4366 \times 10^{13}) = 2.745 \times 10^{15} \text{ kg} \quad (39)$$

Also for C-14 we add the amount from equation (37) to that of (18) and (27) giving

$$9.144 + 3456 + 452.66 = 3917.8 \text{ kg of C-14} \quad (40)$$

The C-14/C-12 ratio thus becomes

$$3917.8/(2.745 \times 10^{15}) = 1/(7.0065 \times 10^{11}) \quad (41)$$

But the ratio today is given as $1/(848 \times 10^9)$, so compared with today's standard we have the ratio of C-14 to C-12 as

$$1/(7.0065 \times 10^{11}) = z/(848 \times 10^9) \quad (42)$$

Therefore

$$z = 1.2103 \quad (43)$$

Now if z = 1 the carbon-14 to carbon-12 ratio would have been equal to today's value. The result from (43) shows that the C-14/C-12 ratio was 21.03% HIGHER at 1900 BC than it is today. This is extremely close to the value of 23% higher shown in Figure 3 and deduced from an entirely different chain of reasoning in Table 5. In other words, there is a set of concordant results.

THE C-14/C-12 RATIO THEORETICAL DETERMINATION

Using the above methods it is now possible to determine theoretically what the C-14/C-12 ratio should be at any time through history from the Flood to the present based on the carbon inventory and data from c decay. Remember, this is initial modelling, and it is proposed to refine this model later. Nevertheless good results are achieved.

Several factors occur in the computations. First, if we assume that the present standard rate of production is normal at 8.2 kg/year, then it is possible to work out the unamended C-14 production with time since the Flood. This is done in column 2 of Table 9 where column 1 is the year. Column 3 then gives the nett total strength of the magnetic field based on (a) the average value of how much faster c was, which can be calculated from equation (1) as has been done in examples above, and (b) the decay in the magnetic field itself. This latter quantity is taken as linear for the purposes of this exercise at the above stated rate of 5.5% per 100 years. These two effects are combined to give in column 3 the nett magnetic field strength equivalent compared to today that will effect the generation of neutrons by incoming cosmic rays. In column 4 is given the actual C-14 production rate corrected for this magnetic field effect on the basis of the stated 10% reduction in production for a 4-fold increase in the field. Again, for the purposes of the calculation the effect is taken as a linear function.

Column 5 lists the total C-14 in the upper biosphere. This is the addition of the results from the actual C-14 production in column 4, as given above, plus that existing in dead organic material, the fresh water and the immediate post-Flood atmosphere. This fixed amount coming through from the Flood totals 452.66 kg (the total of equations (23), (25) and (26) as given in equation (27)). In addition to this quantity is the amount of C-14 coming into the equilibrium process from the upper oceans, as described in equations (35) to (37). This amount, too, is a carry-over from the Flood and progressively becomes operative over time by the linear process assumed in the discussion leading up to (35). These various processes are then added together along with the results from column 4 to give the total C-14 in the upper biosphere. Since living organisms as they arise will take in the C-14 from the atmosphere whose input is already accounted for, there is thus no need to consider them separately.

Column 6 lists the amount of C-12 in the upper oceans that is progressively equilibrating on the same basis as the discussion for column 5 and equations (35) to (38). Column 7 lists the total quantity of C-12 in the upper biosphere that is progressively equilibrating. This includes column 6 as well as the fixed quantity from Table 8, that is the atmosphere, the fresh water and the dead organic material, the result being given in equation (24). In addition to this is phased in the 8.33×10^{14} kg of C-12 that comes from living matter. The process is again assumed to be linear having commenced at 1000 BC, by which time after the Flood the plant and animal populations had become significant, but then increased more markedly to their present C-12 value.

The only item left for discussion is the deep ocean carbon. As mentioned following equation (35), 1900 BC (at which time about 11 % of the upper ocean was equilibrating) is taken as marking the approximate boundary for the commencement of the equilibration process in the deep ocean. Mathematically the zero date has been taken as 1800 BC and the 3.5×10^{16} kg of C-12 equilibrating today is assumed again to become operative by a linear process from then until now. The only refinement is that half the first value given in 1700 BC (with 1800 BC as the zero) is quoted against 1800 BC to give a smoother tapering in, which also makes 1900 BC the zero for all practical purposes.

There is an additional feature to the deep ocean statistics. It will be noted that the total C-14 content in column 5 in 1960 is short of the measured amount by 11,336 kg. It is also a fact that there is C-14 in the deep ocean. This model proposes that, as the deep ocean has come as a result of the Flood from the interior of the earth, when the fountains of the great deep were broken up and the water that had been trapped under the crust burst forth, then these waters brought their C-12 with them. That is, as stated above, they were charged with carbon dioxide from the internal sources of the earth. These sources

Table 9.

Year	C-14 Production Without C Decay	Total Effect Magnetic Field	Actual C-14 Atmos Prod.	Total C-14 Upper Bios.	Upper Ocean C-12	Total C-12 Upper Bios.	Deep Ocean C-12	Deep Ocean C-14	Total C-14 Kg.	Total C-12 Kg.	%
	Kg	x now	Kg	Kg							
2300 BC	820	7.554	665	1,119.6	1.09×10^{13}	2.701×10^{15}			1,119.58	2.701×10^{15}	35.0
2200 BC	1,640	7.239	1,343	1,799.5	2.175	2.713×10^{15}			1,799.5	2.713	56.0
2100 BC	2,460	6.950	2,032.5	2,491.0	3.260	2.723			2,491.0	2.723	77.6
2000 BC	3,280	6.684	2,731.9	3,192.3	4.35	2.734			3,192.3	2.734	99.0
1900 BC	4,100	6.436	3,440.3	3,902.6	5.439	2.745	0	0	3,902.6	2.745	121.0
1800 BC	4,920	6.206	4,156.7	4,620.9	6.526	2.756	4.65×10^{14}	150.7	4,771.6	3.222	125.0
1700 BC	5,740	5.989	4,880.4	5,346.5	7.614	2.767	9.3085	301.5	5,647.9	3.698	129.0
1600 BC	6,560	5.787	5,610.9	6,079.0	8.702	2.778	1.86×10^{15}	602.9	6,681.9	4.639	122.0
1500 BC	7,380	5.596	6,347.6	6,817.6	9.789	2.789	2.7925	904.5	7,722.1	5.581	117.0
1400 BC	8,200	5.415	7,089.8	7,561.7	1.08×10^{14}	2.799	3.723	1205.9	8,767.6	6.523	114.0
1300 BC	9,020	5.243	7,837.6	8,311.4	1.196	2.811	4.654	1507.4	9,818.8	7.465	111.5
1200 BC	9,840	5.080	8,590.3	9,066.1	1.305	2.822	5.585	1808.9	10,875	8.407	109.7
1100 BC	10,660	4.924	9,347.7	9,825.4	1.414	2.832	6.515	2110.4	11,936	9.348	108.3
1000 BC	11,480	4.775	10,109.5	10,589	1.523	2.843	7.446	2411.8	13,001	1.03×10^{16}	107.1
900 BC	12,300	4.632	10,875	11,357	1.632	2.882	8.378	2713.4	14,070	1.126	105.9
800 BC	13,120	4.493	11,646	12,130	1.740	2.921	9.309	3014.8	15,144	1.223	105.0
700 BC	13,940	4.361	12,420	12,906	1.849	2.960	1.02×10^{16}	3316.3	16,222	1.320	104.2
600 BC	14,760	4.232	13,198	13,685	1.958	2.999	1.117	3617.8	17,303	1.417	103.6
500 BC	15,580	4.108	13,979	14,469	2.066	3.038	1.210	3919.3	18,388	1.514	103.0
400 BC	16,400	3.988	14,765	15,256	2.175	3.078	1.303	4220.7	19,446	1.611	102.4
300 BC	17,220	3.872	15,553	16,046	2.284	3.116	1.396	4522.3	20,568	1.708	102.1
200 BC	18,040	3.759	16,345	16,840	2.393	3.155	1.489	4823.7	21,663	1.805	101.8
100 BC	18,680	3.649	17,139	17,636	2.502	3.194	1.582	5125.2	22,761	1.9018	101.5
0 AD	19,680	3.542	17,937	18,436	2.611	3.233	1.676	5426.7	23,863	1.9988	101.2
100 AD	20,500	3.437	18,738	19,239	2.719	3.272	1.768	5728.2	24,967	2.0958	101.0
200 AD	21,320	3.335	19,542	20,045	2.828	3.312	1.862	6029.7	26,075	2.1928	100.8
300 AD	22,140	3.235	20,349	20,854	2.937	3.350	1.955	6331.2	27,185	2.2898	100.6
400 AD	22,960	3.138	21,159	21,666	3.045	3.389	2.048	6632.6	28,299	2.387	100.5
500 AD	23,780	3.043	21,971	22,480	3.154	3.428	2.141	6934.1	29,414	2.484	100.4
600 AD	24,600	2.948	22,786	23,297	3.263	3.468	2.234	7235.6	30,533	2.581	100.3
700 AD	25,420	2.856	23,604	24,116	3.372	3.507	2.327	7537.1	31,653	2.678	100.2
800 AD	26,240	2.766	24,425	24,939	3.481	3.545	2.420	7838.5	32,778	2.775	100.17
900 AD	27,060	2.678	25,248	25,764	3.589	3.585	2.513	8140.0	33,904	2.872	100.11
1000 AD	27,880	2.591	26,074	26,592	3.698	3.624	2.606	8441.5	35,034	2.966	100.0
1100 AD	28,700	2.505	26,903	27,423	3.807	3.663	2.699	8743.0	36,166	3.066	100.00
1200 AD	29,520	2.421	27,733	28,255	3.916	3.702	2.793	9044.5	37,300	3.163	100.00
1300 AD	30,340	2.337	28,567	29,091	4.025	3.741	2.886	9346.0	38,437	3.259	99.99
1400 AD	31,160	2.256	29,403	29,929	4.133	3.779	2.978	9647.5	39,576	3.357	99.98
1500 AD	31,980	2.175	30,241	30,769	4.242	3.819	3.072	9948.9	40,718	3.454	99.97
1600 AD	32,800	2.096	31,081	31,611	4.351	3.858	3.164	10,250	41,861	3.551	99.97
1700 AD	33,620	2.017	31,294	32,456	4.459	3.897	3.258	10,552	43,008	3.648	99.98
1800 AD	34,440	1.940	32,769	33,303	4.568	3.936	3.351	10,853	44,156	3.745	99.99
1900 AD	35,260	1.864	33,617	34,153	4.677	3.975	3.444	11,155	45,308	3.842	100.01
1960 AD	35,752	1.818	34,127	34,667	4.742	3.998	3.500	11,336	46,000	3.899	100.03

also gave rise to the carbon for the sedimentary carbonates locked up in the rocks today. Along with the carbon dioxide would be a variety of other gaseous products, as during Creation Week, including nitrogen. These gaseous products, along with the water for the deep oceans, were driven out from the centre of the earth by radioactive heating.[27] They were also responsible for bringing radioactive material with them to the crust and mantle and depositing them there. Along with the radioactive material were fast moving neutrons which would smash into the nitrogen atoms forming C-14 just as the atmospheric neutrons do. This process would be going on continuously from Creation to the Flood and it need then come as no surprise if the water from the interior of the earth not only contained carbon-12 in it but also C-14 in the carbon dioxide, etc., brought with it. With the required 11,336 kg of C-14 in the total of 3.5×10^{16} kg of C-12 in the oceans, the concentration is 0.275 of that in the current upper biosphere. It is also about 1.73 times the amount of C-14 in the pre-Flood biosphere and so is not excessive by any standards, particularly when it is considered that it is the neutron activity within the whole of the internal structure of the earth that is involved. This means that during about 2000 years 1 gram of C-14 was formed in volume inside the earth equal to about 10^5 cubic kilometres.

On this basis, then, a total of 11,336 kg of C-14 is brought in on the linear process that was used for the C-12 content of the deep oceans simultaneously. The deep ocean C-12 content that was equilibrating at any date being given by column 8 and the amount of C-14 in that portion of ocean being given by column 9. A uniform distribution of C-14 throughout the non-equilibrating ocean regions is assumed. To column 9 is then added the results from column 5 to give total C-14 content recorded in column 10, while column 11 gives the total C-12 content by the addition of columns 7 and 8. Column 12 gives the C-14/C-12 ratio as a percentage compared with today's value which is set at 100%.

THE RESULTS

As can be seen from a glance at column 12 the theoretical results are in very close accord with that predicted from the experimental results. The experimental values rise from a C-14/C-12 ratio of about 14% of today's value up to about 123% as the peak around 1900 BC (that is, 23% above today's value). In 1900 BC the theoretical value is 21 % above today's, while the peak according to theory comes in about 1700 BC with a value about 29% above today's.

The experimental values then taper down to 15.78% above today's value in 1500 BC while the theory gives 17% above. At 1000 BC experiment gives 9% above, while theory suggests 7%. At 500 BC experiment indicates 4.8% above while theory drops to 3%. At 0 AD the theory value of 1.2% above agrees fairly well with the experimental value of 2.3% and both have virtually tapered off to the present value by 500 AD. A comparison between Tables 5 and 9 therefore shows very close accord, and thus strongly suggests that c decay theory and radiocarbon dating mutually support each other, the C-14 dates implying that c has in fact decayed.

ANOMALOUS DATES

In conclusion, a brief word about anomalous dates may be in order. It has been assumed throughout this discussion that the atmosphere has remained well mixed with uniform distribution of C-14. Certainly this would be so post-Flood. However, the pre-Flood atmosphere probably had a different circulation pattern with only one Hadley cell per hemisphere from pole to equator.[32] Additionally, cosmic rays are preferentially channelled towards the poles by the magnetic field. Thus in the pre-Flood model a situation is conceivable in which there was a gradation of C-14 content, there being high concentration at the poles and low concentration at the equator. This could lead to pre-Flood objects giving a range of dates depending on latitude, those from high latitudes registering far 'younger' radiometrically than those from equatorial regions. This may account for the spread of dates from Flood debris and ice-age material.

There is also an apparent trend for animal life to come into equilibrium with C-14 far more slowly than plant life does and consequently read systematically 'old' radiometrically. It is for this reason that a living mollusc has been dated by C-14 as being 2300 years old[33] and freshly killed seals dated as 1300 years old.[34] This trend would be in evidence both pre-and post-Flood. Thus in the post-Flood environment shortly after the Babel incident for humans, or in the immediate post-Flood environment for animals, it is conceivable that remains dating significantly older that 24,000 years BP radiometrically would occur. In any case these specimens are in the vast minority, since there are only 191 dating from 24,000 BP to an infinite age on C-14 dating out of 15,000 C-14 dates.[35] Under these circumstances it would seem that many of the animal and human remains dating 'older' than 24,000 BP are in fact from the post-Flood epoch.

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