> Behold the king had ended his time of existence of many good years of victory, power, and justification from the 1st year to the 54th year. In the 30th of Phamenoth of the majesty of the king, Menkheperra deceased, he ascended to heaven and joined the sun's disc, the follower of the god met his maker.
>
> When the light dawned and the morrow came, the disc of the sun arose and heaven became bright. The king Aa-kheperu-ra, son of the sun, Amenhotep, the giver of life, was established on the throne of his father, he rested on the ka name, he struck down all the thrust.

Thutmose III was a ruler in Egypt; Thutmose III was a great builder; Thutmose III died suddenly in 1447 B.C. on the 30th of Phamenoth, the equivalent of the Hebrew Abib; the precise time when the Israelites went through the Red Sea. Thutmose III was the Pharaoh of the Exodus! The correlation of the Egyptian history and the facts recorded by the Bible could not be more exact!

The World Hears

As we continue to compare the sacred and secular records that relate to the Exodus, we might recall that when Thutmose I was king there was an ever-present possibility of revolt by Syria and the nations of northern Palestine. This probably occasioned the increased oppression of the Israelites and the murder of their newborn sons. Then under the energetic leadership of Thutmose III, Syria and all of Palestine were brought under complete control so that his 17th campaign, which was conducted in his 42nd year, was followed by 12 years of peace. His successor, Amenhotep II, co-regent with him for the last four months of his life, was immediately faced with revolt. Breasted reports:

> Syria, of course, revolted on the death of Thutmose III, and already in his second year we find his energetic son, Amenhotep II, on the march into northern Syria to quell the rebellion. Doubtless the harbor cities had also rebelled, and hence the young king is forced to proceed by land. Leaving Egypt in April, as his father had done on the first campaign thirty-three years before, he had already in early May won a battle at Shemesh-Edom in northern Palestine.[15]

This great disaster clearly must have been the signal for the nations of Palestine-Syria to revolt. No wonder Amenhotep II was so busy with quelling rebellion. The news of Egypt's defeat in the Red Sea would have spread like fire to the nations who were potential enemies of Egypt. One thinks of Rahab's words to the spies in Joshua 2:10:

> And she said unto the men, I know that the LORD hath given you the land, and that your terror is fallen upon us, and that all the inhabitants of the land faint because of you.

We know that the dissemination of this news was God's intention. We read that God said to the pharaoh in Exodus 9:16:

> And in very deed for this cause have I raised thee up, for to shew in thee my power; and that my name may be declared throughout all the earth.

The Tenth Plague

One other Biblical comment will be examined and then we will be finished with the question of the pharaoh of the Exodus. The Bible declares that as a result of the tenth plague, the first born of all the Egyptians died, including the first born of pharaoh. Is there any evidence of this in the archaeological findings? There surely appears to be. At the time of the Exodus two pharaohs were on the throne. The great Thutmose III was reigning in his 54th year. His son Amenhotep II, who apparently had just reigned four months as co-regent with his father, also reigned. The archaeologist Gardiner makes reference to this:

> A difficulty arises, however, from the fact that the well-known biography of Amenemhab (Urk IV, 895, 16), places the death of Tuthmosis III in his 54th year on the last day of the seventh month, and affirms that Amenophis II, his son and successor, was already on the throne. The next morning . . . possibly -- it even amounts to a probability -- is that Amenophis II for exactly four months before the latter's death . . . the most important evidence is that in the Thebean tomb of Dedi (No. 200), where the two kings were shown enthroned and inspecting a military display together.[16]

The archaeological evidence thus points to the condition of a co-regency of the aged Thutmose III and his young son Amenhotep II (Amenophis II). Amenhotep II obviously was not the first born of Thutmose III or he would have died in the tenth plague. The Bible declares very plainly in Exodus 12:29:

> And it came to pass, that at midnight the LORD smote all the firstborn in the land of Egypt, from the firstborn of Pharaoh that sat on his throne unto the firstborn of the captive that was in the dungeon; and all the firstborn of cattle.

The concept that Amenhotep II was not a firstborn son, even though he was the next ruler, is acceptable when we study the record concerning similar situations. A later pharaoh, Rameses II, who also reigned a long period of time (67 years), was followed by a son who was his 14th. Likewise, Amenhotep II could have been a much later child than the firstborn of his father Thutmose III.

If Amenhotep II was not a firstborn son, who was the first born of the pharaoh who died in the tenth plague? The secular record appears to provide an answer. Co-regent Amenhotep II was followed many years later by his son Thutmose IV, but there is evidence that Thutmose IV was not a first born son. In the book *Bible and Spade* we read:

> On an immense slab of red granite near the Sphinx at Gizeh it is recorded that Thotmes IV, while yet a youth, had fallen asleep under the famous monument and dreamed a dream. In this the Sphinx appeared to him, startling him with a prophecy that one day he would live to be King of Egypt, and bidding him clear the sand away from her feet in token of his gratitude, which on his accession, he did. It is clear from this inscription that Thotmes' hopes of succession had been remote, which proves, since the law of primogeniture obtained in Egypt at the time, that he could not have been Amenhotep's eldest son. In other words, there is room for the explanation that the heir apparent died in the manner related in the Bible.[17]

In other words, at the time of the Exodus, there were two pharaohs on the throne. The one was Thutmose III who died in the Red Sea. The other was Amenhotep II who was probably a son of Thutmose III, but obviously not the firstborn, for then he would have died in the plague. Since the next ruler, Thutmose IV, appears by the foregoing evidence to be a son later than the first born, we can readily assume that it was his brother, the first born of his father Amenhotep II, who was the son who died in the plague.

Therefore, we see that there is circumstantial evidence that young Amenhotep II, who ascended the throne just four months prior to the Exodus, lost his first born in the tenth plague as the Bible declares. His aged father, Thutmose III, who was co-regent with him, died in the Red Sea as the Bible shows. The correlation of Egyptian history and the facts as recorded in the Bible is very precise indeed. All these puny efforts have only verified what has always been true: God's eternal Word. Let God be true . . . .

NOTES:

[1] John Van Seters, *The Hyksos*, Yale University Press, 1966, p. 185. (New York, Charles Scribner & Sons, 1899.)

[2] W. M. Flinders Petrie, *History of Egypt*, Vol. 1. pp. 260-262. In this index Petrie lists at least 150 names beginning with 'Ra' all found on tablets dating before the 18th Dynasty.

[3] *Ibid.*, p. 69.

[4] R. A. Parker, "The Lunar Dates of Thutmose III and Rameses II," *Journal of Near Eastern Studies*, Vol. 16 (1957), p. 41.

[5] William C. Hayes, "Chronology," *The Cambridge Ancient History*, Cambridge University Press (1964), p. 17.

[6] Sir Leonard Wooley, *The Beginnings of Civilization*, The New York American Library, 1965, p. 105.

[7] W. M. Flinders Petrie, *History of Egypt*, New York, Charles Scribner & Sons (1904), p. 125.

[8] He is variously called Thutmoses III, Thutmos III, Thutmosis III, Tothmosis III, etc.

[9] *The Encyclopaedia Britannica* (1959 ed.), p. 58.

[10] R. O. Faulkner, "The Battle of Megiddo," in the *Journal of Egyptian Archaeology* (London, The Egypt Exploration Soc., 1942), p. 4.

[11] W. M. Flinders Petrie, *A History of Egypt during the XVIIth and XVIIIth Dynasties*, New York, Charles Scribner & Sons (1904), p. 136.

[12] Arthur E. P. Weigall, *A Guide to the Antiquities of Upper Egypt*, The MacMillan Co. (1910), pp. 219-220.

[13] Jack Finegan, *Handbook of Biblical Chronology*, Princeton University Press, 1964.

[14] The Julian equivalents in “The Macedonian Calendar in Palestine” are doubtful. It seems as if the Macedonian month “Artemisios” should be placed opposite the Feb./Mar. equivalent as it appears in the Egyptian table. This is further suggested by the Early Roman Calendar depicted on p. 74 of Finegan’s book, *Handbook of Biblical Chronology*, where March is shown as the first calendar month.

1. Martius	7. Semtembris
2. Aprilis	8. Octobris
3. Maius	9. Novembris
4. Junius	10. Decembris
5. Quintilis	11. Januaris
6. Sextilis	12. Februarius

The logic behind this reasoning is clearly seen in the Latin prefixes and the corresponding numeral.

[15] Breasted, *Ancient Records of Egypt*, Vol. 11, p. 34.

[16] Alan H. Gardiner, *Reginal Years and Civil Calendar in Pharaonic Egypt*, Vol. 31 (1945), p. 27.

[17] Stephen L. Gaiger, *Bible and Spade*, Oxford University Press, London, 1936, p. 74.

Chapter 10

The Israel Stela

We have identified the pharaoh who killed the new-born sons as Thutmose I, the princess who drew Moses from the water as Hatshepsut, the daughter of Thutmose I, the pharaoh who sought to kill Moses as King Hatshepsut, the pharaoh who would not let the children of Israel go and who was drowned in the Red Sea as Thutmose III, and the pharaoh whose first born was killed in the tenth plague as Amenhotep II. How wonderfully the sacred record provides foundation truth for the secular and the secular record provides fill-in information for the sacred.

Thus far in our attempt to mesh the sacred record with the secular record, we have discovered two very important astronomical dates that positively tie the two records together and provide a solid basis for expanding the secular dating of the pharaohs. The first date was the first year of the great Pharaoh Sesostris III of the 12th Dynasty which was 1888 B.C. as determined by a Sothic rising during his reign. That year precisely meets the Biblical chronological requirement of being two years before Joseph was made prime minister.

The second date was the first year of the greatest pharaoh of the 18th Dynasty, Thutmose III, whose last year, 1447 B.C., is established by a Sothic rising as well as two lunar dates during his reign. This coincides exactly with the Biblical date of the Exodus.

Because the sacred record is absolutely trustworthy, we should expect more synchronization with the secular evidence, especially when the secular chronological evidence is tied down by astronomical observation.

We shall now examine a third tie point. In doing so, we shall provide an explanation of one of the most puzzling yet significant tablets discovered in the ruins of antiquity.

A Stela Speaks

Among the tablets that have been unearthed in archaeological diggings, there is only one that speaks explicitly of Israel. Archaeologists discovered that it was written during the fifth year of Pharaoh Merneptah, who ruled near the end of the 13th century B.C. Because this stela mentions Israel, archaeologists have been ready to conclude that Israel was an independent nation at that time. Why Israel is mentioned in the stela is not easily determined. Had Egypt conquered Israel during Merneptah's reign? The stela records that "Palestine has become a widow for Egypt" and that "Israel is desolated, his seed is not." Let us study this stela to see the chronological tie point between Israel and Egypt.

The stela reads as follows:

The kings are overthrown, saying: "Salam!"

Not one holds up his head among the Nine Bows.

Wasted is Tehenu,

Kheta is pacified,

Plundered is Pekanan, with every evil,

Carried off is Askalon

Seized upon is Gezer

Yenoam is made as a thing not existing.

Israel is desolated, his seed is not.

Palestine has become a widow for Egypt.

All lands are united, they are pacified;

Everyone that is turbulent is bound by King

Merneptah given life like Re, Every day.[1]

The great archaeologist Breasted concludes that the phrase "Palestine has become a widow for Egypt" must mean "Palestine has no protector against Egypt." This makes abundant sense, as we shall presently see. But can we be helped in our chronological synchronization with anything else on this stela?

The phrase "Israel is desolated, his seed is not" is the all-important phrase. At what time in Israel's history was the nation without seed? *There was indeed such a time.* It is recorded in the Book of Judges. The Bible records the exploits of one of the greatest of the judges, Gideon. Under his leadership 120,000 of the enemy had fallen (Judges 8:10). The men of Israel were so happy with his ability that they wanted him and his descendants to rule over them (Judges 8:22). Gideon did in fact rule as judge for 40 years during which time the land had rest (Judges 8:28). No doubt in the eyes of the world this great leader was tantamount to a king. In fact, his son Abimelech did reign as a king for three years (Judges 9:16, 22).

Israel Is Without Seed

Upon Gideon's death, a terrible tragedy occurred. Abimelech, a son of Gideon by a concubine, murdered the seventy sons of Gideon upon one stone (Judges 9:5), in order to have no competitors for the kingship. Only one son escaped. Surely, this is the event to which Merneptah makes reference when he states, "Israel is desolated, his seed is not." This heinous and terrible crime, committed against the family that had brought peace and tranquility to the nation of Israel for so long, must have been a national tragedy of the gravest consequence. Insurrection, anarchy, civil war, were all possible on the heels of this great murder. Israel was without seed. There was no longer a ruling family except the murderer himself and one son who was himself. No wonder Merneptah concludes Palestine is without a protector and ripe for conquest.

When did this event, recorded on the Israel stela in the fifth year of Merneptah, occur? In the Biblical chronology we determined (Chapter 5) that Gideon died in the year 1207 B.C. This must have been the fifth year of Merneptah. His first year must have been either 1212 B.C. or 1211 B.C., depending upon what time of the year he became king.

The information we have thus far developed seems to be of no particular help in synchronizing the secular account with the sacred account. Actually, it appears as though we are on the wrong track for most archaeologists choose a date of 1225 B.C. or earlier for Merneptah's first year.

When we look to his father's reign, however, we see the precise concordance that does exist. Merneptah's father was the famous Rameses II, the pharaoh so many have incorrectly felt was perhaps the pharaoh of the Exodus. We know two very important facts of his life that relate to the question we are presently considering. The first is that he reigned for a total of 67 years. This means that if our assumption is correct, Merneptah began to reign in 1212 or 1211 B.C., then Rameses II must have become king in 1279 or 1278 B.C. The other fact that we know from his life is that in his 52nd year a new moon occurred on II prt 27.[2] Within the possible limits of his reign, there are only a few years when the new moon could have occurred on this date. Parker shows that these are: 1253, 1250, 1239, 1228, and 1225. Accordingly, since these are the only years that could have been his 52nd year, the only years that could have been his first year are 1304, 1301, 1290, 1279, and 1276. Most archaeologists have looked at 1304 and 1290 as the most logical choices for his first year.

The dates of 1304 and 1290, while possibilities because of the astronomical "fix," are not necessarily in either case the correct choice of the five possible dates named above. Archaeologists have opted for 1304 and 1290 because of very sketchy and incomplete information from the Assyrian and Babylonian chronologies. While these are quite helpful back to about 1100 B.C., they are of more doubtful value earlier. The Assyrians from the earliest period named their years after an annually-appointed official called a *limmu*. Accurate lists of these officials were compiled. They were especially accurate from June 15, 763 B.C., a date fixed by a record of an eclipse of the sun, back to the 11th century B.C. Earlier than the eleventh century, no *limmu* lists have been preserved but dates back to the 17th century have been preserved with an accuracy within a few decades or less. This is a result of king lists which have been found which are demonstrably based on earlier *limmu* lists. The Babylonian chronology has been figured back to about 1350 B.C. with a maximum margin of error of being about 50 years either way. Thus, the Assyrian chronology for the period of Merneptah's reign does not help with precise dating. When we turn to the Biblical record, however, we discover a wonderful synchronization.

Let us again recall that the secular evidence based upon astronomical information gives five possibilities as the first year of Rameses II, who ruled 67 years and who was followed by Merneptah, who wrote the Israel Stela in the fifth year of his reign. These five years are 1304, 1301, 1290, 1279, and 1276. Let us begin with one of the five possible years, the year 1279 as the first year of Rameses II. He then would have died 67 years later in 1212 B.C. at which time his successor Merneptah would have ascended the throne. Merneptah's fifth year, when the Israel Stela was written that describes a terrible tragedy in Israel, would then have been 1208 B.C. or more likely 1207 B.C. And

1207 B.C.[3] coincides exactly with the terrible tragedy which enveloped the nation of Israel upon the death of Gideon.

Thus, we must conclude that Rameses II began to reign 1279 B.C. This is in agreement with the astronomical data and is permitted by the background information available from the Assyrian and Babylonian records. By means of Biblical chronological record it alone is proven to be the correct date.

After a reign of 67 years, Rameses II died and was followed by Merneptah who began to reign in 1212 B.C. In Merneptah's fifth year, the year 1207 B.C., Gideon, the ruler over Israel, died, and seventy of his sons were murdered. Merneptah took note of this sad and tragic event by recording it on what has become known as the Israel Stela.

We see not only the precise agreement between the language recorded on the Israel stela and the reasons for this, but we also see the perfect synchronization that occurs between the sacred and secular records once we have accepted the Bible as being scientifically and historically trustworthy. It is wonderful that God has given us at least three dates in history, reaching back almost 4000 years, that assure us of the validity of our solution to the Biblical chronology. Surely there must be many more points of synchronization that can be ferreted out by diligent research.

Let us approach the question of the timetable of man and the earth from an altogether different frame of reference. In the next chapter, we will leave Egypt and turn to an examination of the oceans.

NOTES:

[1] James H. Breasted, *Ancient Records of Crypt*, Vol. III, University of Chicago Press, 1906, p. 263.

[2] Richard A. Parker, "The Lunar Dates of Tutmose III and Rameses II," in *Journal of Near Eastern Studies*, Vol. 16, 1957, p. 41.

[3] Please see Appendix VII for more discussion on this date.

Chapter 11

Let the Oceans Speak

We are certain that the Bible is accurate, authoritative, and trustworthy in every field of knowledge whether that be theological, historical, scientific, or any other. It gives us a very definite and precise chronological timetable that begins with the creation of this world and its first man Adam and covers the great historical events of the first 11,000 years of history. The evidence produced by the secular record is not at all in disagreement with the sacred record and the sacred record helps in a great fashion to place the secular record in proper perspective. Because the Bible is true and accurate in its accounts of people, places, and time, it can help to distinguish between what is true and false about the secular viewpoints.

Data from the observable universe concerning the history of the earth is becoming increasingly available as men search out the secrets of the universe. Does this evidence demonstrate that in spite of all that we have said thus far, the world must be far older than 13,000 years? Can we really expect to find correlation between the Biblical and secular records if we are going to insist on the literal interpretation of the creation story and the flood account? Is the evidence that shows that this world is billions of years old so conclusive that it is hardly worthwhile to expect complete reconciliation between the Bible and science?

To answer these questions, we shall examine some of the available evidence. It must be emphasized that because this world is under the bondage of decay, and much of the record is confused and obliterated by storms, floods, decay, fire, pestilence, and so forth, we cannot expect to reconstruct the history of the world in a complete and detailed manner. But from the secular record we should at least be able to obtain some indication of the timetable of the past.

Two areas of study seem to be quite fruitful in contributing information toward an answer to the question of the age of the earth. One study concerns the oceans; the other study concerns radioactive decay. Because of their importance in the development of modern views of the earth's age, they must be honestly faced. Therefore, we shall study the oceans and radioactive dating.

The Oceans: A Key to the Past

In an earlier generation, scientists suggested that the oceans might be of real help in determining the age of the earth. As they thought about the problem of the earth's antiquity, their eyes were directed to the seas. After all, the seas completely surround the land masses and thus receive the output of the rivers that flow into them. The rivers carry sediment and chemicals in solution which have eroded from the continents. Scientists have assumed, therefore, that most of the chemical composition of ocean water is derived from the weathering of rocks. Sverdrup, et al., writes:

> According to present theories, most of the solid materials dissolved in the sea originated from the weathering of the crust of the earth.[1]

H. Kienen wrote in 1965:

> Apart from meteoric dust and gaseous matter, the ultimate sources of all sediments are igneous and metamorphic rocks.[2]

Mr. Kuenen continued:

Ground water containing dissolved matter including silica, calcium, sodium, iron, magnesium, phosphorous, humic acids, etc., reaches the sea by way of rivers, or directly by seepage along the shore. Apart from gases, including carbon dioxide, derived directly from the atmosphere, this is the main source of dissolved matter in the sea water. . . A minor contribution comes from volcanic exhalations and from the expulsion of sea water trapped between the grains of the older marine sediments.[3]

Thus, today, scientists expect that the chemical content of the oceans should tell us much about the history of the earth. Because salt, NaCl, is the most abundant constituent of sea water and because both Na and Cl are present in the rocks, it was supposed that a knowledge of the amount of NaCl in the seas compared with the amount entering the seas each year by the weathering of the land would give a close approximation of the age of the earth. An earth age of about 100 million years was estimated by earlier scientists by following this assumption.

Then came other dating methods. By radioactive decay procedures, it was decided that the earth must be some four and a half billion years old. The 100 million years established by the ocean evidence was decisively rejected in favor of the longer radioactive age which provided a much more acceptable timetable for the presumed evolutionary developments. We now hear very little from researchers investigating the content of sea waters as far as total earth dating is concerned.

But the oceans are still with us. Since this world presumably has been around for more than four billion years, and since during much of this time, oceans as well as continents have existed, certain relationships and equilibriums must exist between the continents and the oceans. The earlier scientists' contention of an earth-ocean time relationship should still be valid. Assuming that the present activities in nature are a key to the past, we should be able to examine the relationship of the materials of the continents to those of the oceans and in this way arrive at some kind of a timetable for geological history.

Ocean Water Suggests a Time Schedule for History

As we have noted, geologists arrived at the conclusion that the chemical composition of the sea water and the ocean floor sediments are principally a product of the weathering of continental rocks. If this weathering of rocks was a short-time phenomenon, the sea water could be expected to contain far different proportions of one element relative to others than those proportions found within the average rocks of the continents. This is due to the fact that some rocks erode more easily than others and therefore, these easily-erodable chemicals should begin to be most abundant in sea water. The difference in relative chemical proportions would also be due to other variables, such as the fact that some elements are not as readily transportable by rivers and ocean currents as others and some are less solvable in water than others.

Nevertheless, if the time of erosion were long enough, the elements in the sea water and on the sea floor should approach an accurate reflection of the chemical content of the continental masses. For then even the hardest of rocks would be eroded, and even the least transportable minerals ultimately would be carried by the rivers to the sea. Thus, when scientists talk about millions of years we would suspect that on a world-wide basis the proportion of one element in the sea water and on the sea floor to all other elements in the same environment should approximate the ratio of that element to all other elements in the continental masses, for in a very general way all the mass must somehow be conserved. For example, if the percentage of silicon in the continental masses is 27.5%, then if the oceans were old enough, we would also expect the total of all the silicon in the ocean water and on the ocean floor to approach 27.5%.

Furthermore, if we could know something about the total quantities of various elements in the seas and sea floor, and if we could know the approximate rate of world-wide erosion, we could estimate the length of time required to bring the elements into the ocean. This in turn should give us an approximate age for earth.

Fortunately, scientists have rather accurately determined the chemical composition of both the sea water and the land masses. Sverdrup *et al.* have prepared a table (Table I)[4] that shows the amounts of various chemicals that should have entered the oceans during a period of 260 millions of years. This is the estimated length of time which would be required to provide the present quantity of salt in the ocean water assuming uniform weathering throughout this period of time. He writes that Goldschmidt (1933) estimates that to accumulate the present concentration of salt (NaCl) in solution, 600 grams of rock would have been weathered for each kilogram of water in the ocean. Thus, Table I shows that for each 600 grams of rock weathered, 17,000 mg (17 gr) of sodium were released for ultimate availability to the oceans. Likewise, 165,000 mg (165 gr) of silicon were released, and so forth.

With this estimate of potential elements available, one wonders what is the actual quantity of elements in sea water. The second column of Table I gives us this estimate. For example, in a kilogram of sea water there is on the average about 0.5 mg of aluminum in solution. This is only 0.001% of the estimated 53,000 mg expected if weathering had continued for as long as 260 million years, the estimated time required to provide the observed amount of salt. In fact, if we examine all of the elements listed in Table I, we are struck by the total lack of relationship between the chemicals in the ocean and the continents. For example, chlorine is 67 times too prevalent in sea water, nickel is 500,000 times too scarce. Silicon, which is one of the most common constituents of rocks, should be 50,000 times more plentiful in ocean water if it were to be proportionate to that in rocks.

Table I
Elements in Sea Water and in the Earth's Crust

Element	Sea Water	Potential 'supply' in 600 g of rock (mg/kg of sea water)	Percent-age in Solution
Silicon	4	165,000	0.002
Aluminum	0.5	53,000	0.001
Iron	0.002	31,000	0.0001
Calcium	408	22,000	1.9
Sodium	10,769	17,000	65
Potassium	387	15,000	2.6
Magnesium	1,297	13,000	10
Titanium	. . .	3,800	?
Manganese	0.01	560	0.002
Phosphorus	0.01	470	0.02
Carbon	28	300	9
Sulphur	901	300	300
Chlorine	19,353	290	6700
Strontium	13	250	5
Barium	0.05	230	0.02
Rubidium	0.02	190	0.l
Fluorine	1.4	160	0.9
Chromium	p	120	?
Zirconium	. . .	120	?
Copper	0.01	60	0.02
Nickel	0.0001	60	0.002
Vanadium	0.0003	60	0.0005
Tungsten	. . .	41	?
Lithium	0.1	39	0.2
Cerium	0.0004	26	0.002
Cobalt	p	24	?
Tin	p	24	?
Zinc	0.005	24	0.02
Yttrium	0.0003	19	0.002
Lanthanum	0.0003	11	0.003
Lead	0.004	10	0.04
Molybdenum	0.0005	9	0.005
Thorium	0.0005	6	0.01
Cesium	0.002	4	0.05
Arsenic	0.02	3	0.7
Scandium	0.00004	3	0.001
Bromine	66	3	2000
Boron	4.7	2	240
Uranium	0.015	2	0.8
Selenium	0.004	0.4	1
Cadmium	p	0.3	?
Mercury	0.00003	0.3	0.001
Iodine	0.05	0.2	25
Silver	0.0003	0.06	0.5
Gold	0.056	0.003	0.3
Radium	0.093	0.066	0.05

Perhaps the reason for this total disproportion between the expected volumes of elements in the sea water and their actual occurrence is that the sea water will hold in solution only a tiny bit of each element such as silicon with the balance going out of solution to the sea bottom either by precipitation or by the action of organisms. This, however, does not appear to be the case. For example, sea water is not saturated with silicon. F. A. J. Armstrong writes:

> Sea water is undersaturated with respect to silica, although since reported values for its solubility are somewhat inconsistent, it is not possible to say how much.[5]

Kuenen writes:

> Under normal conditions, sea water is not supersaturated with any product, and circulation is automatically set up in areas of excess evaporation, preventing the formation of excessive concentrations.[6]

Thus, the evidence appears to indicate that not only are many elements far too insufficient in ocean water as compared with the quantities that should be present if the oceans were millions of years old but that the evidence points to the fact that sea water in general is not saturated with chemical elements. This suggests a very young ocean. If the ocean had existed long enough, those elements which are especially soluble would have reached a saturated condition in many parts of the world.

The unsaturated condition of the oceans also suggests that they should provide a reasonable tool for measuring their age. This is a result of the fact that an estimate can be made of the average annual quantity of chemicals flowing into the ocean from the rivers. Dividing the total quantity of an element existing in an unsaturated condition in ocean solution by the quantity of the same element flowing into the ocean should give us some concept of the ocean's age.

Table II [7] gives us this information. We see that it would have taken 2.0×10^7 (20 million) years of continental weathering to supply all of the lithium (Li) presently found in this in ocean solution. Likewise, sodium (Na) would have presumably been accumulating some 2.6×10^8 (260 million) years.

When we look at Table II more closely, we discover a very strange fact. Some of the elements are in very short supply in the oceans. Aluminum, for example, has such a tiny quantity in ocean solution that 100 years of continental weather would have provided it. In fact,

Table II

Residency Periods for Chemicals in Ocean Solution

(Years)

Lithium	Li	2.0×10^7	Silver	Ag	2.1×10^6
Beryllium	Be	150	Gadolinum	Gd	5.0×10^5
Sodium	Na	2.6×10	Tin	Sn	1.0×10^5
Magnesium	Mg	4.5×10^7	Antimony	Sb	3.5×10^5
Aluminum	Al	100	Barium	Ba	8.4×10^4
Silicon	Si	8.0×10^3	Lanthanum	La	400
Potassium	K	1.1×10^7	Cerium	Ce	80
Calcium	Ca	8.0×10^6	Praseodymium	Pr	320
Scandium	Sc	5.6×10^3	Neodymium	Nd	270
Titanium	Ti	160	Samarium	Sm	180
Vanadium	V	1.0×10^4	Europium	Eu	300
Chromium	Cr	350	Dysprosium	Dy	460
Manganese	Mn	1400	Holmium	Ho	530
Iron	Fe	140	Erbium	Er	690
Cobalt	Co	1.8×10^4	Thulium	Tm	1800
Nickel	Ni	1.8×10^4	Ytterbium	Yb	530
Copper	Cu	5.0×10^4	Lutetium	Lu	450
Zinc	Zn	1.8×10^5	Tungsten	W	10^3
Gallium	Ga	1.4×10^3	Gold	Au	5.6×10^5
Germanium	Ge	7.0×10^3	Mercury	Hg	4.2×10^4
Rubidium	Rb	2.7×10^5	Lead	Pb	2.0×10^3
Strontium	Sr	1.9×10^7	Bismuth	Bi	4.5×10^4
Yttrium	Y	7.5×10^3	Uranium	U	5.0×10^5
Niobium	Nb	300	Thorium	Th	350
Molybdenum	Mo	5.0×10^5			

nineteen of the elements found in sea water are found in amounts less than that which would be provided in 1,000 years of continental weathering. This startling information suggests two conclusions:

1.The oceans must be very young because small quantities of many of the elements are in solution.

2.The oceans must be very young because of the wide discrepancy of residency periods of various chemicals. Differential erosion over a relatively short period of time together with other variables such as water transportability and solubility of elements would account for the wide spread in residency times.

One other fact should be noted in this regard. Chlorine, sulphur, bromine, and boron exist in much larger amounts than that which would be supplied while the sodium was being weathered from rocks into the ocean waters. This suggests a third conclusion.

3.That salt (NaCl) and perhaps a number of other chemicals are in the oceans completely apart from normal rock weathering.

A Look at Sediments

Even though the sea water does not appear to be saturated with many, if any, of the chemicals that enter it, perhaps they were taken out of solution in some manner. The paucity of so many of the chemicals in the oceans suggests that they may have been taken out of solution. It is true that the mechanisms of solution in, and the removal from, sea water are rather complex and scientists are busily engaged in attempting to understand them. But if the chemicals are not in the sea water, they must be on the sea floor. Therefore, even though the chemicals in the water do not relate quantitatively to those in the rocks, surely the remainder would be found on the sea floor, with the overall chemical content reflecting an ancient ocean. The facts, however, do not indicate this.

Obviously, much more work must be done before a complete analysis of the quantity and composition of the sea floor sediments can be known. Already many cores have been taken and there is much literature that is available concerning this question. The present knowledge is perhaps summed up by the comment of H. Kuenen:

> The differences in composition between oceanic and continental sediments, both as to major constituents and trace elements, are large.[8]

In other words, whether we look to the composition of sea water or to the composition of the ocean sediments, there is little to suggest a long-time relationship between the oceans and the continents.

Wilson sets forth these problems when he writes:

The failure to recover any rocks older than Cretacious from the ocean floors suggests that the ocean basins may be younger than the continents. It has also become evident that the petrology, sedimentations, and structural geology of ocean chasms are quite different from these of continents . . . the ocean basins and oceanic islands are dramatically different from continents in crustal thickness, age, composition, ore deposits, structures, magnetic anomalies and in the patterns and characteristics of their active mountain belts and earthquakes. Several continents have rocks at least 3.2 x 10^9 years old, which is 20 times the age of the oldest oceanic island, dredging or core.[9]

Thus, we see by the tremendous chemical disproportions between the oceans and the continents that a very young ocean is the most probable conclusion. Let us now examine the ocean sediments from another aspect. If we knew the annual amount of sediments flowing by rivers into the ocean basins and had some idea of the volume of sediments on the ocean floor, dividing the first quantity into the second should give us the approximate age of the oceans. Or to put it another way, if we knew the annual quantity of sediments flowing into the oceans, we could multiply this figure by say 100 million years, four and a half billion years, or any other length of time which we believe approximates the age of the earth, and be able to estimate the average thickness of sediments on the ocean floor.

Let us compute the thickness of sediment that should be found if the oceans were 260 million years old as suggested by their salt content. We shall begin by figuring the quantities added to the oceans by the rivers of the world. Clark[10] (1924) has estimated that the rivers contribute 2.73 x 10^{15} grams of dissolved solids to the sea each year. In the 2.6 x 10^8 years that it presumably took to provide the sodium in the oceans a total of 7.1 x 10^{23} grams would have been provided. Of this total 5 x 10^{22} grams are presently in solution[11] in the ocean water indicating that (71.0 x 10^{22}) - (5 x 10^{22}) or 66.^{0} x 10^{22} grams should have gone out of solution and become sediment. A small part of this may have been recycled due to ocean spray, etc., but the major part must still be present somewhere in the oceans.

The estimate of 66×10^{22} grams of sediment might be checked by approaching the question from another viewpoint. Sverdrup *et al.*, writes[12] that Goldschmidt (1933) estimates that to accumulate the present concentration of salt (NaCl) in ocean solution, a total of 600 grams of rock has been weathered for each kilogram of water in the ocean. This is the basis upon which Table I was developed. Since there are 278 kg. of water for each square centimeter of the earth's surface, and the area of the earth's surface is 5.1×10^{18} kg., the total weight of water equals

$278 \times 5.1 \times 10^{18}$ kg. $= 1.42 \times 10^{21}$ kg.

Goldschmidt further estimates that for every 600 gr. of rock that has been weathered, 65% or 390 grams actually should have become available for solution in the oceans or as sediment on the ocean floor. This equals $390 \times 1.42 \times 10^{21}$ grams $= 5.53 \times 10^{23}$ grams. Since 5×10^{16} metric tons or 5×10^{22} grams are in solution, the amount that must have become sediment equals 55.3×10^{22} grams - 5×10^{22} grams or 50×10^{22} grams. This is very close to the 66×10^{22} grams based on Clark's estimate of river sediments.

With the knowledge that there are presently an estimated 5×10^{22} grams of chemicals in ocean solution and that there should be at least another 50×10^{22} grams in sediments (based on an ocean age of 260 million years), let us determine what the ocean floor should look like. Svendrup[13] estimates that if the 5×10^{22} grams of chemicals which are presently in ocean solution could be extracted, they would provide a layer of salts 45 meters thick over the entire earth. Since the oceans cover 70.8% of the earth's surface, this hypothetical layer would be 63.5 meters thick on the ocean floor.

Since we have seen that an ocean 260 million years old should have provided sediments equal to a minimum of 50×10^{22} grams, we would therefore expect an average sediment depth of ten times 63.5 or 635 meters or 2100 feet (with the ocean area the same), that is, if the continents had been weathering uniformly for 260 million years. Since the continents presumably have been here far longer (minimum 3 billion years), one could logically expect the sediments should be far deeper than 635 meters. In fact, by this time the oceans should have almost filled up and the land should have been eroded to level plains. The mountain building presumed to have taken place a few hundred million years ago would have changed these figures a bit, but the basic concept of the oceans filling with sediment as the land masses eroded should hold true.

Let us now examine the evidence as far as the ocean sediments are concerned. In 1949, Maurice Ewing wrote in the *National Geographic Magazine* concerning the exploration of the floor of the Atlantic Ocean:

> In more than 3,000 places over vast areas of the Atlantic we have now measured with sound echoes, the depth of the sediment on top of the bed-rock of the ocean floor. These measurements clearly indicate thousands of feet of sediments on the foothills of the Ridge. Surprisingly, however, we have found that in the great flat basins on each side of the Ridge this sediment appears to be less than 100 feet thick, a fact so startling that it needs further checking.[14]

Much of the Pacific floor, too, is covered by sediments under 100 meters in depth,[15] with some areas as thin as 20 meters.[16] The following statement relates to investigation of the East Pacific Rise:

> A deep-towed magnetometer profile made across the East Pacific Rise crest shows sediment accumulation increases from less than 2 meters at the rise crest axis to about 20 meters at the western end and 10 meters at the eastern end of the profile.[17]

Evidence from the oceans is not automatic support for the view of a very old earth. In fact, the evidence appears to point to the opposite conclusion. Patrick M. Hurley wrote in the *Scientific American*:

> The topography of the ocean floors has been rapidly revealed in the past two decades by the depth recorder. . . . It became a great puzzle how in the total span of earth's history only a thin veneer of sediment had been laid down. The deposition rate measured today would extend the process of sedimentation back to the Cretacious times, or 100 to 200 million years, compared with a continental and oceanic history that goes back at least 3,000 million years. How could three-quarters of the earth's surface be wiped clean of sediment in the last 5 per cent of terrestrial time? Furthermore, why were all the oceanic islands and submerged volcanoes so young? [18]

Kuenen writes:

> Two great problems challenge earth sciences in this domain. The huge wedge of terrace sediment underlying the shelf off the east coast of the United States has been built up in little more than in 108 years, that is, in less than 2 or 3 per cent of geological time.

> What has happened to the terraces that must have been produced earlier? Have they subsided into the mantle and been absorbed, have they been pushed under the continents, or have they been incorporated into mountain chains? The second problem is the discrepancy between the estimated thicknesses on the deep sea floor, and the values actually found. Various suggestions have been offered, (1) the layers below the unconsolidated sediment are mainly consolidated deposits; (2) the rate of sedimentation has been much slower than in recent times, especially in pre-tertiary times; (3) creep of the sea floor under the continental blocks under the influence of convection currents in the mantle; (4) the ocean floor is relatively young; (5) the sedimentary carpet has been invaded from below and metamorphosed so completely as to become basic rock.[19]

Here then is a great enigma. If the oceans are only hundreds of millions of years old, sediments averaging 600 or more meters (2000 ft.) should be found all over the ocean floor. Instead sediments are normally found to be far less than this, and in many cases, the ocean floor is almost bare of sediment. No theory outside of that of a very young ocean has thus far been set forth that seems as plausible or direct. If the age of the earth is truly billions of years, then the puzzle of the missing ocean sediments is enormously increased.

Summary

To summarize this chapter, the following truths suggest themselves.

1. There appears to be a great discrepancy between the three or four billion year age derived from radioactive decay data and the evidence obtainable from the oceans. Either the ocean data is completely untrustworthy or there is a question regarding the dependability of radioactive dating.

2. If the accumulation of sodium by the weathering of continental rocks as a part of NaCl in the oceans is the guide for the age of the oceans a number of unanswerable problems remain.

    a. Some chemicals (Cl, Br, etc.), must have been a part of the oceans since the beginning or they must have been introduced apart from rock weathering.

    b. The sediments in the ocean should be much thicker than actually found.

c. Almost all the other elements which supposedly weathered while the sodium was weathering are in far too short supply to allow for a weathering period of 260 million years which is required to bring this amount of sodium into the oceans. Therefore, using NaCl as a standard results in an untenable solution.

3. If the accumulation of the other major constituent of the ocean salts, chlorine, is to be the guide to age dating, the following would obtain.

a. An accumulation period of about 2 or 3 billions of years would result. This is much closer to the radioactive age determination. The oceans can then be considered to have been devoid of chemicals in solution at one time in its history.

b. This would compound the sediment problem. In this long period of time the oceans would have filled with sediment.

c. This also provides no answer for the short supply of many of the ocean chemicals. This, too gives an untenable solution.

4. If the accumulation of the smallest amounts of chemicals is used for age dating the following would obtain.

a. The apparent age of the ocean would be under 1,000 years.

b. The ocean would have begun with essentially its present complement of salt and several of the other chemicals. We know from other histories that this solution is untenable.

5. Another conclusion suggests itself as the only plausible one in light of the Biblical statement as well as in the light of the evidence forthcoming from studies of the oceans. That conclusion is that the ocean and the earth is 13,000 years old as the Bible teaches. This conclusion is supported by the following secular evidences.

a. The elements in the ocean water are not found in a saturated condition, thus indicating that the flow of chemicals into the ocean is a short-time phenomenon.

b. The proportions of elements found in the water or on the ocean floor bear no relationship to the proportions found in the continents. Such variables such as resistance to erosion, water transportability, and solubility and others, over a very short period of weathering accord with these extreme differences in chemical proportions. This, too, points to a very young ocean.

c. The fact that many of the chemicals in ocean solution are present in amounts that could have been provided within the last 1,000 years or less if all rocks were equally susceptible to erosion, points dramatically to the 13,000 year age of the earth. This is precisely what would be expected in view of the differences in erosion resistance, solubility, etc., of the continental rocks. Easily erodable rocks would have provided elements in excess of those expected within 13,000 years whereas very hard rocks would provide far less than that expected in 13,000 years of history.

d. The thin layer of sediments on the ocean floor also point to a very young earth. This is especially true when we consider the cataclysmic worldwide flood of Noah's day. It alone must have provided enormous quantities of sediments for ocean solution and disposition. In fact, its impact upon the oceans was so severe that no accurate estimate of time will ever be derived from the ocean chemicals.

e. The fact that certain salts such as NaCl are in such abundance in ocean solution strongly suggests that they have been present in essentially their present quantities from the very beginning.

The all-important fact remains that even without considering the effect of the flood on the oceans, we must conclude that under no circumstance may we consider that the ocean evidence points to an age of millions of years. When recognition is given to the Noachian flood sediments which must be subtracted from the elements in the oceans, then we arrive more emphatically than ever at a very young ocean. The 13,000 year date of the Bible appears to be the only true alternative to the present theories of a very old earth.

NOTES:

[1] H. U. Sverdrup, Martin W. Johnson, Richard H. Fleming, *The Oceans,* Prentice-Hall, Inc., New York, 1942, p. 219.

[2] H. Kuenen, "Geological Conditions of Sedimentation," *Chemical Ocean*ography, J. P. Riley and G. Skirrow (ed.), Academic Press, London and New York, 1965, Vol. 2, p. 1.

[3] *Ibid.*, p. 4.

[4] H. U. Sverdrup, *The Oceans*, p. 220.

[5] F. A. J. Armstrong, "Silicon," *Chemical Oceanography*, J. P. Riley and G. Skirrow (ed.), Academic Press, London and New York, 1965, Vol. 2, p. 410.

[6] H. Kuenen, *Chemical Oceanography*, p. 5.

[7] *Ibid.*, Vol. 1, p. 164.

[8] *Ibid.*, Vol. 2, p. 20.

[9] Teyo J. Wilson, "Theories of Building of Continents," *The Earth's Mantle*, T. F. Gaskell, Academic Press, London and New York, 1967, p. 447.

[10] H. U. Sverdrup, *The Oceans*, p. 172.

[11] *Ibid*., p. 219.

[12] *Ibid*., p. 219.

[13] *Ibid*., p. 219.

[14] Maurice Ewing, "New Discoveries on the Mid-Atlantic Ridge," *National Geographic Magazine,* Nov., 1949, pp. 612-613.

[15] John Ewing, *et al.*, "North Pacific Sediment Layers Measured by Seismic Profiling," *The Crust and Upper Mantle of the Pacific Area,* William Byrd Press, Richmond, Va., 1968, pp. 150, 165.

[16] *Ibid*., p. 148.

[17] Roger L. Larson and Fred N. Spiers, "East Pacific Rise Crest, a Near Bottom Geophysical Profile," *Science*, Jan. 3, 1969, p. 68.

[18] Patrick Hurley, "The Confirmation of Continental Drift," *Scientific American*, April, 1968.

[19] Kuenen, *Chemical Oceanography*, Vol. 2, p. 20.

Chapter 12

Earth's Radiocarbon Timepiece

Thus far in our study of the secular evidence that relates to the age of the earth, we have seen that the oceans potentially offer great help in tying together the secular and sacred records. Not only do they reveal, from many standpoints, the impossibility of an earth with an age of billions of years, but they point rather dramatically to the truth that the earth is only thousands of years old. Thus, the evidence produced from a study of the oceans meshes consistently with the trustworthy record of the Bible which gives us a date of 11,013 B.C. for the creation of our earth.

What about other dating methods? Do they show an earth age of four and a half billion years? Do they demonstrate that man is at least two million years old? We should examine at least one of the major dating methods to discover some of the reasons for the discrepancies that exist between the Bible and ocean data on the one hand, and the radiometric dating method on the other.

Within the last few decades, scientists have discovered what appears to be a tremendous tool which has been used in an attempt to reconstruct the timetable of the past. This tool is derived from a study of radioactive isotopes. Many of the elements of which this planet is composed exist in forms of different atomic weights. These forms are called isotopes. For example, the element potassium exists as the isotopes K^{39}, K^{40}, and K^{41}. Some of these isotopes are unstable. Over a period of years some of the unstable atoms lose particles by radioactive decay and change into other elements. The most abundant isotope of potassium is K^{39} and it does not change. The least abundant is K^{40} and it is unstable both with respect to beta emission and electron capture. Each atom of potassium of atomic weight 40 will be transmuted either by emission of a beta particle to become an atom of calcium (Ca^{40}) or by electron capture to become an atom of argon (Ar^{40}). Thus, the relative abundance of K^{40} is decreasing and that of Ca^{40} and Ar^{40} is increasing with time. By careful analysis, the rate of this change or decay can be measured. In the case of K^{40}, 1290 million years will be required for half of the atoms of K^{40} in existence today to become atoms of Ca^{40} or Ar^{40}. The half life of K^{40} is, therefore, 1290×10^6 years.

By making certain assumptions regarding the mineralogic and petrologic factors, the geologic environment, and other conditions that existed at the time of the formation of the specimen being studied, it is possible to apply the knowledge of its half life to arrive at an estimate of its age, that is, at least the age from the last crystallization of the rock. Not only potassium but uranium, lead, rubidium, and other elements can be used in this kind of age dating. As a consequence of this age dating possibility, scientists have decided that the earth must be about four and a half billion years old.

Are Radioactive Dating Assumptions Correct?

There are major drawbacks to this method of dating. First of all, we lack knowledge concerning the validity of all the assumptions made about the conditions that existed on the earth during the initial span of time since its beginning. Therefore, dates derived from radioactive decay measurements could be in serious error. Moreover, we lack other reliable dating methods that are tested and proven accurate by which we can check our radioactive dates. For example, we have already seen how the ocean evidence gives us a conclusion that is much different from an earth age of some billions of years. If we did have another reliable method and found a lack of concordance, we could modify our assumptions until we knew we were using the radioactive evidence properly. We shall presently see how this can be done with radioactive carbon. Finally, while we may arrive at approximately concordant dates using different isotope methods to date the same rock, we cannot know for sure whether these concordant dates are a result of having found an accurate age or if they are a result of some ancient phenomena that synchronized the atomic clocks. For example Richard Armstrong writes:

> On all micas both K-Ar and Rb-Sr dates may be determined. This provides a useful check although it is known that even concordant results are not necessarily a significant measure of age.[1]

Potassium-Argon Dating Reveals Many Anomalies

Potassium-argon dating is a method which can be used to illustrate the potential for arriving at incorrect dates because of lack of knowledge concerning the conditions that existed at the time the rock under study was formed. These isotopes have been used in dating rocks supposedly as young as a few hundred thousand years or as old as several billions years. The assumption must be made, in using this dating method, that at the time the rock was formed, any initial $Argon^{40}$ gas which would come from the atmosphere was entirely driven off. Thus, any $Argon^{40}$ found in the rock presently must be assumed to be a result of potassium decay since the rock was crystallized from a molten condition. Richard Armstrong writes of this but also indicates a problem that is raised because of this assumption.

> One of the basic conditions for K-Ar dating is that the mineral phase dated contained no primary Ar^{40} at the time of its origin. This is never strictly true. In the natural environment, particularly at great depths within the crust, excess Ar^{40} is present in whatever fluid phases exist. During remobilization of an ancient metamorphic terrane quite high Ar pressures might develop. No mineral phase ever crystallizes absolutely free of contamination from its environment; this contamination may occur on an atomic scale with foreign atoms being accidentally trapped in the crystal lattice, or as bulk contamination in the form of solid and fluid inclusions. It is only logical to accept that a finite Ar^{40} background must exist for every mineral. The practical question is to what extent this background affects mineral dates.[2]

A practical result of this problem of original Ar^{40} can be very significant in young rocks. G. H. Curtis[3] writes of tufts of the Eifel volcanic districts of Germany that gave an age at least two million years greater than it should be based on ages of tufts below it. This, incidentally, is the kind of material and the dating method used by Dr. Leakey in arriving at dates of the earliest man in Oldevai Gorge in Africa.

David Fisher et al. reports concerning dating of basalt on the sea floor by K-Ar dating, state that, "We have observed large amounts of Ar^{40} in some rocks, leading to anomalously high ages . . " [4] C. S. Noble and J. J. Naughton report that some lavas which are very young, probably less than 200 years old, showed ages as high as 21×10^6 years when dated by potassium argon. He adds:

> . . . in some instances volcanic rocks erupted into the deep ocean, do in fact inherit radiogenic argon and helium, and when dated may yield unrealistic old ages.[5]

Tektites and Potassium-Argon Dating

Another problem that can be offered is related to the dating of tektites. In many places in the world small pieces of glass shaped like buttons have been found. These are called tektites. Scientists have been quite intrigued by these tektites, wondering if they are of moon or of meteorite origin, or if they are indeed of this planet. They are found especially in four rather large strewn fields at several locations on the earth. The largest strewn fields are in Australia where tektites are found over almost the entire continent. These Australian tektites are called australites.

Scientists have become thoroughly acquainted with tektites: their shape, chemical composition, extent of appearance in a strewn field, and other factors. They discovered that they do have a potassium content as well as an $Argon^{40}$ content. Because of their chemical nature and non-granular structure, there is every appearance that they were formed at high temperature and were extremely resistive to contamination. They are, therefore, apparently ideally suited to dating by the K-Ar method. Indeed, the tektites of most of the fields appear to show an age by the K-Ar method which is in reasonable agreement with the geological strata in which they were found. Thus, the tektites found in Texas, which is another of the strewn fields, show a K-Ar age of about 35 million years, and are found in strata that has been dated by other methods to be 35 to 55 million years of age.

The problem is raised with the tektites of Australia, the australites. These date quite uniformly over the entire continent of Australia at about 700,000 years. Unfortunately, however, they are found in strata that is recent. Baker concludes they were emplaced not over 6000 years ago and not under 3000 years ago.[6] Moreover, some of their physical characteristics also indicate recent emplacement. No scientist to the present time has suggested a rationale for an older strata than some 5000 years.

Here then is a major problem. Tektites are quite common; so many tests on them can be made. All signs indicate high formation temperatures and, therefore, probably good accuracy when this method of dating is used. But the emplacement conditions indicate they were formed about 5,000 years ago. If the $Argon^{40}$ found in them was that which remained at formation it would then cast suspicion on the dates of all tektites in view of the similarities that exist between all tektites, and if the dating of tektites by K-Ar is invalid, then all dating by K-Ar is suspect. This in turn would cast doubt on those dating methods showing concordant dates with K-Ar, and invalidate the present application of these methods.

This problem has been outlined at length to indicate that all is not conclusive as far as dating is concerned. An accountant is as concerned about a few cents in his balances which cannot be reconciled as he is about a large sum of money. The few cents of error could be an indication of offsets of several thousand dollars. So the individual problems in radioactive time measurements could be an indication of presently unknown information that could lead to an altogether different conclusion regarding these dating methods.

Cosmic Rays And Isotopes

> Robert L. Whitlaw raises another serious problem in relationship to K-Ar dating. He points out that atmospheric argon today is 99.6% Ar^{40}, 0.337% Ar^{36}, and 0.063% Ar^{38}, all the isotopes being stable. He continues that the assumption is made that:
>
> If the . . . argon taken in a rock sample contained an infusion of atmospheric argon, it would show up by the presence of $Argon^{36}$, since the argon that decayed from potassium in the specimen would be pure Ar^{40} . . . . This being so, it becomes a simple matter to measure the quantity of Ar^{36} in the specimen, multiply it by 295.6 (i.e. the Ar^{40}/Ar^{36} ratio in the air) to determine the amount of Ar^{40} that came in from the atmosphere and finally to subtract this amount from the total Ar^{40} found.

The remainder would be the Ar^{40} formed from potassium alone. He goes on to suggest that this line of reasoning will work only if the ratio of Ar^{36} to Ar^{40} in the atmosphere has remained constant over the eons of time. Whereas there is no data to support this constant ratio, there is an indication that Ar^{36} is produced by the action of cosmic rays, thus indicating an increase in atmosphere Ar^{36} with time. He states:

> It can be shown that Ar^{36} is a probable product of cosmic radiation bombarding the earth's outer atmosphere, just as is radiocarbon.

> Several nuclear reaction sequences leading to Ar^{36} in the presence of free energetic neutrons and photons can be shown.[7]

His suggestion that Ar^{36} is a product of cosmic ray flux is reinforced by statements by other scientists. J. R. Arnold and M. Honda write:

> The meteorites are targets containing a record of the cosmic-ray bombardment to which they have been subjected.[8]

E. Vilisek and H. Wanke report Ar^{36} is produced by cosmic rays. They indicate:

> The cosmic ray exposure age of a meteorite can be calculated if one knows the concentration of a stable cosmic-ray produced isotope as well as the decay rate of a corresponding radioactive isotope at the time of the meteorite's fall. Such favorable pairs are H^3, Na^{22}/ Cl^{36}/Ar^{36}, Ar^{39}/Ar^{36}, K^{40}/K^{41}, and others.[9]

P. R. Goel and T. P. Kohman add their comments to the idea of $Argon^{36}$ being produced by cosmic rays.

> The reaction products of cosmic-ray interactions in meteoroids include both stable and radioactive nuclides. The concentration of a stable cosmogonic nuclide, which accumulates during the whole exposure, represents the total dosage that the specimen has received. Wanke has shown that in large iron meteorites, significantly different values of the Ar^{36}/Cl^{36} cosmic-ray exposures age are found among different specimens of a given fall, the difference being mainly due to the widely different Ar^{36} contents. This shows that different portions of the meteoroid have been exposed to cosmic radiation for different durations of time.[10]

This problem of the origin of isotopes by the action of cosmic rays is a very serious one if these isotopes are to be used for dating purposes. We shall presently see substantial evidence suggesting that cosmic ray activity began only 13,000 years ago. This would then throw into complete disarray any dating method that utilized cosmic ray-produced isotopes as the potassium-argon method does and which assumes that cosmic activity had continued for millions of years.

There is one radioactive isotope, however, that is in a class by itself. This is by virtue of the fact it has a half life of only 5730 years and because it is found not only in inorganic materials but also in organic materials. The short half life makes possible the dating of materials in historical time where many checks can be made by completely independent dating methods of known accuracy. Moreover, the dating of organic materials permits the dating of a wide range of specimens such as wood and bones, as well as inorganic rock. This is known as radiocarbon dating. We shall now examine this in great detail.

Earth's Radiocarbon Timepiece

Within the last two decades, scientists have discovered this fascinating and apparently reliable tool for the dating of organisms which have died within the last several millenniums. Natural carbon occurs in several isotopes, the most plentiful of which is carbon 12. It is found especially as the carbon in carbon dioxide of the air which we breath and as the dissolved carbonates in ocean water, as well as the carbon in the fossil fuels and sedimentary rock carbonates. While C12 is stable, the carbon isotope C14 disintegrates into C12 with a half life of 5730 years Wherever C12 is found in living organisms, C14 atoms can be found with it in the approximate same proportion as it occurs worldwide, dissolved in the ocean, in living organisms, in the biosphere and in CO^3 of the atmosphere. This ratio is known as the specific radio activity of carbon which we will designate as "I." When a living organism such as a tree, a shell fish, or an animal dies it ceases to be a part of the exchange reservoir of carbon. No longer does its "I" value conform to that of the rest of the world. From the moment of death the C14 atoms begin to disintegrate at a constant rate so that 5730 years later only one half of the C14 atoms remain and its new "I" value is one half of that at the time of death. Thus, it is possible to measure the "I" value of any specimen that died hundreds or thousands of years earlier and make an accurate estimate of the year of death.

Among a number of assumptions, two very important ones must be made. The first is that the "I" value in the world can be known at the time the specimen died, and secondly, that the specimen itself has not been contaminated subsequent to death.

Since no one living centuries or millenniums ago took measurements, scientists have always assumed that the "I" value has