TREATMENT Lothar Wolff

HOW OLD IS OLD?

Roskam
3-29-70

p. 8

1. Young man of about 30 -- girl's voice over: "Attractive, yes, for a man of his age. He must be over 30."

Middle-aged man making a speech. Older man's voice over: "Still a young fella in politics -- about 50 yrs. old."

Cat stretching on a sofa. Woman's voice: "Ancient, decrepit sofa. We've had it 20 yrs."

Old clay pot. Man's voice: "Not especially old. 900 yrs."

Bristlecone pine. Man's voice: "Now this pine is about ____ thousand years old. That's old. For a pine tree."

Hand holding rock. Man's voice: "This ____stone is _____ million years old. Kind of a youngster."

Series of faces, contrasting ages.

NARRATOR

Young and old. There is a difference--- although it can depend upon your point of view.

2. Animation #1. We begin this sequence with a clock face and/or calender and dissolve through to our first time scale (see "Yardstick of Time", National Geographic, August, 1958, p. 252). The first time scale is a personal, psychological one. Time and age are measured according to our feeling (how long does it take a bond to mature? a lover to climb the stairs?). Ideally, we will convey the subjective nature of this time scale visually and amusingly, so that the Narrator does not have to describe it verbally.

NARRATOR

(Continues, remarking that we have devised clocks and calenders to measure time -- but no mere measurement can decide for us what is significant. There are many time scales. The most immediate is personal and subjective.)

Annimated time scale illustrates the point. We dissolve through to our second animated time scale. The second time scale is collective, social, historic. Probably we can't be as amusing in our second scale which should include instantly identifiable historic events or personalities, moving backwards in time (e.g. Victoria, Napoleon, Cleopatra).

NARRATOR

(A more sophisticated scale is collective, social, historic---and pre-historic, too---)

3. Dissolve out of annimation to Egyptian footage. First shot of the sequence must immediately establish Egypt and antiquity (even if we have to have the Pyramid cliche).

NARRATOR

(Continues saying that when our attention is caught by a broader scale of time, we support scientists to questions that begin grow like some wild weed: "When was that? What happened? What happened before that? And before? And before?"

(NOTE: As we have not yet recieved from Germany the footage of Professor Emery's work in Egypt, this segment is somewhat indefinite as regards picture. My assumption is that the footage will support at minimum the following story. Hopefully, it will give us more.)

Footage of the Emery dig in Egypt. Workman digging out the underground galleries, long lines of men carrying sand in rubber tire buckets, lifting inscribed block out of

gallery, Emery assistant removing and dusting artifact.

NARRATOR

All over the world Archeologists pry into the past --before written history or into times whose history is incomplete. In temples and tombs --and in rubbish heaps-- men have left records of their work under tons of earth and sand and debris. The archeologist digs --dusts --sorts -- sifts --cleans.

Footage of cataloguing --ending on close up of the record book.

NARRATOR

And then he catalogues and compares his findings to determine their age and their significance. How does a scientist know when this statue or that pot or some other temple was made? These items bear no date. How can they be placed in time --before history? There are two great methods of determining the age of an object. One of them is called relative dating. It's origens are commonplace.

4. Relative dating sequence.

No sinc sound in this sequence. We do not see the actors' faces when they are talking.

Open on a photograph album as similar as possible to the Egyption catalogue.

Pull back to reveal two women at a kitchen table---one older, one younger.

WOMAN'S VOICE

Jack when he was 14 --

CU picture of boy in album.

WOMAN'S VOICE

Or was he 13?

Woman's face -- puzzled.

Old man and young man walking in a cornfield.

MAN'S VOICE

Drought was in '36. Then we had a hard winter right before -- or right after. It's hard to recollect.

CU old man, scratching his head under his hat.

Old man and young man walking and talking.

NARRATOR

Relative dating -- the position of an event in relation to other events.

CU picture of boy in photo album.

WOMAN'S VOICE

13. He has to be 13 here because he got that suit for his 13th birthday and then he spilled paint on it late that summer.

CU Woman's face. She looks pleased with herself.

Old man slapping the younger on the back.

MAN'S VOICE

The drought came first! Had to. 'Cause we were short of grain that hard winter.

NARRATOR

Relative dating.

Visual transition --earth to earth, fence post to old beam, fieldstone to tomb block, or whatever.

5. Emery excavation in Ebypt.

NARRATOR

In Egypt, Professor Walter Emery has been digging in the sands for more than 30 years. He uncovers the lost past, dates it and fills in our knowledge of civilizations before us. In the past half dozen years he has uncovered nearly 5000 artifacts --statues, pottery, mummies, tablets. As he moves down in the earth he encounters layers of history, as though they were arranged in chapters ---a Christian graveyard covering the ruins of a Pharoh's temple. Layers of Roman influence, Greek, Arabic. All these discoveries are incidental to Professor Emery's main purpose, which is to discover the tomb of a great physician and inventor and advisor to the Pharohs who lived ____ years before Christ, Imhoter.

NARRATOR (CONTINUED)

The techniques of relative dating have served archeology well, but they impose severe limitations. A scientist maight say "This event, B, came before event C and after event A---and still not be able to place a positive date on it. Early in this century a technique was developed which allows scientists to give absolute dates to events before history.

6.

Dendrochronology sequence. (SEE ATTACHED SCRIPT)

(SEE ATTACHED SCRIPT)

7. Farmer (other than American) looking into a horse's mouth to examine his teeth.

NARRATOR

For generations farmers have known that the truth --at any rate about his age-- lies in the horse's mouth. It is hard for even an articulate horse trader to tell you just what it is about a horse's teeth that tells him it's age. But there is something in the degree and the kind of wear that settles any argument.

7A Early human jawbone and teeth from British Museum and from the Calcutta Museum.

NARRATOR

(Continues describing the importance of teeth and jawbones in tracing back man's family tree.)

7B Still pic sequence -- his tory of man and pre-man (See Early Man in Life "Nature Library', pp. 42-45). Drawings of early men and pre-men move across the screen (go back only as far as Ramapithecus and drop Pananthropus; this leaves 10 figures).

NARRATOR

(Discusses the problem of distinquishing between men-like apes and ape-like men and of determining at what point we should

NARRATOR (CONTINUED)

call "men" the creatures that preceded us.)

7C. Tabun sequence.

NARRATOR

(Tells us that at this site in Israel scientists are exploring caves which were inhabited by men _____ years ago. The information collected from diggings in these caves may help us understand the transition from Neandertal to Modern man. So far almost 4000 artifacts have been recovered---most of them stone chipped into tools. Concludes sequence telling us that the history of man---or rather, his pre-history---and of the world has been extended so radically in recent years that scientists themselves are startled at our antiquity.)

8. Very young children at play. This is a non-sinc sequence. (Sound recording of children's conversation may be laid over footage of playing children.) They children are discussing the age of the world, the sun, the moon, their fathers, God.

NARRATOR

(Remarks that the urge to search the past and to know the age of the world seems to be a universal human phenonomon. But however intriqued man may have been by thoughts of beginings, he has until recently been helpless as a child to explore his way backwards.

8A. Calenders -- Aztec, Christian, Jewish, Chinese, etc.

NARRATOR

(Tells us that most civilizations have created calenders and "histories" to explain the begining of man and of his world.)

8B. ANIMATION #3. Another time-scale, similar to that in sequence 2---a biological time-scale from modern man down to walking fish.

NARRATOR

(Remarks that nearly all time-scales, or modes of thinking about the passage of time, are man-centered, or at least biological or evolutionary. If we think of time before man, we tend to think of time leading to man.)

Dissolve to another time scale -- this one is geologic. For Formation of the earth, the continents, the oceans, the mountains, etc.

NARRATOR

(It was a late development in science to study the formation of the universe and of the earth and of immense periods of time in which man had no place whatsoever.)

9. ANIMATION #4. Stratification. The formation of a of hill with layers of soil deposits and fossils.

NARRATOR

(Describes the development of the science of geology which did not begin until the mid-18th century. Men had long observed the stratification of the earth but had perhaps been inhibited from speculating about the time periods each layer represents because orthodoxy prohibed consideration of such great periods of time. The slow building of the features of the earth required time so greath that the mind of man comprehends it with reluctance.

10. Ice dating sequence. Footage of ice cores being taken from glaciers.

NARRATOR

(Explains that not only mountains have been built up, layer by layer, but so has everything on the crust of the earth. Including the ocean floor. Including also the glaciers. Explains that the ice core is being taken to determine weather conditions

NARRATOR (CONTINUED)

_____ thousand years ago.

Cut to ice-dating laboratory in Hanover, New Hampshire.

NARRATOR

(Describes the ice-dating techniques, something of the data gathered and introduces Carbon 14 dating.)

11. ANIMATION #5. Carbon 14.

NARRATOR

(Describes the cycle of Carbon 14 which begins in the upper atmosphere where the neutrons of Cosmic Rays strike atoms of nitrogen 14 and produce Cargon 14. Carbon 14 mixes with carbon dioxide in the air and is taken up by all living plants and then finds its way into all living animals. All Carbon 14 in living organisms contains a constant porportion of Carbon 14. If any Carbon 14 is taken out of the system---if a branch breaks off a tree, or an animal dies--- no new Carbon 14 is added to that particular system (broken branch or dead animal) but the old Carbon 14 runs out, decaying at a constant rate into nitrogen. At the end of 5800 years, half the Carbon 14 in the remains of the branch or of the animal has decayed away. Thus, by discovering how much Carbon 14 is left in any once-living thing, we can discover how old it is.)

12. Cut to Carbon 14 dating laboratory. A test in progress.

NARRATOR

(Tells us that Carbon 14 dating was one of several atomic clocks which were developed as by-products of work on the atom bomb in the second world war. At first it was thought that the decay rate of Carbon 14 was absolutely constant. Now it has been discovered that the decay rate can be influenced by weather conditions as well as by atom bomb tests. The half-life then of Carbon 14 will vary with the time the object tested died. The new understanding of the complexity of this clock has led to revisions of the age of museum items all over the world.

Cut to dates being changed on museum shelves.

13. Cut to pictures of DArwin and his critics, of Westminster Abbey, etc. as

NARRATOR

(Tells us of some of the great and dangerous controversies about the age of man and the world. Of the exact ---to the hour---date given for the begining of the world by the Archbishop of Canterbury. Of the inability even of scientists to accept the implications of Darwin's theory of evolution which required longer periods of time than had ever before been imagined. Today the age of the world--and of man in it---is constantly growing older. Scientists are surprised and even wary of accepting the immensity of time that stretches out behind us.)

14. A very old man playing with an infant.

NARRATOR

How old is old? is no longer a threatening or controversial question. We are intriqued by the length of the past, but not worried about it. Worry about the effects of time is now reserved for the future.

4-6-70

HOW OLD IS OLD?

Revised dendrochronology sequence. (incorporating Dr. Bannister suggestions of March 20th)

Screenplay and rough narration.

Animation sequences with fine narration.

Beth
Ralph

6. [Setting. Shoot in vicinity of Flagstaff, Arizona. No modern devices seen (automobiles, chainsaws, etc.) in order to preserve turn of the century atmosphere. Laboratory of Tree-Ring Research has old photos of early 20th Century Flagstaff - town, forest views, Douglass on old buckboard, etc. In particular, an excellent 1902 picture of Douglass in field dress.]

Ponderosa pine forest in Flagstaff region. Long shot of pine covered flanks of San Francisco peaks dropping slowly down to tops of nearby pines then down to ground level. Beyond the foreground pines we can see, but not clearly, a horse and wagon moving on a forest road. Pan with this wagon and intercut scene with old stills of Douglass and area along with modern lumbering activity: an axe biting into the trunk of a pine, an old cross-cut saw cutting through a tree, a tree falling, a stump freshly exposed.

Cut to hands laying a large sheet of paper on the newly cut stump, and then making a graphite rubbing of the complete cross section in order to record the ring patterns. Hands, still unidentified, lift completed drawing and hold for straight on shot.

NARRATOR

At the turn of the century, lumberjacks in the Southwestern United States were probably amused at the antics of an astronomy professor who followed them through the woods to study the stumps of the pine trees they cut. The scientist was Andress Ellicott Douglass, who was examining the annual rings in freshly cut trees. He hoped to establish a relationship between the cycles of sun spots and weather conditions on earth..That didn't work out. But on his way to that failure he created an important new science --dendrochronology, which enables us to reconstruct the climate of the past and to fix dates on pre-historic events.

6A ANIMATION #2

As shot of rubbing fades out (it probably won't show much detail anyhow), superimposed animation section of same diameter as rubbing comes on. Section is complete, showing bark and clearly defined annual rings of variable thicknesses going back to pith. On another part of the screen we see a pine tree in shimmering sunshine. As Narrator speaks we see a new ring gradually emerge under bark (spring-type music?) --light colored early wood band followed by dark colored late-wood band. Tree is dormant during autumn, winter and early spring --birds fly out of the trees, snow falls (winter music?) Repeat one more growing season.

NARRATOR

Pine trees normally gain one new layer of wood each year of their lives. The new wood is added --during each growing season -- just under the bark. To tell the age of a tree --as every boy knows --you simply count its growth rings.

Cut to two D-shaped half-sections arranged withthe flat side of the "D's" facing each other.* A few lines, with year dates marked, connect the two upper halves of the half-sections at various crossdated diagnostic rings. The half-section on the right has a longer ring series than the other, and behind it is a drawing of a mature pine tree --heavy, drooping branches, massive trunk, truncated crown with spike top, etc. Background of the younger half-section is a smaller, but more vigorous looking tree. Seasonal mood music continues accompanied by other sound and visual effects --rain and snow, wind, changes in sun intensity, birds twittering, etc. New rings continue to form under the bark on each of the half-sections, but this time the two trees simultaneously add a thin ring during the late spring and summer after the autumn, winter, and spring months have shown little rain and snow (continue weak sunshine throughout the winter, however), or they synchronously add a thick ring when the autumn, winter, and spring have lots of precipitation. Repeat cycle several times during narration with new date line occasionally popping on newly added years.

NARRATOR

> In many arid regions the width of each year's ring is partly dependent on weather conditions. In a favorable year the tree will add a wide ring. But if the year has been hot and dry, for example, all the trees in the area will put down a narrow ring. Over a period of years, a sequence of wide and narrow rings will be developed which is common to all the trees.

* See Bannister drawing.

NARRATOR (Cont'd.)

When the ring pattern of one tree precisely matches the pattern of another, the two trees are said to crossdate with each other --even though they may have grown several hundred miles apart.

Half-section on right stops adding new rings while the tree in the background appears to die. Color of background tree changes from green to gray, branches droop and a few fall off, leaving, finally, a silhouetted, stark, lifeless pine tree. Bark of dead half-section deteriorates. Younger tree keeps adding new rings with an occasional year date indicated. Calendar year of last ring (1961, for example) of dead section pops on at end of following narration.

NARRATOR

Because we know the date of the last ring of a living tree, we can crossdate it with a dead tree and determine the exact year the dead tree died.

*Log section, screen left, moves up and off with year date lines connected to right hand side stretching out accordingly. New half-section moves up into screen left. New half-section has old appearance --cracks, little bark, etc. --and on the screen with it is an old log cabin pioneer house. A new year date line (1857) pops on extending from outside ring on top half of log cabin beam to middle of ring series in lower half of dead tree half-section. Now entire scene moves up and off. Another half-section moves up from bottom on right

*See Bannister drawing.

hand side. This time it's a half-section of a squared timber with a Spanish mission nearby. Year date line connecting inside growth of log cabin beam with outer ring of Spanish mission timber is 1672. Scene moves up and off as another half-section moves up screen left. We see the following sequence: a living tree, a living tree which dies on screen, a log cabin beam, a Spanish mission squared timber, a half-sectionfrom an Indian pueblo such as Oraibi (ca. 1560), ~~a [illegible]~~ a timber from a prehistoric cliff dwelling (1290); and finally a charcoal fragment from a campfire in 798. Year lines with successively older dates appear as sequence progresses back in time.

NARRATOR

> Through cross-dating dendrochronologists can discover, for example, when a log cabin was built, or a Spanish mission --when an Indian pueblo was repaired or a prehistoric cliff dwelling was constructed. Tens of thousands of overlapping tree ring specimens from both trees and ruins in the American Southwest have enabled dendrochronoligsts to build a master tree-ring chronology extending from the present to _____ years before Christ.

(END ANIMATION #2)

6B. [Archaeological Dating. Field and collection shots at Kiet Siel Ruin, Navajo National Monument, Arizona. Procedure shots in Laboratory of Tree-Ring Research. Kiet Siel development scene in animation.]

Dissolve to long shot of Kiet Siel Ruin taken from helicopter or from across the canyon. Move in for medium distance shots followed by closeups from within the ruin with emphasis on protruding vigas.

NARRATOR

Here is one example of the ability of dendrochronologists to reconstruct the prehistoric past on the evidence of tree rings. This deserted ruin -- Kiet Siel --was once a thriving village of 150 early Indians, forbearers of the Pueblo Indians of today.

Enter intrepid scientists, Dean and Bannister, carrying coring equipment and notebook. One starts to extract a core (use exposed primary beams of Room 15) while other takes notes. Closeup of core taking process accompanied by sound of drill. Closeup of stone-axe cut beam end.

NARRATOR

Dendrochronologists from the University of Arizona extract cores from the ancient roofing timbers.

Cut to Tree-Ring Laboratory sequence. Kiet Siel cores on table being catalogued. Cores being surfaced for study. Cores being studied under microscope. Closeup of sanded core with slow scanning of tree-ring sequence. Cores being measured on Henson measuring machine. Keypunch machine, verifier, CDC-6400 with printout, Calcomp plotter spewing out plotted chronology. Closeup of dissecting needle pointing to outside ring on core held in hand.

NARRATOR

In the laboratory each tree ring sample is carefully examined. The width of every ring is measured and recorded. The patterns of rings are compared and crossdated withthe master tree-ring chronology of the region. These techniques reveal that this sample was taken from a tree felled in 1275 --not 1274 or 1276, but early in the summer of 1275 A.D.

6C. ANIMATION #2A

Cut to animation scene showing view of Kiet Siel based on Dean's reconstruction of 1271. (See U.S. Dean "Chronological Analysis of Tsegi Phase Sites in N.E. Arizona." Figs, 24, 35, 36, 37.) Cliff dwelling seems to grow in complexity as new rooms are added through 1275, 1282, and finally as it appeared at completion in 1286. Throughout the sequence, we are looking down at the ruin from a point in space slightly above and a few hundred hards in front.

NARRATOR

The logs of Kiet Siel tell dendrochronologists much more than simply the date it was built. The beginning, the development, the death of the community are written in the dates of its timber remains. In 1271 --a few family units are scattered about the floor of the protecting sandstone cave. 1275 --an influx of migrants; new rooms are added for living, for storage, and for religious rituals. For several years the population is constant --a few newlyweds add rooms for their expected families. 1283 --more outsiders arrive and building space is limited. Old rooms are remodeled. After 1286 there is no new construction. Nearby farming fields are drying up. Families begin to leave --searching for a better future in lands to the south.

(END ANIMATION #2A)

Dissolve back to shots of Kiet Siel. Slow pans of empty "streets", fallen roofs, and deserted rooms.

NARRATOR

Undoubtedly the village continued to live --for a while --but as the water table lowered and fields of corn and beans could not survive, neither could people. Kiet Siel was probably completely abandoned by 1300 A.D.

Film of forests --first ponderosa pine, then sequoias, and finally bristlecone pine. Intercut with shots of scientists working in the field (coring trees, taking samples of stumps, carefully collecting charcoal) and in the laboratory (sanding and preparing samples, making charts, studying bristlecone pine under a microscope).

NARRATOR

Dendrochronology --from its very beginning -- has produced absolute dates for items that are hundreds of years old. The older the trees from which its master chronologies are built, the further back in time dendrochronology can probe. It began with ponderosa pines, moved on to the much older redwoods and then, with the discovery of these ancient trees --bristlecone pines in the White Mountains of the American southwest -- dendrochronology jumped back in time by thousands of years. Bristlecone pines are the oldest living things on earth. They are not large trees. In the adverse conditions in which they survive, the rings of growth they add each year may be paper thin. Too small to be counted without the aid of a microscope. But with the help of these long enduring trees, dendrochronologists can now provide exact dates for wood more than 7,000 years old.

HOW OLD IS OLD?

Anthropology sequence
Screenplay and Rough Narration

7. Farmer (preferably not North American --Mexican or Middle-Eastern, perhaps) looking into a horse's mouth. Let us get into the horse's mouth, too, with close shots and extremely close shots.

NARRATOR

Farmers have always known that the truth --about his age, at any rate --lies in the horse's mouth. Horse traders find it hard to explain just what it is about a horse's teeth that give away its age --but something in the degree and the kind of wear betray without fail the years the horse has lived.

7A. Extreme close-up of ancient jaws and teeth (from Time-Life Book --avoid, however, pictures with hands in them).

NARRATOR

Human teeth are perhaps the most important clues to the age of man. Being the hardest substance in the body, they last the longest. There are more of them than there are bones in the fossil collections of the world.

7B. Sequence of pre-men taken from Time-Life book pictures, pages 62-69.

NARRATOR

Man and the ancestors of man have left few remains as fossils. For one thing men have never been as numerous as oysters and clams. They lived in small groups, reproduced slowly, lived a long time --usually out in the open where their bones were picked by scavengers, nibbled by ants, bleached and decomposed by the rain and the sun.

Until the 18th Century few men were curious about the age of life or questioned the tradition that the creation was begun on the morning of (month and day) of 4004 B.C.

But once the idea of man's evolutionary development is accepted, his origins can, theoretically, be traced back to the origin of life itself -- some 2 billion years ago.

Primate tree -- p. 42-45 in Early Man.

NARRATOR

Apes, near-apes, and ape-like men comprise a primate tree that is nothing as straight as an oak. It is more like a luxuriant jungle vine with many shoots and tendrils growing side by side -- sometimes withering, sometimes dying. Homo-erectus, Homo Sapien, Solo man, Rhodesian man, Neanderthal and Modern Man.

7C. Tabun footage.

NARRATOR

On the Western slope of Mt. Carmal in Israel scientists from the Universities of Arizona and Michigan dig in a cave abandoned by Neanderthal man some 35,000 years ago.

NARRATOR (cont'd.)

The director of the project, anthropologist Arthur Jelinek, heads a team studying the transition from Neanderthal to modern man.

About a hundred thousand years ago a group of Neanderthals made their home here. A convenient, natural hole in the roof of the cave allowed the smoke from their fires to escape. Then, in a process of erosion the hole expanded and grew larger and larger until the cave was no longer a comfortable shelter. The Neanderthal families moved out --but they continued using the cave, now as a trap for game. Antelope, for example, were driven along the cliffs until they fell through the old cave chimney. Broken and dead, or dying at the bottom of the cave, they were butchered there.

This story, and much more is coaxed from the layers of debris one square meter at a time only 2 or 3 centimeters deep.

Each pail of material is marked and separated from all others until it is carried to the open air laboratory --washed and sorted.

These are bones of small animals, killed and eaten by owls and dropped to the floor of the cave.

A volejaw.

A good-sized snake.

A medium sized bird.

An ordinary mouse.

Another volejaw.

NARRATOR (cont'd.)

It may take ten years to complete the analysis of the data gathered in this expedition.

This open spot was once --at a very early time --a part of the cave. Spraying, trowling and brushing bring out color differences in the sandy layers and help to draw a more accurate profile of the sequence of life once lived here. By these meticulous techniques, the history of man --or his pre-history --has been so radically extended that scientists themselves are startled at our antiquity.

HOW OLD IS OLD?
Narration
2nd revise 8/31/70
Roskam

TEASE:

GIRL: (OSV)

Young man on sailboat — Why is such an old man wearing a beard?

OLD MAN: (OSV)

Politicians and admirers — He's still a pretty young fella -- in politics.

MIDDLE-AGED WOMAN: (OSV)

American Indian statue — This beautiful speciman is in excellent condition for its age -- over a hundred years.

MAN: (OSV)

Bristlecone pines — It may not look it, but this pine tree is still living -- after 4,000 years.

YOUNG MAN: (OSV)

Old Jar — This clay jar is getting along -- about 5000 years.

Grand Canyon

WOMAN: (OSV)

The formation of the Grand Canyon, as we know it today, has taken about 2 billion years.

Pull back of NASA still: view of earth

MAN: (OSV)

The more we learn about the earth, the older it gets, Now we'd say about 4 1/2 billion years.

NARRATOR:

Young and old. There is a difference. But it depends upon your point of view.

TITLE.

NARRATOR:

Montage of scientific investigators

How old are the works of man?

How old is man?

How old is the world we live in?

How old is old?

These scientists are each working in different disciplines to unravel the mysteries of age. Man has devised many ways of measuring time and many tools.

Flash back into history (from present to old Egypt)

Most of us measure time first in terms of our own lives -- and then in terms of events and the collective experience of history.

NARRATOR:

Egyptian Archeological Sequence

When we become interested in placing events in time before written history, we employ specialists to explore questions that begin to grow like weeds. When was this temple in Egypt built? By whom? And what happened before that? And before? Archeologists have scoured the world for evidence of the past activities of man. In temples and tombs -- and in rubbish heaps -- men have left clues to their lives, buried now under tons of earth and sand and debris. The archeologist digs -- dusts -- sorts -- sifts -- cleans. And then he catalogues his findings and attempts to place them in a sequence of time -- determining which object belongs to which dynasty.

These painted stones, for example, came from the temple of King Akhinaton which was destroyed and then used to provide filler for new pylons in honor of the god, Amun, in about 1400 BC.

Egyptian Archeological Sequence (cont'd)

Near the great step pyramid of Sakkara, Professor Walter Emery of the University of London is searching for the tomb of an Egyptian genius, Imhotep, physician, inventor and advisor to Pharohs. Imhotep -- who lived somewhere near here -- was deified by the Egyptians more than 2000 years before Christ. Dr. Emery has been digging in this rubble for more than 30 years, uncovering the past and placing it in a sequence of time. In the last few years he has uncovered nearly 5000 artifacts -- statues, pottery, tablets, mummies.

As he moves down in the earth he uncovers history in layers. Here, Egyptians of the 26th Dynasty placed mummified baboons as offerings to their god Imhotep.

Until recently archeologists have had no way to determine exact dates of any of their findings before the beginnings of written history. They had to rely on a method of relative dating -- saying, for example, this object "B" belongs to a period before this object from "C" but after this object from the time of "A".

Relative dating has served archeologists well for over a hundred years.

But with the advent of nuclear physics, a new world opened in the measurement of time -- a world of precision that scientists had had no reason even to hope for.

Thermoluminesence

University of Pennsylvania

Museum

These clay jars are about to be dated by a nuclear clock in a process called thermoluminesence. Any object that has ever been fired can be tested by this process.

Dr. John Winter grinds a jar fragment to powder in order to fire it again after thousands of years.

Clay and other natural materials absorb ~~rays from the sun~~, the soil, the environment. Some of this energy is stored. When the material is heated, the stored energy is released as light.

The amount of light discharged by the old clay will reveal the dosage of energy it has collected, and consequently its age. The more the energy collected, the older the pot.

Thermoluminesence can date clay that was fired 7000 years before Christ.

Some 70 years before the development of thermoluminesence, the first method of placing exact dates on pre-historic objects - - -

Dendrochronology

Sequences

- - - was developed in the woods of the American southwest. Lumberjacks, at the turn of the century, were probably curious at the sight of a young astronomer who rode a buckboard wagon over the rough roads to take a close look at their work. The scientist, Andrew Ellicott Douglass, was investigating a possible relationship between cycles of sun-spots and weather conditions on earth.

Dendrochronology (cont'd)

In the course of his investigations, Douglass created an important new science -- dendrochronology, or tree-ring dating -- which now enables scientists to place exact dates on events before recorded history.

Douglass studied the stumps of freshly cut Ponderosa Pine trees. With pencil rubbings of stumps, he made records of the annual growth rings of individual trees.

In a laboratory under the football stadium of the University of Arizona in Tucson, Douglass' methods are still followed. Although, in this center of dendrochronology research, especially designed modern equipment eases the painstaking job of counting and measuring thousands of tree rings, one by one.

Douglass' discovery was essentially simple. Pine trees normally gain one new layer of wood each year. The new wood is added, in the growing season, just under the bark. To tell the age of a tree, you count its growth rings. In many dry climates the width of each ring is partly dependent on weather conditions. In a good year for growth the tree will usually add a wide ring. But if the growing season has been, for example, hot and dry, the tree will add a narrow ring. Over a period of years, all the trees of a region will develop a sequence of rings -- thick and thin --

Dendrochronology (cont'd)

which is common to every one of them. When the ring pattern of one tree precisely matches the pattern of another, the two trees are said to cross-date with each other -- even though they may have grown several hundred miles apart. Because we know the date of the last ring of a living tree, we can cross date it with a dead tree -- in the form of an old timber, or a piece of furniture -- and determine the exact year the dead tree died. In this case -- not 1274 or 1276, but following the growing season of 1275.

This precisely dated old wood can -- in some cases -- provide a record more exact than written history.

Kiet Siel

Under this overhanging cliff, a large cave shelters the ruins of Kiet Siel -- once a thriving village of early American Indians. Dr. Bryant Bannister and Dr. Jeffrey S. Dean, from the Laboratory of Tree Ring Research at the University of Arizona, extract cores from the ancient building timbers. These samples, which they will carefully analyze and cross-date, provide the clues to Kiet Siel's lost past.

The beginning, the development, the death of this village are written in the dates of its timber remains. In 1271 -- a few family units are scattered about the floor of the protecting sandstone cave. 1275 -- an influx of migrants; new rooms are added for living, for storage, and

Kiet Siel (cont'd)

for religious rituals. For several years the population is constant -- a few newlyweds add rooms for their expected families. 1283 -- more outsiders arrive and building space is limited. Old rooms are remodeled. After 1286 there is no new construction. Families begin to leave -- searching for a better future in lands to the south.

Undoubtedly the village continued to live -- for a while -- but as the water table lowered and fields of corn and beans could not survive, neither could people. Kiet Siel was probably completely abandoned by 1300 A.D.

Tens of thousands of overlapping tree ring samples allowed dendrochronologists to specify the building date -- and the time of repair -- of each building in this ancient village.

The same cross-dated master chronology of tree-ring samples describes weather conditions in the southwest area from the present to 59 years before Christ.

Bristlecone Pine Forest

A much longer chronology comes from samples of a much older tree -- the Bristlecone Pine in the White Mountains of California. Bristlecone Pines are the oldest living things on earth. They are not large trees. In the dry climate in which they survive, the rings of growth they add each year may be paper thin -- too thin to be counted by the naked eye. With these long enduring

Bristlecone Pine Forest (cont'd)

trees scientists can provide exact dates for wood up to 7,500 years old.

Carbon 14 lab at Museum,
University of Pennsylvania

Dendrochronology is a simple technique of dating and easily understood compared with such sophisticated clocks as Carbon 14. Curiously, it is the uncomplicated tree-ring counting that helps keep the complex nuclear clocks running on time.

These chips of Bristlecone Pine are being tested, not to determine their age -- which is known -- but to test the accuracy of the Carbon 14 technique. The chips are being burned to form carbon dioxide -- the first step of a process which will reveal how much Carbon 14 there is in the wood.

Still pictures of dead objects

Carbon 14 exists in all living things -- and all things, now dead, which have ever been alive. Carbon 14 is produced in the upper atmosphere through the action of cosmic rays. It mixes with carbon dioxide in the air. It is evenly spread through the atmosphere of the world. Carbon 14 is taken in by all living plants. It finds its way into all living animals. As long as an organism is alive it contains a ~~constant~~ measure of Carbon 14. But when anything living dies, no more new Carbon 14 is taken into its system. The Carbon 14 it contains begins to run out -- to decay. The decay of Carbon 14 continues at a constant rate. In a little more than 5000 years,

an equilibrium amount

consistent amt.

constant again

Laboratory (cont'd)

half the Carbon 14 is gone. In another period of about 5000 years another half has decayed. By measuring what remains, scientists can date objects that once lived thousands of years ago --- this technique has become science's most important tool for placing real dates on objects from the past.

Almonds taken from an ancient shipwreck off the coast of Cyprus.

Egyptian reeds, taken from the tomb of Tjanefer at the time of Ramses III.

Bristlecone pines . . . .

Carbon 14 lab (cont'd)

After this sample of bristlecone pine has been burned and turned into carbon dioxide, the dating process becomes largely invisible. The gas is purified. At the end of this first step it will be stored in a bottle for a month or so so that other radioactive elements in it will have time to decay.

Dr. Elizabeth Ralph, of the University of Pennsylvania, is engaged in studies for the refinement of the Carbon 14 method. It was once thought that Carbon 14 was everywhere and at all times evenly spread throughout the world. Now it is know that nuclear explosions and periods of great climate change -- such as the ice age -- can affect the amount of Carbon 14 in the air. The amount of Carbon 14 carried in the gases flowing through this system will be counted electronically. After a physicist has accounted for the corrections established by Dr. Ralph, he will be able by this method to date -- within a few hundred years -- objects up to 50,000 years old. In the few years of its existence, the Carbon 14 technique has revolutionized archeological and geological dating.

Horse's Mouth

In pre-revolutionary times -- and perhaps even in pre-historic times -- horse traders told the age of a horse by the condition of its teeth. It is hard for horse traders to tell you why the

Horse's Mouth (cont'd)

truth lies in the horse's mouth, but something about the degree and the kind of wear of his teeth invariably tells how long the horse has lived.

Still of ancient human jawbone with teeth

Human teeth perhaps provide the most important clues to the age of man. They are the hardest substance in the body. They last the longest. There are more of them than there are bones in the fossil collections of the world.

Primate tree
(art work from Early Man)

The ancestors of man have left few remains. For one thing they were never as numerous as oysters and clams. They lived in small groups. They reproduced slowly. They lived a long time -- usually out in the open where their bones were picked by scavengers and decomposed by the rain. The primate family tree of apes, near-apes and ape-like men stretches across 25 million years -- Homo Erectus, Solo man, Rhodesian man, Neanderthal man.

Tabun Israel sequence

Through Carbon 14 dating of soil samples, scientists have learned that Neanderthal man abandoned this cave some 35,000 years ago.

The cave lies in Israel on the Western slope of Mt. Carmel. It is being studied now for evidence of the transitional period from Neanderthal to modern man.

Anthropologist Arthur Jelinek heads this team of scientists from the Universities of Arizona

Tabun Israel sequence (cont'd)

and Michigan.

About a hundred thousand years ago a group of Neanderthals made their home here. A convenient, natural hole in the roof of the cave allowed the smoke from their fires to escape. Then, in a process of erosion the hole expanded and grew larger and larger until the cave was no longer a comfortable shelter. The Neanderthal families moved out.

Anthropological investigations reveal that the Neanderthal men continued using the cave as a trap for game, such as antelope. They drove the animals along the cliffs until they fell through the old cave chimney. The animals were butchered at the bottom of the cave where they fell.

The story of Neanderthal man's life here is coaxed from layers of debris, one square meter at a time -- for a depth of only 2 or 3 centimeters.

Each pail of material from a particular square meter of the cave floor is separated from all others. It is marked and carried to an open air laboratory. Dirt from each segment of the cave floor is washed and sorted in a search for old tool fragments and pieces of bone. These items will be tested by Carbon 14 and other nuclear clocks in laboratories around the world -- or their age will be determined by the previously dated geological beds in which they were found.

Tabun Israel sequence (cont'd)

It may take ten years to complete the analysis of all the data gathered in this expedition.

Dr. Jelinek examines the bones of small animals, which were killed and eaten by owls who dropped the bones to the floor.

A volefaw.

A snake.

A bird.

A mouse.

Artwork -- biological time scale

If we think about time before man, we tend to think of time as leading to man. Once the idea of evolution was accepted, it became theoretically possible to trace the origin of life itself -- over 2 billion years.

ANIMATION - geological time scale

But even evolutionary time is brief compared with geologic time -- the time it has taken to form the earth as we know it now. If we had stood in space and taken a peak at the earth every hundred million years or so, we would have seen continents forming and disappearing. Mountain ranges rising -- and worn down by the elements.

The apparent permanence of earth melts into the instability of constant change when viewed in terms of geologic time.

Grand Canyon I

We have long considered history to be the written record of human events. But non-human events have also left their record -- in a language clear to the interested reader.

Layer upon layer of earth and rock and minerals -- each strata filled with the fossils of once-living things -- reveal the history of the earth in discrete chapters. Until the advent of nuclear clocks, scientists understood only the relative date of each strata --- that these layers were built in a certain sequence, but as to when, scientists might guess, and be off by millions of years. Now, everything on the crust of the earth is subject to exact dating.

Antarctica - ice coring

. . . Even the deep mantles of ice that cover the north and south poles of the world. At the U.S. Byrd station in Antarctica, a giant ice-coring machine bores deeply into the glaciers. This machine was designed to carve out and extract cylinders of ice at any depth. It has pulled cores from the bedrock beneath at 7,000 feet. The deeper the level from which the core is removed, the older the ice, and the more the history it reveals. The snow that formed the ice in this core fell at about the time our ancestors emerged from the caves. The dust in the ice caps can be tested by nuclear clocks. The nuclear tests of this ice reveal to glaciologists changes in

Ice coring (cont'd)

climate and the world atmosphere over more than a hundred thousand years.

Ocean coring

A much greater span of time is investigated by Glomar Challenger, a vessel which looks no more imposing than a floating oil rig. In fact the Challenger is designed to carry out the most intensive studies of the ocean floor. Samples of sediment on the floor of the ocean are drawn from a depth of 3,000 feet -- from a floor beginning 25,000 feet of salt water beneath the ship's hull.

The core -- wrapped in a plastic case -- is cut into sections for easier handling. In this ooze are compressed millions of years of the earth's history.

Lamont Labs

Sections of the sea floor cores are catalogued and stored in geological archives. The color of the sediment is one clue to the conditions which formed it. Dark, coarse sediment is usually found nearer the shore of a continent, where pieces of the mainland are continuously washed into the sea. A thinner sediment -- partly composed of microscopic fossils -- is typical of material further out in the sea.

Fossils mixed in the sediment will be tested by nuclear clocks. Then they will become oceanographers' best clue to the age of the material.

Lamont Labs (cont'd)

Today, oceanographers can place an age of about 200 million years on the ocean basins -- which is not a long time from a geologist's point of view. The oceans are relatively young, one tenth the age of the continents.

Grand Canyon II

The science of geology did not begin to develop until the middle of the 1700's. Before that time scientists may have been inhibited by orthodoxy from thinking in terms of such great periods of time.

An Irish Archbishop, James Ussher, in 1650 studied his Bible and concluded that the earth was created in 4004 B.C.

Another cleric fixed the month -- October -- and the day, the 23rd.

No scientist today would presume to that precision, but now a nuclear clock

Potassium-40

University of Pennsylvania

Potassium Argon Laboratory

called Potassium Argon does enable physicists to date materials as old as the earth itself. Potassium-40, and other radio-active materials were created in the primeval fireball in which the earth itself was formed. The radio-active materials are unstable and gradually, over vast periods of time, they decay. Potassium-40, which is one of the most common elements on earth, slowly, slowly decays into the ~~mineral~~ element Argon. The Argon content of rocks and the Potassium-40 loss are appraised with the aid of electronic equipment

Argon - mineral?

Potassium Argon Lab (cont'd)

by Dr. Henry Faul. From this information he can ascertain the age of many rocks.

Potassium Argon dating is a new tool in an array of techniques that allow us to probe into the very beginning of our world.

View of earth from space - zoom in

The mind of man comprehends the vast history of his own kind and of his world with reluctance.

Most of us measure time in days or seasons and relate it to the scale of our own lives.

ANIMATION - Man from infancy to old age

We think in tens or twenties and measure the passage of time as a road to the height of our own powers -- or of accomplishments past when time is measured in memories.

Old man and boy

How old is old? was once a controversial question. But now we are intrigued with the length of our past -- not worried about it. Worry about the effects of time is reserved for the future.

C14 Lab U of Pa 7/14/70

How Old is Old?

Combustion of bristlecone pine
sample P-1701 from tree section
P-SW-INY-22, 4525 B.C. (6495 B.P.)
[C-14 date shown on calculator = 5895 B.P. (before present)]

Egyptian sample - reeds
Collected from
Dra Abu el-Naga, Thebes
Tomb 158 (Tjanefer)
Pyramid
by Lanny Bell (University Museum)
winter 1970
Sample representative of 20th Dynasty,
1267-1168 B.C.
(not yet dated by C-14)

Almond shells from Kyrenia (Cyprus)
wreck, excavated from sunken ship
by Michael L. Katzev, Research Associate,
University Museum. Almonds were found
in 12 different amphoras.
C-14 date for P-1621 = 238 ± 62 B.C.
with MASC correction factor applied,
this would be about 300 B.C.

4525
1970
6495

TIME
LIFE
FILMS

TIME & LIFE BUILDING
ROCKEFELLER CENTER
NEW YORK 10020
212 - 586-1212

2 September 1970

Dr. Elizabeth K. Ralph
Associate Director
Applied Science Center for Archaeology
The University Museum
University of Pennsylvania
33rd and Spruce Streets
Philadelphia, Pennsylvania 19104

Dear Dr. Ralph:

Enclosed is a copy of the HOW OLD IS OLD? script containing sequences from your laboratory on pages 10, 11, and 12. Would you please check it for accuracy and telephone me collect with any changes or suggestions. Because we are running against a deadline here, I would greatly appreciate it if you could call me just as soon as possible.

Many thanks for your cooperation.

Sincerely,

Mary Batten

Mary Batten
THE WORLD WE LIVE IN

Also
p. 6 ✓
7
10
11
12
18

MB:sf
enc.

Called 9/4/70

TIME
INCORPORATED

TIME & LIFE BUILDING
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NEW YORK 20
JUDSON 6-1212
BOOK DIVISION

August 27, 1973

Dr. Elizabeth Ralph
MASCA
The University Museum
University of Pennsylvania
33rd and Spruce Streets
Philadelphia, Pennsylvania 19104

Dear Dr. Ralph:

We do not expect to see copies of The Monument Builders until early in December, but most of the copy is closed now and we would like to thank you for your wonderfulhhelp with our Carbon-14 problems. We appreciate your interest in the book and you can be sure that a copy will wing its way to you as soon as they are available. In the meantime, I would like you to know that a check for $100 is being processed for you here and it should be reaching you within two weeks.

Many thanks again.

Sincerely,

Peggy Bushong

Peggy Bushong
Chief Researcher
THEEEMERGENCE OF MAN Series