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HISTORICAL RECORD OF A 360 DAY TROPICAL YEAR

by Kenneth C. Herrmann

It has been seriously suggested by some Bible scholars that the earth had a shorter tropical year in the past; a year of exactly 360 days; and that the lunar month was an exact 30 days, rather than the present 29 1/2. This concept, normally familiar only to fundamentalists and Bible scholars, gained worldwide attention in the 1950s with the publication of Immanuel Velikovsky's Worlds in Collision, which convincingly presented evidence that planetary orbits as well had been altered in the historic past.

The purpose of this paper is to determine the truth or error of this contention that our solar system was markedly different in the past with earth, moon and planets in different orbits, and with different periods than those we note today. In arriving at a conclusion we have retained the Biblical account and basic chronology upheld by Velikovsky and also the validity of the unusual astronomical observations he has supplied with so much labor. But his concept of differing orbits will be called into question and thoroughly disproven.

Earth's Rotational Speed versus Altered Orbits

From a Biblical standpoint, Joshua's long day (Joshua 10:12) and the retreat of the shadow on the sundial of Ahaz (2 Kings 20:9-11) suggest that a 30 day month and 360 day year might have been obtained by changing the earth's rotational speed, and that such a change would be well within the Creator's domain. Slowing the earth's rotation by a mere 1.4% would produce a neat tropical year of 360 days; but the opposite approach, an increase in rotational speed of 1.6%, would be required to produce a 30 day synodic month. This simplistic solution will have to be set aside.

Different orbits for the moon and earth present a plausible alternative, and they might be taken in conjunction with an altered rotational speed. Less plausible alternatives are a change in the mass of the sun, or of the earth, which would then effect a change in the periods of their satellites. Or a change might be presumed in other forces holding the solar system together.

Historical Evidence

In Velikovsky's controversial Worlds in Collision, it is suggested that the planets, as well as the earth and moon, may have had other orbits in the past. Formidable evidence is presented; it is a palatable, scientifically acceptable solution that evades us. "The texts of the Veda . . . speak uniformly and exclusively of a year of 360 days . . This Hindu year of 360 days is divided into twelve months of thirty days each. . . . It is striking that the Vedas nowhere mention an intercalary period." (47; pp 330,1) Another quote, "The old Babylonian year was composed of 360 days." (p 333) And another, "The Assyrian year consisted of 360 days; a decade was called a sarus; a sarus consisted of 3600 days. (p 334) Another, "The ancient Romans also reckoned 360 days to the year. Plutarch wrote in his 'Life of Numa' that in the time of Romulus, in the eighth century, the Romans had a year of 360 days only. . . . (and) that the ancient month was composed of thirty days." (p 339)

Day Counts

One might contend that these quotes refer to "day counts" or to calendars rather than true tropical years. A nation with a 360 day calendar might easily add a 30 day month once every 6 years to achieve a more proper, average length of 365 days; or as in the case of Egypt, add 5 days every year after a 360 day calendar year of twelve 30 day months. Or as in the case of the Mayan "Long Count", consecutive 360s could be counted millennium after millennium without correction for the differing tropical year. This Long Count has as its zero marker Friday, August 11 (Julian) 3113 B.C. (43), a date which belongs to the Hebrew pre-Flood world and as such has been ignored too long by theologians. Its significance will become apparent as we search out tangible evidence of the length of planetary periods in the past.

Altered Planetary Orbits

The inference of a markedly different solar system in the past demands attention when we consider the Hindu astronomical observations of the synodic periods of the planets, "which are easy to calculate against the background of fixed stars . . . about five days too short for Saturn, over five . . . for Jupiter, eleven . . . for Mars, eight or nine . . . for Venus, less than two . . . for Mercury." (47; pp 354, 5) And these observations must be taken in the context of an earth with a 360 day year and a 30 day month. Is this all possible? Is it fiction? Is it historical fact? Is Velikovsky correct when he writes

that the "reason for the universal identity of time reckoning (among nations) between the fifteenth and eighth centuries lay in the actual movement of the earth (and) moon"? (p 342)

Biblical Synodic Periods

The Bible also gives evidence of such a year and month, making the case all the more insistent. The books of Daniel and Revelation contain references to "times" and years of 360 days and to months of 30 days. (37) The prophetic year is always one of 360 days. The Flood waters of Noah prevailed 150 days from the 2nd month and 17th day to the 7th month and 17th day (Genesis 7:11; 8:4), seemingly five full months of 30 days each.

One is tempted to wonder if the solar system has truly undergone catastrophic alteration from a Garden of Eden purity giving us an awkward 365 1/4 day year and 29 1/2 day month, and that all will be restored to "normalcy" in a Millennial Age. Before committing ourselves to purchasing this one-way ticket to the world of Fundamentalist Fantasy, let's take a second and more careful look at those odd Hindu synodic periods.

Slide Rule Solution

The first item that struck me ten years ago in giving the matter serious attention was that every one of these Hindu synodic periods was shorter than the ones we know today. Picking up a slide rule, my curiosity was further aroused to note that they all appeared to be shortened by about the same percentage, a totally unacceptable situation if the earth were to be placed in a smaller, faster orbit. Inner planets should then have their synodic periods lengthened (for it will take them longer to overtake the faster moving earth) while outer planets would be overtaken more quickly and should have shortened synodic periods, but each by a different percentage.

Doing a careful doublecheck on these Hindu figures with a calculator, I divided the modern synodic period by 365 1/4 and multiplied by 360 and was startled to obtain a new set of figures in exact accord with the Hindu observations; 114.2 for Mercury is "less than 2" shorter; 575.5 for Venus is the required "8 or 9" shorter; 360 for the sun is the expected outcome; 789 for Mars is the required "11" shorter; 393 for Jupiter is the required "over 5" shorter; and 372.7 for Saturn is "about 5" shorter, all in accord with the twice repeated Hindu

observations. The problem was only partially solved. A slower rotating earth would give these Hindu synodic figures for the planets, but would produce a lunar month shorter than 29 1/2. Another alternative must exist.

Rather than consider these Hindu figures a basis for changed planetary orbits, they must be accepted as supporting evidence for stable orbits with synodic periods viewed or described in a different fashion. The correct solution will become apparent in re-examining the definition of the decan. One must first determine whether a more distant moon coupled with a more slowly rotating earth is a feasible solution.

Eclipses of the Sun are Proof of God

Before thinking to take liberties with the orbit of the moon, one should be aware of the fact that our sun and moon are the same apparent size in the heavens, each about 1/2 degree, and that these apparent sizes vary from 31.5' to 32.5' for the sun, and from 29.3' to 33.5' for the moon giving solar eclipses in a series of gradations from annular through total, with a maximum totality of 7 1/2 minutes. (1) Only on earth of all planets does such a situation exist, and only on earth are there intelligent beings who can appreciate and utilize this information obtainable in no other way. Through eclipses man is given a brief glimpse at the various atmospheric layers of the nuclear reactor which heats the earth (30), tantalizing him with the possibility of bringing fire down from the sun to power his dreams on earth, information with the potential for good and for evil.

This unique positioning and size of the earth's moon is presented in the February 1974 issue of Physics Today as proof for the existence of a Creator God Who designed both the solar system and man. (29) We are thus introduced to an Intelligent Force capable of altering earth's orbit, and the planetary and lunar orbits, yet left with the question of whether He has done so in historic times.

A further comment with regard to the positioning of our moon is that any change in distance of either sun or moon would significantly alter the height of ocean tides, which would in turn alter the period of regression of the moon's nodes, which would markedly alter eclipse cycles dependent upon the nodical month. The 19 year Metonic cycle would also cease to exist; no evidence of it should be found in the remote past.

Definitions Clarified

What is a year? It is the sun's eastward passage through the stars, a complete circuit of the heavens by the sun, which requires roughly 365 1/4 days, and during which time the sun has moved eastward 360 degrees. This 360 degree year can be divided into twelve units, the twelve Signs of the Zodiac, each Sign composed of 30 degrees. "The ° was the simple picture of a sun and stood for 'day' Thus 360° meant a year of 360 days." (20)

Were the Hindus and Babylonians measuring planetary periods in degrees of eastward movement of the sun? We are accustomed to counting days in terms of sunrises, of which there are 365 or 366 in a calendar year. But one could as well measure time by counting degrees that the sun moved through the stars. A year would always be a uniform and exact 360 degrees (unless one wanted to be very precise and subtract the 50.3" for precession, which differentiates the sidereal from the slightly short tropical year, and of which the ancient astronomers were also aware, but that would be a digression here.)

A Decan Defined

Note the Babylonian account, "The zodiac . . . was divided into thirty-six decans, a decan being the space the sun covered in relation to the fixed stars." (47; p 333) The answer is before our eyes in the text of these ancient accounts. A decan is "the space the sun covered" and is not exactly equal necessarily to 10 sunrises; even today the sun covers a decan in covering 1/36 of the arc of a tropical year.

The word decan has an additional closely related meaning in that "Each sign of the zodiac is accompanied by three other constellations, called decans" (23), thus 36 decans in sequence would constitute the tropical year of 360 degrees. These 36 constellations plus the 12 which are Signs give a total of 48 ancient constellations.

The earth rotates almost exactly 180 times between autumnal and spring equinoxes, during which time the sun moves eastward the space of 180 degrees; here a decan would be 10 sunrises as well as being 10 degrees. The other half of the tropical year finds the earth farther from the sun, moving more slowly in its orbit, and with 185 turns on its axis as the sun moves through 180 degrees of celestial longitude.

A Month Defined

The 30 day "month" of the ancient accounts could in cases refer to the 30-degree-long Signs of the Zodiac. Or, as mentioned earlier, it might be a count of days. A third possibility is also worth considering. Suppose the reference were to a "solar month" (which is 1/12 of a tropical year, thus 30.4368 for us today), what then? Diminished by the same percentage as the Hindu planetary synodic periods, once more we arrive at the same answer of an exact 30 days!

The reason the term "solar days" can not be employed for these 360ths of a tropical year, as we used the term solar month for 12ths is that "solar day" has already been assigned the meaning "an interval between successive crossings of our meridian by the apparent sun". It is a problem in semantics.

Dividing the Heavens

To demonstrate the proper meaning of the word "day" in Hindu thinking, turn again to the quotation from Worlds in Collision, "a passage from the Aryabhatiyz, an old Indian work on mathematics and astronomy: 'A year consists of twelve months. A month consists of 30 days. A day consists of 60 nadis. A nadi consists of 60 vinadikas.'" (47; p 331)

We today measure the arc of the heavens in exactly the same kind of units. The circuit of the heavens consists of twelve Signs. A Sign consists of 30 degrees. A degree consists of 60 minutes of arc. And a minute of arc consists of 60 seconds of arc! The systems are identical, differing only in the names given to the units.

In our system there are 3600 seconds in a degree and 360 degrees in a circle. The Hindu system had 3600 vinadikas in a "day" and 360 "days" in the sun's circuit of the heavens.

An interesting aside here is to consider the division of the circle of the heavens into 365 1/4 degrees by Chinese astronomers. (36) (47; p 340) Even in our day we have seen a new type of degree, a centesimal degree with 400 to the circle and 100 to the quadrant (46), one ideally suited to the computerized world. Each centesimal degree is then divided decimally into 10ths, 100ths, 1000ths, etc. rather than the familiar minutes and seconds of arc.

A Unified System of Measurement

The Chaldeans sought out a unified system of time, motion and human energy. An active foot-courier was expected to walk a stadium (600 Greek feet) (44) in the time required for the sun to cross the horizon on the day of the equinox, determined to be 1/720 of a day, or two minutes of time. (5) The stadium was 1/10 of a minute of arc on the face of the earth. Units of weight and measure were also earth and heaven based.

Surely these examples should caution us to handle the observations of the ancient astronomers with a good measure of respect. We have inherited and unknowingly used an earth based system of measures developed millennia before the advent of the metric system. The captain of a ship measures distance in nautical miles, which are minutes of arc on the earth's or ocean's surface. The speed of the ship is stated in knots, which are "nauts" per hour.

The 360 Day Roman Calendar Year

This is the place to review the statement that the eighth century (B.C.) Roman calendar of Numa had but 360 days. Would you believe that even the Julian calendar had a 360 day framework until the year 321 A.D. when Emperor Constantine dropped the system of Kalends, Nones, and Ides, substituting instead a planetary week and requiring his subjects to rest on the "venerable day of the sun"? (3) Until this time, the "bissextile" day was added immediately after February 23, six days short of March 1, New Year's Day. Thus February 23 was the 360th day of the calendar year! On leap years, the "6th before the Kalends of March" (inclusive counting) was doubled, hence the term bissextile. (7)

December 24, Day 300, was the winter solstice, leading to the assignment of December 25 as the birth of Christ, the Son of God, as it had been observed by the Roman populace as the birth of the "Sun" of the heavens. (27) The midnight hour between the two days was assigned as the moment of the birth of the new sun, even through the the actual solstice varies over a two day period.

The autumnal equinox, Day 210, was September 26, three 30 day "months" earlier on September 26, an astronomical marker that tied the Roman calendar to the seasons. The turning points of the year drifted

in the calendar from original locations assigned them by Numa, Julius Caesar, and Sosigenes. The vernal equinox was restored to its Council of Nicea, 325 A.D., location by Pope Gregory in the establishing of the Gregorian calendar in the year 1572. (1)

Other Calendars of 360 Days

In many historical accounts, it is obvious that a 360 day "count of days" is meant. The Egyptians had a 360 day calendar year, no more; but outside the year were five additional days bringing the total to 365. Assyria also had 360 days in its calendar year but allowed the five additional days to accumulate for three years at which time a 15 day unit could be added bringing the calendar once more in step with the Egyptian. (24) Neither Egypt nor Assyria troubled themselves about the extra quarter of a day.

In India, there are many calendars and great concern over time-keeping. Two groups with the same calendar separated from each other and are out of step one 30 day month. One group insisted on following an ancient rule that once every 120 years an extra month must be added to account for the ignored 1/4 of a day. (32)

Evidence Favoring a Uniform Solar System

Having disposed of the most insistent evidence favoring a 360 day tropical year and a 30 day synodic month, we can now turn to the wealth of positive evidence favoring a solar system identical to the one we know; the 19 year cycle and planetary periods identical to ours can be found throughout all of man's history.

The problems of the Venus Tablets of Ammizaduga are discussed in A. de Grazia's book, The Velikovsky Affair, (8) and in a recent issue of Pensee (42), both authors favoring unusual orbits. In view of the quantity of material being presented clarifying the 360 day problem, it seems fair to set aside for the moment one unit of confusing information with regard to Venus' movement. Perhaps it is a genuine account and Venus did actually behave in that fashion; if so, I have no personal objection.

A logical first step should be to re-examine the Biblical account the Hebrew, Mayan and Chinese calendars, and their respective eras which reach back into the antediluvian world. Each calendar is based

upon the movement of "light bearers" and the appointed stars of the heaven. We will find additional evidence for a 360 day "count of days" and with it incontrovertible evidence for a solar system with today's measurements and periods.

A Brief History of Astronomy

"The time is long past when scientific men accepted the date given for the Creation by Archbishop Ussher, who arrived (by the naive method of adding up the ages of the patriarchs) at the figure 4004 B.C." (38) While many fundamentalists will grant that the heavens and earth have a history going back countless millions of years, man's history is quite another matter. It is a fact of astronomy that the vernal equinox is moving slowly westward along the ecliptic; and also that the perihelion point is moving even more slowly eastward; the angle between the two (known as the anomaly) increases at the rate of one degree every 60 years (1)(45) At present the vernal equinox is 100 degrees from the perihelion point; thus they coincide around 4000 B.C.! Is this a coincidence, or were the heavens set in order at the time of man's creation?

Who originated astronomy? "Josephus, in his 'Antiquities of the Jews', lib. I, cap. ii, sec. 3, says--'Now this Seth (the son of Adam) . . . became a virtuous man . . . (and his) children . . . were the inventors of that peculiar sort of wisdom which is concerned with the heavenly bodies, and their order.'" (23) "The constellations themselves, of which the twelve signs of the zodiac are only the most prominent, traditionally numbered 48. Their names and positions date back to . . . the third millenium B.C." (41)

"The date of the zodiac is given as 3000 B.C., which agrees very well with the significant position of the four Royal Stars . . . which marked the four cardinal points, and were thus especially prominent." (37) "Four bright stars marked the 'season points', 5000 years ago: Aldebaran at about 0^h right ascension, Regulus at 6^h, Antares at 12^h, and Fomalhaut at 18^h." (26)

Five bright stars held key positions in the sky of 3000 B.C., four marked the seasons and a fifth was a different "North Star" than the one we know today. "The earliest pole star of which we have historical knowledge is Thuban, which is also known as Alpha Draconis . . . The pole was closest to Thuban about 2800 B.C." (1) "About 3000 B.C. . . . the earth's north pole pointed fairly near the star Alpha Draconis, which then was the Pole star." (22)

The entire sphere of the heavens was not mapped out by the ancients. 'Maunder. . . writes, 'the old constellation figures. . . cover only a portion of the heavens, and a large roughly circular region in the southern hemisphere is left entirely vacant. Swartz was the first to make the significant suggestion that. . . the inventors. . . lived too far north to permit their viewing this part of the heavens.' Maunder considers that the designers lived between 36° and 42° north latitude. . . computing where the centre of the vacant space coincided with the southern pole, we get the date of 2800 B.C., which was probably the date when the ancient work of the constellation making was completed." (35)

"That the Euphratean constellations are much older than Hipparchus is shown by the fact that they began with Taurus, the 'Bull in Front'. If the sun was in Taurus at the vernal equinox when the constellation was named, the date would have been about 2450 B.C. Virgil was echoing this tradition when he wrote; 'The gleaming Bull opens the year with golden horns, the Dog sinks low, his star (Sirius) averted.' but he was already more than two millenniums out of date." (38) "Many of the authorities hold that the zodiac was planned while the spring equinox fell in the constellation Taurus. In support of this claim it may be said that. . . the sun was ascending all through the signs that face the east, and was descending all through the signs that face the west, a significant and logical arrangement which could hardly be accidental.' (35)

Based on the testimony of the heavens as witnessed by the multiple authors quoted, we can fairly conclude that astronomy and its counts of time, its calendars, its lunar and planetary cycles rightly belong to the ages described in the first chapters of Genesis.

A 52 Year Planetary Cycle

Mayan chronology has a beginning year of 3113-2 B.C. and a 52 year cycle, which cycle is the result of a 365 day calendar interacting with a 260 day calendar. (31) With this 52 year cycle is a Long Count of time in 360 day units.

This 365-260 day system is decidedly planetary and as such has a direct bearing on the question of the synodic periods and orbits of the planets. The 260 day count of time is quickly recognized as 1/3 of the 780 day synodic period of Mars. Five counts of 260 are 1300 days, equal almost exactly to 44 synodic months as we know them. Sixteen counts of 260 are equal very closely to 11 synodic periods of

Saturn, there being but a single day's difference. (40) Here then is evidence that Mars, the moon and Saturn are all in their proper orbits and that earth had a 365 1/4 day tropical year. The 52 year cycles go back that far and thus the 260 day and 365 day calendars with them.

Planetary Worship in the Days of Enos

Is it logical to accept the premise that the antediluvian world produced this system? (31) (19) The peculiarities of the 365-260 day system, its 52 year cycles plus a 360 day count of time with its base date of 3113 B.C., should bring to the mind of theologians and astrochronologists alike the statement of the twelfth century learned Jewish rabbi, Maimonides who narrates, "In the days of Enos (and his days bracket the foundation dates of Hebrew, Mayan, Chinese and Indian chronologies) the son of Seth, the sons of Adam erred with great error, and the counsel of the wise men of that age became brutish; and Enos himself was one of them that erred. . . They said, 'Forasmuch as God hath created these stars and spheres (referring to the timekeeping services rendered by the sun, moon and planets alike, and the background of stars against which they are seen). . . (God hath) set them on high. . . and imparted honor to them, and they are ministers and minister before Him, it is meet that men should laud and glorify and give them honor. For this is the will of God that we should laud and magnify whomsoever He magnifieth and honoreth'. . . When this thing came into their hearts they began to build temples unto the stars, and to offer sacrifices unto them. . . And this was the root of idolatry, for in the process of time there stood up false prophets among the sons of Adam, who said. . . 'Worship such a star, or all the stars, and make sacrifices unto them. . . build a temple for it, and make an image of it, that all the people, women and children, may worship it.'. . . So in the process of time, the glorious Name was forgotten out of the mouth of all living. . . no people knew aught save images of wood and stone, and temples of stone. . . And the wise men that were among them. . . thought that there was no God save the stars and spheres. . .But as for the Rock Everlasting, there was no man that did acknowledge Him or know Him save a few persons in the world, as Enoch, Methusaleh, Noah, Shem, and Heber. . . till that pillar of the world, Abraham, our father, was born." (48)

Eight Year Cycle of Venus

The 365 day calendar is also tied to the heavens, eight such calendar years being equal almost exactly to 5 synodic periods of

Venus (40), this eight year cycle being the apparent origin of the Olympic Cycle of eight years which was later divided into two four year cycles. The cycle requires a 584 day synodic period for Venus, possible only with both planets (Earth and Venus) in their proper orbits. (Jupiter provides a 12 year sidereal period and will be considered later. The other naked eye planet, Mercury, is of less significance in keeping time.)

Sothic Cycle Completed

The Egyptians gave up their 365 day calendar with great reluctance and substituted the inferior calendar of Julius Caesar and Sosigenes in its place. Why the reluctance? It is interesting to note that the Egyptians stalled five years in implementing the Julian calendar until a certain year and day, "Thoth 1 (August 30) of 26 B.C." (34), which year completed a Sothic cycle. "Theon says that the reason for the choice of that year. . . was that a 1,460-year Sothic cycle had terminated then." A complete cycle of 1461 Egyptian 365 day years (533,265 days) or 1460 Julian calendar years of 365 1/4 days had passed since the setting up of the Hyksos government over Egypt shortly after the Exodus. (18)

Peruvians, Aztecs, Mayans

The Peruvians also held to a 365 day calendar with the intercalation of a day every four years. (47; p 340) (39) The Aztecs, like the Mayans, had both the 365 and 260 day calendars and hence a 52 year cycle of 18,980 days. (4) Authorities disagree as to whether the Aztecs intercalated a 13 day "week" at the end of the 52 years to bring the cycle in line with the summer solstice. We do see temples aligned with the summer solstice sunset point and read that all fires were extinguished at the end of 52 years and that new fires were lit from a friction-kindled fire on a wooden shield on the breast of a sacrificial victim. The cycle ended in winter, however, and the sacrifice did not take place until the Pleiades (leading Taurus) had reached the zenith in the night sky.

Is this the same system that was begun in the days of Enos? Then Maimonides' use of the term "brutish" certainly describes it well, for Spanish accounts tell of countless corpses and piles of skulls of the human victims sacrificed to placate the "gods" of Enos. The harshness of the Spanish conquerors was exceeded only by the degeneracy of the religious and political rulers of Mexico and sur-

rounding regions.

Lunar Months during Deluge

There is additional evidence that a lunar month of 29 1/2 days was extant in Noah's time. What farmers always knew, scientists have only recently considered objectively, and to their surprise the rainfall pattern does follow lunar phases. "One of the old, and now shattered myths of scientists has been that there was no such relationship." (21) Australian researchers "did not dare publish their results until they began correspondence with American meteorologists . . . the heaviest rainfall, . . was observed to occur during the days immediately following the new and the full moon." (10) The beginning of the Deluge on the 17th day of the month (Genesis 7:11) antedated their findings by 43 centuries.

Forty days of incessant rainfall would cease on the 27th day of the 3rd month, Kislev. "The weeks after the first quarter and third quarter were lacking in such heavy precipitation, the low point falling about 3 days prior to full moon and new moon." (21) Forty days of incessant rainfall would end 3 days prior to the new moon, a dry period.

China Discards the 52 Year Cycle

Having considered in some detail the Mayan and Hebrew calendars in the time of the Patriarchs, what evidence for a stable solar system is available from an analysis of the Chinese system. Turn to the chronology of China (28) and consider the adoption of 60 year cycles instead of 52; and including once more the lunar months discarded by "Mayan" enthusiasts 416 years earlier. Is it a coincidence that 416 years (3113-2697, the 1st year of Hwang-te) is a multiple of 52?

The 600 year "Great Year"

The Chinese 60 year cycle brings to mind the statement of Josephus that the antediluvians had discovered the Great Year of 600 years, men having lived long enough to become aware of such a cycle. (49) Consider first the shorter 60 year cycle and its relationship to planetary worship possibilities. Saturn completes a circuit of the heavens in just a bit under 30 years, thus making two circuits in 60 years; Jupiter moving considerably faster makes the trip around in

just under 12 years overtaking slow moving Saturn in 20 years when it was but 2/3 of the way around, once again at the arrival of the 40th year (Jupiter having made 3 1/3 circuits), and it overtakes Saturn for the third time during the 60th year having made five circuits for Saturn's two. (1) More exacting figures would show Jupiter overtaking Saturn 154 days short of 60 full years (or 152° short of 60 full circuits by the sun) but 8° past having completed five circuits of the heavens.

Here is a beautiful framework for chronology; two heavenly timekeepers moving slowly across the face of the heavens, a face divided into twelve sections, the 12 Signs of the Zodiac, by the yearly progress of Jupiter; again the evidence is that these Signs were set up around 3000 B.C. In 60 years time Mars would be just short of 32 circuits, the Earth (or Sun) would have made 60, Venus a little over 97 1/2, and Mercury 249 and a bit more.

To determine the periods of the planets and be able to predict their locations with greater accuracy, it would be advantageous to follow them for ten of these 60 year cycles, hence the "Great Year". In that period of time, Saturn would make 20 1/3 circuits, Jupiter 50 7/12, Mars 319 (almost exactly), the Earth or Sun 600 exactly, Venus 975 1/4, and Mercuty 2491 1/6 (all periods rounded to the nearest 1/12 circuit, or Sign of the Zodiac for convenience).

The Shaka Calendar of the Far East

The fact that Jupiter overtakes Saturn for the third time when the sun is 154 days short (on the average) of 60 full tropical years, Jupiter having completed just a bit over five circuits of the heavens, is the likely origin of the unusual naming of consecutive years of the 60 year Shaka calendar after the Signs of the Zodiac in reverse order. Note that by dividing this 59.58 year unit of time into fifths (to produce the more familiar 12 year length), the sun is but 30.8 days short of 12 calendar years, and 30°.4 short (westward) of completion of its twelfth circuit. A reverse order naming of years is strongly suggested.

"Originally (prior to the 60 year Shaka calendar) a shorter twelve year cycle (was used) . . . identify(ing) each year by naming the year for the constellation (Sign of the Zodiac) in which Jupiter was located. . . . However, at some time in the past this basis was reversed, for Jupiter . . . travels through the constellations in reverse order . . . to the (currently used Shaka) names of the year." (2)

The Signs in Shaka calendar order (followed by their common Western names) are: 1 Rat (Aquarius 10), 2 Ox (Capricornus 9), 3 Tiger (Sagittarius 8), 4 Rabbit (Scorpio 7), 5 Dragon (Libra 6), 6 Snake (Virgo 5), 7 Horse (Leo 4), 8 Ram (Cancer 3), 9 Monkey (Gemini 2), 10 Cock (Taurus 1), 11 Dog (Aries 12), and 12 Boar (Pisces 11). A three-component name identifies each of the 60 years. The terms Elder and Younger alternate for the first component; the terms Wood, Fire, Each, Metal and Water each in turn name a pair of years; the Signs in reverse order name consecutive years. Our year 1976 is the Elder Fire Dragon, 1977 the Younger Fire Snake, 1978 the Elder Earth Horse, and 1979 the Younger Earth Ram. This system was set up to replace the earlier 12 year system seen "defective" in the sense that Jupiter was gradually moving ahead of the Sign for which the year was named. Logically in formulating the new 60 year system, the Signs would be given new names to avoid confusion with the nations who still preferred to use the older 12 year system with years named in eastward Sign order.

Discovery of the Metonic Cycle and its Multiples

Credit for the discovery of the 19 year solar-lunar cycle is still traditionally given to the Greek astronomer Meton who proposed a 235 month cycle of 6940 days in 432 B.C. An improvement on the Metonic cycle came in 330 B.C. when Callippus multiplied it by 4, then subtracted a day producing the 27,759 day Callippic cycle, which was exactly equivalent to 76 Julian calendar years of 365 1/4 days each. The third and final Greek correction came in 125 B.C. when Hipparchus multiplied this cycle of 940 months by 4 and once again subtracted a single day to produce a 111,035 day cycle. (3) The calendar year was now shortened to an average of 365.2467 days (still 1.37 days too long over the 304 year period), but the calendar month now averaged 29.530585 (or 16 3/4 minutes too short over the entire period, yet an amazingly accurate measure for the lunar period).

But were the Greeks actually the first to achieve this understanding and accuracy in the measurement of time? A 19 year cycle was known and in common use in the Orient millennia earlier. "In the Han period, we are given a list of 'Six Calendars'. . . all alike have the same basic principle of the Ssu-fen or 'Quarter-day Calendar' . . . The purpose of that 'Quarter-day Calendar' was to reconcile the solar year of 365 1/4 days with the 'common' year of 365 days; the solution found was to insert seven intercalary months in each period of nineteen years. The Chinese calendarist, therefore recognized time-units longer than a year, namely the chang or 'chapter' of 19 years or 235 moons, and the fu or 'cycle' of 76 years or 940 moons or 27,759 days." (11)

A solar-lunar calendar is now considered a "not unreasonable assumption" in the Hsia period, (2205-1766 B.C.) If this is the case, the solar system has been stable from that period down to the present day! "Until quite lately it was reasonable to maintain that the chang and fu, . . could not be earlier than the Han period (202 B.C. - 220 A.D.), . . (but) the conclusion. . . is that the Ssu-fen Calendar, . . anticipates by more than a thousand years the famous Metonic Cycle, the solution to the same problem of reconciling the lunar and solar years, . . The long chang unit of 76 years (4 changs) . . . corresponds to the 'Period of Calippus' of the Hellenistic scholars." (11)

Independent discovery of the 19 and 76 year cycles by Greece and China is assumed and is certainly a possibility. Both were confronted with the same problem of relating the 29 1/2 day month with the 365 1/4 day year, and both came up with the same answer. Could they have obtained it from an earlier source? It is concluded by some that "Egypt was the Home-land of Science as we know it; it was passed on to the Greeks who recorded it in writing and gave it to the world." (33) Meton and Callippus are to be credited with calling our attention to the 19 and 76 year calendar cycles but they are hardly the discoverers. Chamber's chapter on cycles provides a wealth of information on calendar cycles in the book of Daniel. (6)

Even Hipparchus claim to the discovery of the 304 year cycle is subject to challenge as it is 1/3 of the 912 year assigned lifespan of Seth, a peculiar coincidence. Such a 912 year span of time also occurs between Creation week and the setting up of the Mayan 52 year cycles (4024 - 3112 B.C.) strongly suggesting that a "recognized unit of time" (12 Callippic cycles in length) had transpired prior to the institution of the Mayan system. (15) Eclipse-cycle properties of the 912 year unit make it increasingly intriguing.

The Value of Calendar-Eclipse Cycles

Lunar eclipses are indispensable to calendar makers who use the lunar month. "Eclipses of the moon give more accurately than any other kind of observation the actual time when the sun and moon are in opposition." (9) The commencement of a lunar eclipse can be determined with half-minute accuracy by naked-eye observation (25) and all observers, regardless of their differing longitudes and latitudes, will see this phenomenon at the same moment of time (which is not at all true of solar eclipses). If lunar eclipses 912 years apart were

observed, the intervening number of days, hours and minutes could then be divided by the 11,280 intervening synodic months to obtain a mathematical average of extremely high accuracy for the calendar month.

This particular 912 year "Cycle of Seth", three times the length of the Hipparchus cycle, has an additional feature in that it is a whole number (12,089) of anomalistic months (perigee to perigee) which greatly enhances the accuracy of the measurement. Its 12,241 nodical months (The node is the crossing point of the moon's path over the sun's path, the ecliptic) makes it an eclipse cycle. And the number of synodic months (11,280) being a multiple of the Metonic cycle makes it an all important calendar cycle. (13)

The import of this 912 year calendar-eclipse cycle is that it lends additional support to the idea that the Hebrew calendar was given its mathematical basis in antiquity, the length of the average calendar month being easily available to them in a highly accurate form even apart from astronomical instruments. This knowledge, in forms ranging from vague tradition to very exacting measures, would then have been available to the early Chinese for their Ssu-fen calendar. And it would have been known in the days of Hammurabi, who decreed, "'Since the year has a deficiency, let the month which is beginning be known as the second Ululu, but the tribute due in Babylon on the 25th of the month Tashitu, let it arrive in Babylon on the 25th day of Ululu II.'" (3) Though the month Tashritu (Tishri) was to be delayed 30 days, there would be no delay in the payment of taxes due the king.

Abraham, according to tradition, taught astronomy to the Egyptians. His grandson, Joseph, upon release from prison was made ruler over the land of Egypt and Pharaoh "gave him to wife Asenath the daughter of Potipherah priest (or prince) of On." (Genesis 41:45) This prince was the royal astronomer of Egypt. The Exodus of the children of Israel from Egypt was 430 years from the promise to Abraham; thus the promise to Abraham must have been confirmed on Nisan 15, a solar-lunar calendar known in Egypt spanning that unit of time. (12)

From Egypt and Israel, the knowledge of the 19 year time cycle was available to the Babylonians. Daniel and his friends were found superior in wisdom and understanding to all the wise men and astronomers (magicians and astrologers) that were in the court of King Nebuchadnezzar. (Daniel 1:17-21) This same Daniel also ruled under Darius in the Persian empire that followed. (Daniel 6:1-3) Greece

followed next in line as a world ruling empire and it is only natural that the ideas of the previous millennia filtered down to the Greek philosophers, though hardly in their original perfection.

The Question of the 360 Day Tropical Year Reviewed

Formidable appearing evidence favorable to a 360 day tropical year and 30 day synodic month disappeared into thin air upon close examination. While a 1.4% faster rotating earth could produce a 360 day year, a 1.6% slower rotation would be required for the 30 day month. The odd set of Hindu synodic periods for the planets could not be solved by changing the earth's orbit, but they could be taken at face value if they were considered to be expressed in terms of degrees of arc through which the sun moved (rather than days, i.e. rotations of the earth on its axis). All figures are then in exact accord with modern observations and thus are excellent proof of stable rather than erratic orbits in the past.

A decan is properly defined as 1/36 of the circuit of the heavens which the sun accomplishes in a tropical year, and is 10 degrees of arc. It may be more or less than 10 rotational days depending upon which portion of our elliptical orbit the earth occupies at the time. One "half" of our tropical year, vernal equinox to autumnal, requires 185 turns of the earth on its axis; the other "half" requires but 180 for the sun to move through the other 180 degrees of the heavens.

The heavens are also divided into 12ths, the Signs of the Zodiac, each being 30 degrees. The year is also divided into 12 "solar months" of 30.4368 days each. And it is divided into 12 calendar months of 28(9), 30 and 31 days. Or into twelve 30 day months for a total of 360 days, the complete "year" with an added 5 (and sometimes 6) days that are not considered part of the "year". These various systems of designating time and arc should not be confused; astronomers understand them in context and have no more trouble knowing which is meant than does the layman with everyday homonyms such as "sew, so and sow" or "write, rite and right". Calendar "years" of 260, 360, 365, 354 and 384 are found.

Earth's unique possession, a moon with the same apparent size as the sun and with elliptical orbits producing a gradation of solar eclipses from annular to total enabled man to study and master nuclear energy. Earth alone has intelligent life able to appreciate these eclipses and this situation is convincing proof to the scientif-

ic world of the need for a Creator God. Any tampering with the earth's or moon's orbit could destroy this phenomenon.

Putting a history of timekeeping together in a tentative form, mankind begins his sojourn on earth with solar and lunar counts of time. A 19 year cycle would be discovered. Man began also with a 7 day week and a 360 day count of time.

Human nature soon demanded a "perpetual calendar", one in keeping with the planetary periods as well as the moon and the sun. A 13 day week, a 20 day month, a 365 day non-intercalated calendar year, plus a new count of time in 360s from a new time base. The August 11, 3113 B.C. date was chosen and has a very unique relationship to the original system.

One schism leads to another and what could be better than returning to the 19 year cycle of 235 lunar months but tying with it a 60 year cycle of Jupiter and Saturn. Name the years after the Signs of the Zodiac but in reverse order (in that Jupiter-Saturn conjunctions retrograd in the heavens) and to avoid confusion with the old system, rename the Signs. The fact that this system has come down to us from the pre-Flood world and provides China alone with a dependable history linked to chronology is proof of its workability.

In Conclusion

The concept of unusual and erratic orbits for the planets, earth and moon, as presented in Immanuel Velikovsky's provocative book, Worlds in Collision, has been used as a prod to search out a fascinating picture of man's struggle with time. A strong probability exists that we have an exact count of days from the Friday of Adam's creation down to the present day. During his lifetime an apostacy in timekeeping takes place and a new base for counting days is assigned. (16)

The Hebrew, Mayan and Chinese calendars and eras are seen to be interrelated. No new major system of timekeeping was ever begun except that it bore a very exact relationship to the previous one. Forty-eight cycles of 19 pass before the 52 year system is established. Eight cycles of 52 and a 60 year system comes into being. All three systems come down to us into the 20th century. Each brings with it a feature vital to establishing worldwide chronology. The Hebrews bring

an unbroken 7 day week from the very beginning. The Mayan Long Count is a count of days 47,527 weeks removed from the beginning. Chinese 60 year cycles bring an unbroken historical record of rulers and their accomplishments down to the present day, The Bible provides a genealogical record for the development of the nations and much more, Taken together they form a framework for the 60 centuries of man's accomplishments.

The "caveman" hypothesis for the determination of the 365 1/4 day tropical year over "eons" of time can be laid to rest. Additional discredit has been given to the faulty Egyptian framework for history set up by Manetho and exposed by Velikovsky. An intelligent, observant and informed mankind populated the earth millennia before the Pharaohs of Egypt.

The participation of the planets Venus and Mars in the events of the Exodus has been left to another paper. The accounts of the ancient historians demand our attention and should not be given the catch-all label of "legend" and "myth". Real events took place and eye witnesses recorded what they saw in emotional as well as then current scientific terms. It is a translation of these terms into 20th century thinking and language that is needed.

A quote from the Official Souvenir Program of the 1962 Seattle World's Fair is appropriate. "In the natural order, there is no effect without a cause; no motion without a purpose. Only the spirit of man lives outside this encompassing law. And because it does, man is the only one of earth's creatures with the power to shape his own environment." (50) The sun, moon, planets and stars remain as faithful timekeepers and servants of mankind in complete obedience to the physical laws of their Creator.

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