WEEK / CHON

THE WEEK

BASIC TIMES AND FREQUENCIES

[UPDATE BASEFREQ.WPD, 2002-11-27, # 62]

ITEM	FORMULA	LOG_{10} Seconds	D-H-M-S	HERTZ
electron Schuster	$2\pi\sqrt{(r_e^3/Gm_e)}$	-0.918814	0.120555 s	8.294954
baryon Schuster	$2\pi\sqrt{(r_e^3/Gm_p)}$	-2.550769	0.002813 s	355.442210
hydrogen Schuster	$2\pi\sqrt{(a_o^3/Gm_p)}$	+3.859735	2h 0m 39.94 s	0.0001381
earth Schuster	$2\pi\sqrt{(R_e^3/GM_e)}$	+3.704223	84m 20.84 s	0.0001976
earth Schumann	$2\pi R_e/c$	-0.874433	0.133526 s	7.489158
earth Schwarzschild	GM_e/c^3	-10.829925	1.479364×10^{-11} s	6.759662×10^{10}
earth Schwarz2	$2GM_e/c^3$	-10.528896	2.958721×10^{-11} s	3.379839×10^{10}
orbit Schumann	2π(A.U.)/c	+3.496286	52m 35.35 s	0.0003189
earth rotation ⊙		+4.9365137	86400 s	1.157407×10^{-5}
earth rotation ☆		+4.9353263	23h 56m 4.09 s	1.160576×10^{-5}
earth geosync*	$2\pi\ R_g/c$	-0.052906	0.885307 s	1.12955
neutron star	$\alpha\mu S\ t_p$	-2.785412	0.001639 s	610.1154
sun Schuster	$2\pi\sqrt{(R_s^3/GM_s)}$	+4.000163	2h 46m 43.75 s	0.00009996
sun Schumann	$2\pi R_s/c$	+1.163661	14.576760 s	0.068602
Sun Schwarzschild	GM_s/c^3	-5.307523	0.000004928026	203012.6031
Sun Schwarz2	$2GM_e/c^3$	-5.006494	0.000009851583	101506.5343
Univ Schuster	$\sqrt{(R_u^3/GM_u)}$	+17.456065 ?	9.056346 gyr	
Univ Schumann	R_u/c	+17.456065 ✓	"	
Univ Schwarzschild	GM_u/c^3	+17.456065 ?	"	
½ Univ			4.428173 gyr	
3/2 Univ			13.584519 gyr	

* This is the Schumann period at the distance R_g, = 42241 km (26,247 miles) for synchronous satellites in equatorial orbits.

Notes:

(earth Schuster)^4 = (earth rotation ⊙)^3, 14.817 = 14.810 Δ = 0.007
(earth Schuster)/(hydrogen) = 0.699017 or 7/10 Δ = 0.001
(log day) = (log hydrogen) x (log 19) 4.9365 = 4.9357 Δ = 0.0008
(log hydrogen) = (log earth Schuster) x (log 11) 3.860 = 3.858 Δ = 0.002

$4 \cdot \log(\oplus S) = 3 \cdot \log(\oplus ROT)$

$\log(\oplus rot)^{3/4} = \log(\oplus S)$

$Schw \circ (Schu)^2 = (Shum)^3$

$$\pi\left[\frac{2GM}{c^3} \cdot 4\pi^2\frac{R^3}{GM}\right] = \left(\frac{2\pi R}{c}\right)^3$$

OK for ⊙ and ⊕

7 days = 120 · 84 = 10080 min

7 rot = 120 schuster

$\log \pi = 0.4971499$

Rot of ☉ = ?

$\cancel{24^h \times 60^m \times 7^d = 10080\ {}^m/\text{week}}$

If $\S = 84^m$, $\exists$ $120\ \S/\text{week}$

88-1

1991 # 88

TIMWEEK1.P51 DISK:TIME August 7, 1991

cf. 1994 #7, #15, #54
1994 #13
1995 # 54

A PHYSICAL BASIS FOR THE WEEK

Our basic units of time, the day, the month, and the year, have their obvious origins in the rotation of the earth, the revolution of the moon, and the revolution of the earth. Our smaller units of time, the hour, minute, and second are derived from numerically convenient but rather arbitrary divisions of the day. The origin of the week as a unit of time, however, has always been a bit of a puzzle. It has been suggested that it originated as being a quarter of a month, but the month of lunar phases is not 28 days, but about 29.5 days, which over time renders the week a rather poor unit for keeping track of the phases of the moon.

The week, however, has a non-astronomical origin in the traditions of the Jewish people. God created the world in six days and rested on the seventh. God then ordained the Sabbath and thus established the week as a unit of sacred time. In more modern times this tradition seemed to be arbitrary to some would be reformers. Experiments with weeks of different lengths were attempted during the French revolution and later during the Russian revolution. Weeks of as long as 10 days and as short as 4 days were tried, but the results were negative. There appears to be a basic cycle of seven days that conforms with the human disposition. The seven day week of ancient tradition, even though without astronomical origin, seems not to be arbitrary.

also Market Cycles

for longer or shorter weeks

With such negative experimental results, the question arises whether there might indeed be some physical basis for a seven day cycle after all. Since no heavenly body is known that can provide the basis for this period, perhaps we should look to the earth itself for its origins. What periodicities are associated with the earth besides its rotation and revolution periods? Are there other basic terrestrial periods? ¶ One such basic period acquired prominence when artificial satellites were first put into orbit. This is the so-called 'Schuster Period' -- the period of a zero-altitude satellite. It is the time required for a satellite to orbit the earth at the earth's surface, which is determined by the size and mass of the earth.

The Schuster period is a limiting period. It is the theoretical shortest possible time for any satellite operating solely under the influence of natural forces to orbit the earth. Its value is a few seconds over 84 minutes. But because of the earth's atmosphere, no practical satellite could have that short a period. Practical satellites must operate above the bulk of the atmosphere and the greater the altitude the longer the orbital period. The length of orbital period increases from 84 minutes at the earth's surface to 24 hours at the 'synchronous distance' of about 22,000 miles, where most communications satellites are located, to roughly 30 days at the distance of the moon.

It also link the moon + earth / [illegible] [illegible] Keplerian [illegible]

The Schuster Period is also the rotational limiting period, where equatorial fragmentation
cf Roche Limit

03/02/93

Another property of the Schuster Period:

It is the limiting rotational period for the earth.
If the earth were to rotate faster than one rotation in ~~a day of length~~ 84 minutes, it would begin to disintegrate. The centrifugal force at the equator would exceed the earth gravitational pull and mountains would begin to fly off into space.

We have a considerable "spin safety factor" on earth:

One rotation period = 24×60 = 1440 minute

The limiting rotation period of stability (the Schuster period) = 84 min

$$\frac{1440}{84} = \frac{120}{7} = 17.1 \text{ (safety factor)}$$

Note that implicit in this safety factor is 7 days = 120 schuster periods

The ratio of $\frac{\text{\# Schuster periods}}{\text{\# rotation periods}}$ in a week = the earth's safety factor

rot of ⊕ ↑ perhaps at one time was exactly $\frac{120}{7}$

The earth's spin safety factor is ~~given~~ expressed in terms of the ratio of schuster periods to rotation periods. The first value for which the nth rotation ~~periods and~~ is an integer is 7 ⇒ days in a week!

Also noteworthy is a possible role of the baryon period, one of the basic zeitgebers of the universe. ≐ 2 hr

Mayans used week of 13 days

If P_s were 84^m exactly $= 5040$ sec
then $120 P_s = 7$ days
88-2

1991 #88

$$P_s = \sqrt{\frac{3 R_\oplus^3}{GM_\oplus}}$$

Another interesting property of the Schuster period is that if there were a hole passing through the center of the earth and there were no atmosphere to create drag, a weight dropped in the hole would take exactly half a Schuster period to emerge with zero velocity at the antipode. In the absence of any frictional drag, the weight would oscillate back and forth from antipode to antipode in 84 minutes. In fact the hole would not even have to pass through the center of the earth. With no friction a hole tunneled along any chord through the earth would support the same period of oscillation—84 minutes. It is thus seen that this value of 84 minutes is intimately associated with the earth. It is indeed, along with the day and year, a basic terrestrial period.

∃ also 5068.775 sec

The precise value of the earth's Schuster period is 5042.519 seconds or 84m 2.5s which is the same as 1hr 24m 2.5s. Now comes another interesting property of the Schuster period. There are exactly 120 Schuster periods in one week. The error being less than one part in 2000. This tells us that the earth's Schuster period and the earth's solar rotation period are integrally connected and are in phase at one instant every seven days. Thus the week does have a basis in nature. It is the minimum time required for the rotation period and the Schuster period to return to the same phase.

Get new values for $M_\oplus$, $\bar{R}_\oplus$

When I worked for an aerospace company we had an allotted lunch hour of 42 minutes. I presumed that management was displaying their knowledge of orbital mechanics to impress us we lived in the space age, but curiously 42 minutes seemed to be just the right amount of time for an on site lunch. I have also noticed that in several areas the post office allows 21 minutes parking. Where does the post office get this figure? The time for a weight to fall to the center of the earth doesn't seem connected to the speed of postal service, but it has worked out fairly well (except during the Christmas season). However, the interesting questions are how such an invisible period came to be incorporated into the ancient tradition of a non-technical people; and what is there about the size and mass of the earth that humans seem to sense without instruments and theories?

also 21 min Meditation

But there is also a caveat. There are many calendar reform plans in the wings to simplify the fitting together of months, quarters, and the year. Most of these interject 'free days' two or more times a year, days that would not belong to any of the seven days of the week. Such reforms would destroy the millennia old record of the phase relation between the rotation and gravitation of the earth as mapped onto the days of the week. The week must remain inviolate in accord with how it was established and preserved for thousands of years in the Jewish tradition and later passed on as a heritage for all mankind.

02/17/94

If x = the number of seconds in excess of 84 minutes, the exactness of phase return is lost by $120 \cdot x$ seconds per week. This is analogous to the " of arc of precessional motion of the ♈ per year, leading to the Great Year of about 25,000 years.

What is the length of the "Great Week"?

In 1 week excess = $120x$ sec

But ∃ 604800 seconds in a week

∴ the number of weeks for the weekly excess to total = 1 week

is $\frac{604800}{120x} = \frac{5040}{x}$ weeks

If $x = 2.5$ sec, this is 2016 weeks or ± $38\frac{3}{4}$ years

~ The Sabbath advances 1 day in about $5\frac{1}{2}$ years

Larger values of x ⇒ faster advance of the Sabbath

A more recent value for x is 19.6095 sec based on $\rho_{\oplus} = 5.517\ g/cm^3$

Best values between 233 weeks and 283 weeks → 257 weeks or 4.94 years for the Great Week

4.48 years 5.45 yrs

What is Jubilee? 49 or 50 years Lev 25:8.

The CN week from CHON will also "precess"

The Hebrews approximated to 1 week

The Mayans more precisely found a 1 day advance every 260 days

$$\tau = \sqrt{\frac{3\pi}{G\rho}}$$

$$\boxed{\bar{\rho}_{\oplus} = 5.517\ g/cm^3 \pm .004 \qquad \text{Allen p. 108}}$$

The Great Week is about 5 years

The sabbath advances 1 day in 37 weeks

or 1 day every 260 days

cf. Mayan 260 days

⇒ Gt Week of 1820 days

or 4.983 years

The Mayan 260 day period is related to the ~~1~~ day advance of the 84 min phase-zero

TIMWEEK2.W52 DISK:TIME January 31, 1994

MORE ABOUT THE WEEK

In TIMWEEK1.P51, (1991-#88), several properties of the Schuster period were mentioned. To those reported there should be added the very important property of equatorial fragmentation. The Schuster period is the limiting rotational period for a rotating earth not to disintegrate. For the earth to rotate with a period shorter than 84 minutes, centrifugal force at the equator would exceed ~~the~~ gravitational pull, and the planet would become unstable with mountains flying off into space. But the good news is that we have a considerable "spin safety factor" against that occurring. One rotation period is 1440 minutes, the Schuster period is 84 minutes, giving a safety factor of

$$\frac{24}{60} \qquad \overline{1440}$$

$$\frac{1440}{84} = \frac{120}{7} = \cancel{17\,1/7} \quad 17\tfrac{1}{7} \qquad 84^m = \frac{7}{5}^{hr}$$

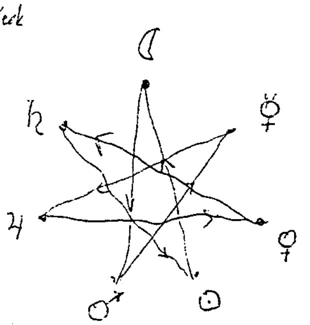
This ratio of 120/7 is also the ratio of Schuster periods to days in a week. Hence the earth's spin safety factor is implicit in the seven day week.

We have seen that the week is the smallest number of earth rotation periods with an integral number of Schuster periods. But also of interest are the "beat periods" between the Schuster cycle and the rotation cycle. Beat frequencies, f_b, are given by

$$f_s \pm f_r = f_b$$

where f_s and f_r are the Schuster and rotational frequencies respectively. Substituting 5/7 hours and 1/24 hours, we get beat periods of $1^h\ 29^m\ 12^s$ and $1^h\ 19^m\ 22^s$. These values are very close to 3/2 hour and 4/3 hour, which divide the 24 hour day into 16 and 18 intervals respectively. It seems that again the ancients were in touch with something we have lost. The division of daylight time into 9 "hours" was an ancient practice. (Still reflected in the Prime, Terce, Sext, None of the monastic day) Did this division of time into nine instead of twelve periods come from subtle or overt experience of ~~the~~ Schuster beat periods?

LATIN	DIA = Order in the Week
Solis	Sunday
Lunae	Monday
Martis	Mardi
Mercurii	Mercredi
Jovis	Jeudi
Veneris	Vendredi
Saturni	Saturni



THE WEEK AS CELEBRATION OF THE 7 PLANETS

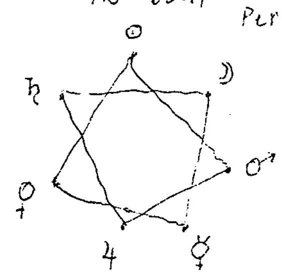
Peri = Order in Sky (sidereal Period)

☽ = 30d
☿ = 88d
♀ 225
☉ 365 (☉ ⟷ ⊕)
♂ 687
♃ 4333
♄ 10795

DIA SKY ORDER

The Dual

Peri: Week Order



The week connects the earth's rotation period of 24 hours with its intrinsic period of 84 minutes.
120 Intrinsics = 7 rotations

Monastic Day
Matins
Lauds
Prime or First Hour
Terce or Third Hour
Sext or Sixth Hour
None or Ninth hour
Vespers
Compline

9 periods goes with 18 beats of $1^h 20^m$ duration

Centrifugal Force Gravitation Pull

$$m\frac{v^2}{R} \leq \frac{GMm}{R^2} \quad \text{Equilibrium}$$

$$\text{If } v^2 > \frac{GM}{R} \quad \text{unstable}$$

$$\text{but } v = \frac{2\pi R}{\tau_s} = \sqrt{\frac{GM}{R}}$$

$$\therefore \text{ if } \tau < \tau_s,\ v > \sqrt{\frac{GM}{R}}$$

$$\tau_s = 2\pi\sqrt{\frac{R^3}{GM_\oplus}}$$

$$\tau_s = \frac{2\pi}{\sqrt{G\rho_\oplus}}$$

Sun	0
M	$17\frac{1}{7}$
T	$34\frac{2}{7}$
W	$51\frac{3}{7}$
Th	$68\frac{4}{7}$
F	$85\frac{5}{7}$
S	$102\frac{6}{7}$
Sun	120

If we launch a surface satellite with a period of 84^m at, say here, 12:00 noon, Sunday then at Noon tomorrow, the satellite will have completed $17\frac{1}{7}$ orbits. And at noon on the day after tomorrow, $34\frac{2}{7}$ orbits ... finally on Saturday, noon $102\frac{6}{7}$ orbits and on Sunday noon 120 orbits

So the next time the satellite will be here at its launch time will be in 7 days

§ = 84 minute unit

The day = $17\frac{1}{7}$ §
The week = 120 §
The Year ≐ 6262 §

What is the Schuster Period of the Moon?

The week also derives from OHON in particular CN and CSi

ROTGRAV.W52 DISK:TIME February 17, 1994

SYNCHRONIZATION OF THE EARTH'S ROTATIONAL AND GRAVITATIONAL PERIODS

cf. 1991 #88
1994 #7
#15
#54
1995 #54

Four basic periods are associated with the earth: The revolution period of one year, the lunation period of one month, the rotation period of one day, and the gravitational (or Schuster) period of 84 minutes (plus a few seconds). Since these various periods have no simple integral multiples, there is the problem of commensuration, or finding the simplest ratios of their values. For example, since ancient times solutions to the problem of when the full moon will occur on the same calendric date have been sought. One answer was the Metonic Cycle of 235 lunations = 19 years. (235 synodical months = 6939.6882 days, while 19 years = 6939.6018 days, the difference being 2h 4m 24s) In the western hemisphere, the Mayans found that 81 moons = 2392 days before the moon appeared in the sky at the same phase at the same time.

The same problem arises in determining the synchronization of the mean solar day with the earth's G-period. To a first approximation the G-period of the earth is 84 minutes. This value synchronizes exactly with the 24 hour rotation period of the earth every seven days. That is 120 x 84 minutes = 7 x 24 x 60 minutes = 10080 minutes. Is it possible that this first approximation to G-period solar day synchronization could be the basis of the week? The question arising here is in what manner did ancient humans sense the G-period.

But the value of the G-period is not exactly 84 minutes. Using the present most probable value for the earth's density of 5.517 ± 0.004 gm/cm^3, the G-period is about 84 minutes and 19.61 ± 1.83 seconds. This means that there is not precise synchronization every seven days, but there is an error of approximately 120 x 20 = 2400 seconds (40 minutes) each week. This value is approximately half a G-period, so we would expect a better approximation to be a fortnight. Actually a minimum synchronization error of 33.4 seconds occurs in 13 days. But this error is accumulative so an exact synchronization, if any, will occur only at some much longer period.

the Mayans used a week of 13 days

To find synchronization periods it is necessary to solve the Diophantine equation

$$N_1 \times CYCLE_1 = N_2 \times CYCLE_2$$

where N_1 and N_2 are integers. For the choice of cycles, G-period and day, we get the following table:

Migrers   Is the day lengthening or shortening?

The mean rotation time of the earth in an ephemeris day is

$$1\ 299\ 548.''204\ 204'' - 0.''0246\ T \qquad \text{Allen p 19}$$

when T is in Julian Centuries

⇒ Thus the period is getting shorter, centuries ago the rotation ~~rate~~ time was longer

Now the Schuster period is $\doteq 84^m 20^s = 5060^s$

and if we take 1 day as $86\,400^s$

then $\frac{D}{S} = 17.075099$

but $\frac{86400}{5040} = 17\frac{1}{7}$ exactly ⇒ 7 day week

What would D have to be for $5060 \to 17\frac{1}{7}$

86742.857 sec

i.e. the day would have to be

343 sec longer to give $17\frac{1}{7}$

But a longer day in the past ⇒ closer to $17\frac{1}{7}$

$$t_E - t_u = 24.^s35 + 72.^s32\,T + 29.^s95\,T^2$$

If t_E ground then ⇒ t_u ~~↓~~
i.e. absolute time   i.e. the day is getting shorter

But I thought the day was increasing → 1 year

Which

We have a 13 day cycle
and a 7 day cycle

7·13 = in phase every 91 days (i.e. each season)

$4 \times 91 = 364$ days $\doteq$ 1 year

---

see

also $3 \log D = 4 \log T$ $222\ T = 13\ D$

DENSITY	PERIOD	No, G-PERIOD	DAYS	ERROR
5.517	84m+19.609s	222	13	+33.3s
5.513	84m+21.445s	973	57	-14.3s
5.521	84m+17.776s	205	12	+44.1s
5.51733	84m+19.3495	222	13	+0.009s

5,5148 84m+18.456 222.044 223 sec ?

The density value of 5.51733, differing very slightly from the most probable value, gives an almost exact synchronization of the day and G-period every 13 days. With this value the maximum error in the 13 day cycle occurs on the seventh day. So, the new twist would be that synchronization does not occur on the seventh day as it would if the G-period were exactly 84 minutes, but that the times get most out of synch on the seventh day. God in creating the world realized that the synch error was increasing every day, and at the end of the sixth day He felt things were getting out of hand, so decided to take the next day off. Things began to improve on the eighth day, but we aren't sure what God did in the second week.

DAYS OF THE WEEK

ENGLISH	SAXON	GERMAN	LATIN	FRENCH	SPANISH
SUNDAY	SUN'S DAY	SONNTAG	DIES SOLIS	DIMANCHE	DOMINGO
MONDAY	MOON'S DAY	MONTAG	DIES LUNAE	LUNDI	LUNES
TUESDAY	TIW'S DAY	DIENSTAG	DIES MARTIS	MARDI	MARTES
WEDNESDAY	WODEN'S DAY	MITWOCH	DIES MERCURII	MERCREDI	MIERCOLES
THURSDAY	THOR'S DAY	DONNERSTAG	DIES JOVIS	JEUDI	JUEVES
FRIDAY	FRIGG'S DAY	FREITAG	DIES VENERIS	VENDREDI	VIERNES
SATURDAY	SETERNE'S DAY	SAMSTAG	DIES SATURNI	SAMEDI	SABADO

RUSSIAN	GREEK	SWEDISH	ITALIAN	JAPANESE	JAPANESE
ВОСКРЕСЕНЬЕ	ΚΥΡΙΑΚΗ	SÖNDAG	DOMINICA	NICHIYOUBI	日
ПОНЕДЕЛЬНИК	ΔΕΥΤΕΡΑ	MÄNDAG	LUNEDI	GETSUYOUBI	月
ВТОРНИК	ΤΡΙΤΗ	TISDAG	MARTEDI	KAYOUBI	火
СРЕДА	ΤΕΤΑΡΤΗ	ONSDAG	MERCOLEDI	SUIYOUBI	水
ЧЕТВЕРГ	ΠΕΜΠΤΗ	TORSDAG	GIOVEDI	MOKUYOUBI	木
ПЯТНИЦА	ΠΑΡΑΣΚΕΥΗ	FREDAG	VENERDI	KINYOUBI	金
СУББОТА	ΣΑΒΒΑΤΟΜ	LÖRDAG	SABATO	DOYOUBI	土

POLISH	HEBREW
NIEDZIELA	REESHOHN
PONIEDZIALEK	SHAYNEE
WTOREK	SHLEESHEE
SRODA	REMVEEEE
CZWARTEK	KHAHMEESHEE
PIATEK	SHEESHEE
SOBOTA	SHAHBAHT

1994 15

MOREWEEK.WPD APRIL 10, 2000

see also 1991 #88; 1994 #7, #13, #15

STILL MORE ABOUT THE WEEK

It has been noted that in looking for a natural cycle related to the week, that it is the earth itself, not the moon or some other planet, that provides the cycle. Indeed, it is the relation between the day and the earth's Schuster period that gives us a cyclical basis for the week. The Schuster period is related to the mass and size of the earth and is the time period in which a satellite would circle the earth at its surface were there no atmosphere or other obstructions. It is the limiting value of time that Kepler's third law would assume for a minimum orbital radius. In this case the minimum orbital radius being the mean radius of the earth itself. The Schuster time T is given by,

$$T = 2\pi\sqrt{\frac{R^3}{GM}}$$

where R is the earth's mean radius, G is Newton's constant, and M is the mass of the earth.

		Value in seconds	$\log_{10}$ value in seconds
T	The earth's Schuster Period	5042.51897	3.7026475
S	The earth's sidereal day	86164.09054	4.9353264
D	The mean solar day	86400.	4.9365137

First note the ratios: $T^4 \simeq D^3$

$\frac{\log T}{\log S} = 0.7502326$ $\frac{\log T}{\log D} = 0.7500531$ $\simeq$ a fractal dimension?

Indicating that to within about 5 parts in 10^5 the ratio of the logarithms of the Schuster period to the day is 3 to 4. An example that many of the astronomical period or frequency ratios are between log values, unlike ratios of frequencies in music. $\frac{T}{D} = \frac{120}{7}$

Next note the following values:

The first solution to the diaphantine equation M x T = N x D gives M = 120 and N = 7.

D/T = 17.134294, 120/7 = 17.142857, with $\delta = 0.009$ or 9 parts in 10^3

Seven days is equal to 604,800 seconds, 120 Schuster periods is equal to 605,102.27 seconds, the difference being 302 seconds or just over five minutes.

302/604,800 = 0.0004993 or 5 parts in 10^4

It is accordingly suggested, without a mythic explanation regarding the origin of the week, that somehow humans tuned in on this basic relation between these two fundamental natural cycles.

COSCUR2A.WPD December 9, 2007

COSMIC CURIOSITIES PART III

THREE TERRESTRIAL CYCLES

EARTH		Value in seconds	$\log_{10}$ value in seconds
T	The Schuster Period	5058.40	3.704013
D	The mean solar day	86400.00	4.936514
S	The mean sidereal day	86163.9	4.935325

Note that $\log_{10}(T)/\log_{10}(D) = 0.750330$ which to about 3 parts in 10^4 is equal to 3/4.

$\log_{10} T^4 = 14.816$ $\log_{10} D^3 = 14.810$

$\log_{10}(T)/\log_{10}(S) = 0.750510$

The Schuster period is determined by the mass M and radius R of the earth and is the time period in which a satellite would circle a spherical earth at its surface were there no atmosphere or other obstructions. $T = 2\pi\sqrt{(R^3/GM)}$

The mean solar day is the rotation period of the earth with respect to the sun.

The mean sidereal day is the rotation period of the earth with respect to fixed stars.

The above values are derived from a mean earth radius 6.371000×10^8 cm and Earth mass of 5.9737×10^{27} g [Cox, Astrophysical Quantities 1999]

$\log_{10}R = 8.804\,207\,605$ $\log_{10}M = 27.776\,243\,408$ $\log_{10}G = -7.175\,296$

SUN		Value in seconds	$\log_{10}$ value in seconds
T	The Schuster Period	10003.754	4.000163
S	The rotation period	2192832	6.343335

compare values with MOREWEEK.WPD APR 10,2000 #22

$\log\left(\frac{T}{2\pi}\right) = 2.905833$

$-13.268\,161$

$46.173\,994$

$\alpha^{12}\mu^{32} = 46.164$ $\Delta = 0.004$

$T = 5059.3495$

$\times 222 =$

~~1123175.6~~

$86400.00 \times 13 = 1123200$

~~1140200~~

$\Delta =$ ~~12975~~ 24.4 sec

cf ROTGRAV.? 94 #13

14.816 14.810

$\boxed{222T = 13D \qquad 4\log T = 3\log D}$

If $T = 84^m = 5040^s$

$\Delta = 4 \log T - 3 \log D = 0.000181 \rightarrow 1.0004168$ sec

If $T = 84^m\ 19\overset{s}{.}4595$

$222T - 13D = 0.000000$ sec

The week is the 7th harmonic of the day
The week is the 120th harmonic of the Schuster Period = S

both = 10,080 ~~min~~

log harmonics: S = Schuster

$4 \log S = 3 \log D$

The 4th harmonic of log S
= The 3rd harmonic of log D

A ratio of logarithms is a fractal dimension

RELATIONS BETWEEN D & S

$$\boxed{\begin{aligned} 7 \times D &= 120 \times S \\ 3 \times \log D &= 4 \times \log S \end{aligned}}$$

independent of the base of logarithms

$21\, D \log D = 480\, S \log S$
$28\, D \log S = 360\, S \log D$

$\frac{90}{7}$ $A = \frac{360}{28} \frac{S \log D}{D \log S} = 12{,}857143 \frac{SD}{DS}$

$\frac{160}{7}$ $B = \frac{480}{21} \frac{S \log S}{D \log D} = 22{,}857143 \frac{SS}{DD}$

$\frac{22}{12} = 1.\bar{7} = \left(\frac{4}{3}\right)^2$

$\frac{160}{7} \frac{\log S^S}{\log D^D} - \frac{90}{7} \frac{\log D^S}{\log S^D} = \cancel{10}$

$4^2 \frac{\log S^S}{\log D^D} - 3^2 \frac{\log D^S}{\log S^D} = 7$

$\frac{360}{28} + 10 = \frac{480}{21}$

$3^2 + 7 = 4^2$ $\qquad 3^2 + 7 = 2^4$
$-3^2 + 5^2 = 4^2$ $\qquad 5^2 + 7 = 2^5$
$7 + 5^2 = 2^5$ $\qquad 11^2 + 7 = 2^7$

$\frac{A}{B} = \left(\frac{4}{3}\right)^2 \frac{SS}{DD} \cdot \frac{DS}{SD}$

1.8

If $K = \frac{3 \cdot 4 \cdot 10}{7} = \frac{120}{7} = 17.142857$, $\log K = 1.2340832$

then $K^{32} = 3.059 \times 10^{39}$

$= 39.490662$

$\delta = 0.134781$

$K^{33} = 40.724746$

$\alpha_{MS} = 40.482954$

$\delta = 0.241792$

$14 \times \delta = 3.385088$

$(\alpha_M)^3 = 3.381222$

MAYAN.WPD JULY 29, 2000

STILL EVEN MORE ABOUT THE WEEK

see also 1991 #88; 1994 #7, #13, #15; 2000 #22

It was shown in Scrap 2000 #22 that the relation between the earth's rotation period (the 24 hour solar day) and the earth's Schuster period, $T=2\pi\sqrt{(R^3/GM)}$, could be taken as the basis for the seven day week.[1]

		Value in seconds[2]	$\log_{10}$ value in seconds
T	The earth's Schuster Period	5060.24	3.704171
D	The mean solar day	86400.00	4.936514
H	The Hydrogen Period	7239.07	3.859683

First note the ratio:

$$\frac{\log T}{\log D} = 0.750361 \cong 3/4$$

Indicating that to within about 4 parts in 10^4 the ratio of the logarithms of the Schuster period to the day is 3 to 4. In other words, $(5060.24)^{1/3} = 17.168$ and $(86400)^{1/4} = 17.145$, $\Delta = 0.023$ or $(5060.24)^4 = 655{,}668{,}714 \times 10^6$ and $(86400)^3 = 644{,}972{,}544 \times 10^6$; whose ratio is 1.0166 or $(5060{,}24)^{4/3} = 86875$ and $(86400)^{3/4} = 5039.48$; Hence $T^4 \cong D^3$.

For seven days, assuming 120 Schuster periods, 7 x 86400 = 604800 seconds and 120 x 5060.24 = 607229 seconds, an error, Δ = 2429 seconds (48 m 40s) in seven days. Possibly a basis for a seven day week.
However,
For thirteen days, assuming 222 Schuster periods, 13 x 86400 = 1123200 seconds and 222 x 5060.24 = 1123373.28 seconds, an error, Δ = 173 seconds (2 m 53s) in 13 days. A very good case for a thirteen day week.

And where has there been a thirteen day week? The ancient Maya used a basic thirteen day period and from their vigesimal number system of base 20 derived a sacred "year" of 260 days. [TZOLKIN] We know that the Maya were good astronomers deriving a calendric year more accurate than our present Gregorian year. So maybe they were also good geophysicists recognizing the relation between the earth's Schuster period and the earth's solar rotation period.

360 Day = TUN
365 day = haab

---

[1]The Schuster period is determined by the mass M and radius R of the earth and is the time period in which a satellite would circle a spherical earth at its surface were there no atmosphere or other obstructions.

[2]These values are derived from a mean earth radius 6.371000×10^8 cm and Earth mass of 5.9737×10^{27} g [Cox, Astrophysical Quantities 1999] ; and $G = 6.674215 \times 10^{-8}\ cm^3/g\ s^2$ [Physics Today July 2000 p 21]

2002 #12

WEEKPLUS.WPD	2002-03-18

EVEN MORE ON THE ORIGIN OF THE WEEK

Nine hundred million [9×10^8] years ago the length of the day was 18 hours. In subsequent time the tides, largely lunar, have gradually slowed the turning rate of the earth increasing the length of the day to the present 24 hours. To balance the resulting decrease in the earth's angular momentum, the angular momentum $\{MR^2/T\}$ of the earth-moon system has changed. This has resulted in the moon moving further away from the earth at a rate of about 3.82 ± 0.07 cm/year.[1] Observations [eg radar ranging of the lunar distance] and calculations [eg records of times and places of ancient eclipses] indicate that the rate of increase in the length of the day has been:

2.43 ± 0.07 milliseconds per century from 390 BCE to 948 AD. and
1.40 ± 0.04 milliseconds per century from 948 AD to 1800 AD [2]

In addition to the rotation period, [length of day], a second important period associated with the earth is the so called "Schuster Period", the time it would take for an artificial satellite to orbit the earth at its surface if the earth were an airless smooth sphere. This period, τ, is a function of the mean density of the earth, ρ, and is given by, $\tau = (G\,\rho)^{-1/2}$, where G is Newton's gravitational constant

Table I gives the values of the Schuster period in seconds corresponding to the best estimates of the earth's mean density in gm/cm^3.

TABLE I

DENSITY	5.513	5.517 ± 0.004	5.521
PERIOD 84m +	21.439 s	19.609 ± 1.83 s	17.779 s

Using the present most probable value for the earth's density of 5.517 gm/cm^3, the Schuster period is close to 84 minutes and 19.61 seconds. If we take this value as being constant over millions of years, we ask at what dates in the past or in the future will the ratio of the rotation period to the Schuster period have small rational values. That is, what are the smallest integers N_D and N_S that are solutions of the Diophantine equation,

$$N_D \times (\text{Length of Day}) = N_S \times (\text{Schuster Period})$$

---

[1] K. R. Lang, ASTROPHYSICAL FORMULAE Vol II p. 80

[2] Ibid p. 80

MOONMAYA.WPD June 15, 2004

SATELLITES
THE MOON AND THE MAYANS

One of the puzzling questions about the Mayan calendar and their system of time has been the origin of their 260 day "TUN". This period does not seem to ~~have any astronomical~~ basis, as does their "HAAB" which corresponds to our year. But tun was as important as haab in the Mayan reckoning of time.

It has been shown in a previous scrap [2000 #43] that the tun could have been the product of their vigesimal, base 20, number system and their selection of 13 days for the week. The origin of the latter could have been the close resonance between the earth's Schuster period[1] and its rotation period. It was noted that the error between **seven** rotation periods of 86,400 seconds and 120 Schuster periods of 5059.61 seconds is 2353 seconds. While the error between **thirteen** rotation periods and 222 Schuster periods is only 33 seconds. This would make a good case for a 13 day week instead of a 7 day week, provided that the Schuster period is the geophysical cycle basic to the week.

Comparisons for the tun:

Twenty 13 day weeks = 260 days; the error to 4440 Schuster periods is 668 seconds.
Thirty seven 7 day weeks = 259 days: error to 4423 Schuster periods is 1055 seconds.
[In both cases the Schuster values exceed the rotational values]

But there is another possibility for the origin of the tun.

The lunar sidereal period is 27.3217 days. Nineteen of these periods equals 519.1123 days. This is an error of 0.8877 days in two tuns or less than a half day per tun.

So if we wish to pick a number of days that closely represents several cycles.

From the Schuster cycle and a 7 day week	259 days
From the lunar sidereal cycle	259.56 days
From the Schuster cycle and 13 day week	260 days

The tun is a useful choice.

---

[1] The Schuster Period, t, is the limiting value in Kepler's third law, $t^2 = d^3/GM$, when the distance, d, is taken as the distance from the earth's center to its surface and where M is the mass of the earth. It is the time a satellite would take to circle the earth at the surface if the earth were a smooth sphere with no atmosphere. Or if there were a hole through the earth, it is the time an object would require to make a round trip through the hole.

Fibonacci Numbers in Planetary Periods

02/02/92

	using $☿_{*} = 87.9686$ d calculated	measured	ACCURATE TO WITHIN A DAY ☿
Set $☿_{*} = 1$	87.9686 d	87.9686	
then $♀_{*} = \left(\frac{8}{5}\right)^2$	225.19962	224.700	0.5
$⊕_{*} = \frac{13}{5} \cdot \frac{8}{5}$ or $\frac{13}{8} \cdot \left(\frac{8}{5}\right)^2$	365.94938	365.2422	0.71
$♂_{*} = 3 \cdot \frac{13}{5}$ or $3 \cdot \frac{13}{8} \cdot \frac{8}{5}$	686.15508	686.980	0.82
$\left(♃ = \frac{21 \cdot 13}{2} \cdot \left(\frac{3}{5}\right)^2 \right)$ Improve	4322.7777	4332.587	10

Note that the ⊕ ^ ♀ syndodic is 585.519 583.914
from the earth this is
$\frac{8}{5} Y = 584.3875$

How do these fit in with Titus-Bode Law?
$T^2 \propto R^3$

$\boxed{\text{CHON's 56 d} = \frac{5}{8} ☿_{*} + 1}$

$T/3 \doteq \frac{Y}{140}$

$\boxed{1 + \frac{8}{13} Y = \varphi Y}$

$28 \times \cancel{\frac{8}{5} = 44}$

$\boxed{56 \times \frac{8}{5} = 89.6}$

$140 \times \frac{5}{8} = 87.5$

54.68

Tie in with CHON use 56 d ~~28~~ — 1 day off

$\frac{5}{8} ☿_{*} = 54.98$ or 55 d

The Pythagoreans:
Pythagoras scales
Kepler ($T^2 - R^3$)
Titus-Bode (Law)
Mendelev Periodic Table
Eddington-Dirac α, S, μ, $\hbar, G, c$
Bennett integers

Those who believe the ur-archetypes are numbers

Those who feel the explanation of the world is to be ultimately found in the properties of numbers

The success of mathematics in describing the world is attributable to the fact that the ur-archetype is number.

Make $☿ = \frac{5}{8}$, then $♀ = \frac{8}{5}$, $⊕ = \frac{13}{8} \cdot \frac{8}{5} = \frac{13}{5}$, $♂ = 3 \cdot \frac{13}{8}$

what is 1 ? = 5 CHON

Moon^2. 365.2422/13 = 28.0955 cf chon

140 d = ? with CHON?

$\frac{5}{13}$ 365.2422 = 140.47

140 = 5 CHON

$1 = \frac{5}{13} Y = 140.47$ d $=$ ~~$\varphi Y(\varphi-1)$~~ $Y(1-\varphi)$

$\varphi^2 Y = 139.49$

$\frac{5}{13} Y = \varphi^2 Y + 1$

SONG REGISTRATIONS

HS-7T

$\frac{584}{365} = 1.6 = \frac{8}{5}$

♀ syn 5 in 8 Y

219

228

$369 \times \frac{8}{13} = 224.615$ ♀☆

$584 \times \frac{5}{13} = 224,615$ ♀☆

$224.615 \cdot \frac{5}{8} = 140,38462$

$554 \cdot \frac{5}{13} \cdot \frac{5}{8} = 140,38$

$365 \cdot \frac{5}{13} = 140,3$

$140,38 \cdot \frac{5}{8} = 87,740384$ ☿☆

~~DER ANFANG~~

~~DIES IST EIN BEISPIEL VON FTPRO SCHRIFT~~

What CHON → 28 . . . ?
→ 140 ?
→ 225 ?

13 CHON = 364

0000000001

♀☆	= 1	[224.700]
⊕☆	= $\frac{13}{8}$	365.1375 [365.2422]
	$\frac{5}{8}$	140.4375
☿☆	$\left(\frac{5}{8}\right)^2$	87.773 [87.9686]
⊕ − ♀	$\frac{13}{5}$	584.22 [583.914]
♂☆	$\frac{13}{8} \frac{15}{8}$ or $3 \frac{5}{8} \frac{13}{8}$	684.63 [686.980]

0000000001

1.6 1.618034 ☿ = 1

$\frac{8}{5} \sim \varphi$

♀ 2.56 $\left(\frac{8}{5}\right)^2 \sim \varphi^2$ 2.618034

⊕ 4.16 $\frac{13}{8} \times \left(\frac{8}{5}\right)^2 \sim \varphi^3$ 4.2360681

♂ 7.8 $3 \times \frac{13}{8} \times \frac{8}{5} \sim 3\varphi^2$ 7.8541021

♃ $\frac{21 \cdot 13}{2} \cdot \left(\frac{3}{5}\right)^2$

$\frac{1}{2} \quad \frac{21}{13} \cdot 13 \cdot 13 \quad \frac{3}{5} \quad \frac{3}{5}$

49.14 $\frac{21}{13} \cdot \frac{13}{8} \cdot \frac{13}{8} \cdot \frac{8}{5} \cdot \frac{8}{5} \cdot \frac{3^2}{2} \sim 3 \times \varphi^6$ 53.832818

♄

$225 = 15^2$

$9^2 + 7 = 88$

$19^2 + 2^2 = 365$

$26^2 + 11 = 687$

9	
15	6
19	4
26	7

687
$26^2 =$ 676
11

<27>&0

Macro Def

Doc 1 Pg 1 Ln 1" POS 1.6"

<27>&0o

Macro Def

Doc 1 Pg 1 Ln 1" POS 1.7"

PERIDIAL 04/01/92

EXAMPLES:

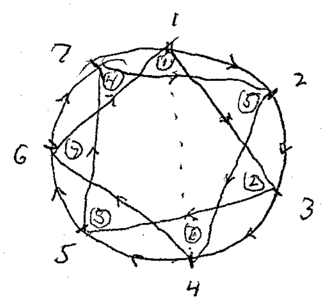
- The Liturgical Year 13 skip 8 (Fibonacci)
- The Enneagram 9 follow $\frac{1}{7}$
- The Circle of Fifths 12 skip 5
- The Days of the Week 7 skip 3

I CHING

FU HI vs KING WEN

PERIDIAL: ∃ a relation between temporal $\begin{bmatrix}\text{sequence}\\ \text{causality}\end{bmatrix}$ (peri) and archetypal $\begin{bmatrix}\text{sequence}\\ \text{causality}\end{bmatrix}$ (dia)

One representation is by the circle, arc circumference (peri) vs. polygon, chord diameters (dia) diagrams.



1	2	3	4	5	6	7	peri	
1	5	2	6	3	7	4	dia I	> Σ = 9
$\boxed{1}$	$\boxed{4}$	$\boxed{7}$	$\boxed{3}$	$\boxed{6}$	$\boxed{2}$	$\boxed{5}$	dia II	

$\frac{1}{7} = 1.4285714\ldots$

DAYS OF THE WEEK ~~DIA II~~

	M	T	W	θ	F	Σ	S	
name corresponding (in Latin)	~~S~~	~~M~~	~~T~~	~~W~~	~~θ~~	~~F~~	~~Σ~~	
	~~1~~	~~4~~	~~7~~	~~3~~	~~6~~	~~2~~	~~5~~	
	☾	♂	☿	♃	♀	♄	☉	
DIA I	1	5	2	6	3	7	4	

Planetary Order

☾	☿	♀	⊕	♂	♃	♄	
M	W	F	S	T	θ	Σ	
1	2	3	4	5	6	7	PERI

i.e. if the planets are placed in peri order ~ sidereal periods, then DIA I gives the order of the days of the week

Archetypes Patterns not in but through time

DIA II ☾ ☉ ♄ ♀ ♃ ☿ ♂ reverse order

ARCHETYPAL ⇔ CAUSAL

Dia, atemporal sequence Peri-temporal sequence

Learn how to obtain essential nutrients from healing quality foods. How to balance your meals and transform your moods. How diet is related to disease, and How the macrobiotic approach extends beyond the individual to include benefits for the social and natural order.

macrobiotics

at the Ginkgo Leaf
21109 Costanso
Woodland Hills
818/716-6332

Another representation for the days of the week ↔ planets

WEEK ORDER →

WEEK ORDER ↓

M	T	W	Θ	F	Σ	S
T	W	Θ	F	Σ	S	M
W	Θ	F	Σ	S	M	T
Θ	F	Σ	S	M	T	W
F	Σ	S	M	T	W	Θ
Σ	S	M	T	W	Θ	F
S	M	T	W	Θ	F	Σ

↗ FIXED DAY

↘ Different slices

↘ Planetary Sidereal period order

WEEK →, WEEK ↓, FIXED ↗, PERIOD ↘

Note the Synodic Period in Days

☿	115.88
♀	583.92
☉	365.22
♂	779.94
♃	398.88
♄	378.09
☾	28

PERIOD ORDER →

WEEK ORDER ↓

↗ WEEK ORDER

PERIOD →, PERIOD ↓, FIXED ↗, ↘ ?

SYNODIC ORDER →

☾	☿	☉	♄	♃	♀	♂
M	W	S	Σ	Θ	F	T
W	S	Σ	Θ	F	T	M
S	Σ	Θ	F	T	M	W
Σ	Θ	F	T	M	W	S
Θ	F	T	M	W	S	Σ
F	T	M	W	S	Σ	Θ
T	M	W	S	Σ	Θ	F

↘ ?

MASS ORDER →

Mass →, Mass ↓, ↘ ?

☉	♃	♄	♀	♂	☿	☾
♃	♄	♀	♂	☿	☾	☉
♄	♀	♂	☿	☾	☉	♃
♀	♂	☿	☾	☉	♃	♄
♂	☿	☾	☉	♃	♄	♀
☿	☾	☉	♃	♄	♀	♂
☾	☉	♃	♄	♀	♂	☿

↘ ?

or

♃	♄	⊕	♀	♂	☿	☾
♄	⊕	♀	♂	☿	☾	♃
⊕	♀	♂	☿	☾	♃	♄
♀	♂	☿	☾			
♂						
☿						
☾						

The only peridial relationship seems to be an artificial one: sidereal periods ↔ week order

Diagrams originating i.e. week order → sideal order
with (natural) natural order → nothing

At the time of the setting up of the order of the days of the week were the sidereal periods known? (in relative distances)

Either they were known and the peridial diagram was an occult way to encode them, or the whole thing is fortuitous.

synodic periods were known

$$\frac{1}{Syn} = \frac{1}{\oplus_{year}} - \frac{1}{Planet *}$$

Maybe this was known

macrobiotics

Learn how to obtain essential nutrients from healing quality foods. How to balance your meals and transform your moods. How diet is related to disease, and How the macrobiotic approach extends beyond the individual to include benefits for the social and natural order.

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SCHUPER1.WB1

		SCHUSTER PERIOD/DAY RESONANCES							
		MOST PROBABLE		84 MINUTE		MINIMUM VALUE		MAXIMUM VALUE	
δ from an integer		5059.5 SEC		5040 SEC		5042.5 SEC		5069.7 SEC	
	1	17.07679	17.07679	17.14286	17.14286	17.13436	17.13436	17.04243	17.04243
	2		34.15357		34.28571		34.26872		34.08486
	3		51.23036		51.42857		51.40307		51.12729
	4		68.30714		68.57143		68.53743		68.16971
	5		85.38393		85.71429		85.67179		85.21214
	6		102.4607		102.8571		102.8061		102.2546
	7		119.5375		120	.0595	119.9405		119.297
	8		136.6143		137.1429		137.0749		136.3394
	9		153.6911		154.2857		154.2092		153.3819
	10		170.7679		171.4286		171.3436		170.4243
	11		187.8446		188.5714		188.4779		187.4667
	12		204.9214		205.7143		205.6123		204.5091
δ=0.0018	13	→	221.9982		222.8571		222.7467		221.5516
	14		239.075		240	.1190	239.881		238.594
	15		256.1518		257.1429		257.0154		255.6364
	16		273.2286		274.2857		274.1497		272.6789
	17		290.3054		291.4286		291.2841		289.7213
	18		307.3821		308.5714		308.4184		306.7637
	19		324.4589		325.7143		325.5528		323.8061
	20		341.5357		342.8571		342.6872		340.8486
	21		358.6125		360		359.8215		357.891
	22		375.6893		377.1429		376.9559		374.9334
	23		392.7661		394.2857		394.0902	.0241	391.9759
	24		409.8429		411.4286		411.2246	.0183	409.0183
	25		426.9196		428.5714		428.3589		426.0607
.0036	26		443.9964		445.7143		445.4933		443.1031
	27		461.0732		462.8571		462.6277		460.1456
	28		478.15		480		479.762		477.188
	29		495.2268		497.1429		496.8964		494.2304
	30		512.3036		514.2857		514.0307		511.2729
	31		529.3804		531.4286		531.1651		528.3153
	32		546.4572		548.5714		548.2995		545.3577
	33		563.5339		565.7143		565.4338		562.4001
	34		580.6107		582.8571		582.5682		579.4426
	35		597.6875		600		599.7025		596.485
	36		614.7643		617.1429		616.8369		613.5274
	37		631.8411		634.2857		633.9712		630.5699
	38		648.9179		651.4286		651.1056		647.6123
.0053	39		665.9947		668.5714		668.24		664.6547
	40		683.0714		685.7143		685.3743		681.6971
	41		700.1482		702.8571		702.5087		698.7396
	42		717.225		720		719.643		715.782
	43		734.3018		737.1429		736.7774		732.8244
	44		751.3786				753.9118		749.8669
	45						771.0461		766.9093
	46						788.1805		783.9517
	47						805.3148	.0059	800.9941
	48						822.4492		818.0366
	49						839.5835		835.079

SCHUPER2.WB1

days	rec	17 + REC	SCH PER
1	1	18	4800
2	0.5	17.5	4937.143
3	0.333333	17.33333	4984.615
4	0.25	17.25	5008.696
5	0.2	17.2	5023.256
6	0.166667	17.16667	5033.01
7	0.142857	17.14286	5040
8	0.125	17.125	5045.255
9	0.111111	17.11111	5049.351
10	0.1	17.1	5052.632
11	0.090909	17.09091	5055.319
12	0.083333	17.08333	5057.561
13	0.076923	17.07692	5059.459 ←
14	0.071429	17.07143	5061.088
15	0.066667	17.06667	5062.5
16	0.0625	17.0625	5063.736
17	0.058824	17.05882	5064.828
18	0.055556	17.05556	5065.798
19	0.052632	17.05263	5066.667
20	0.05	17.05	5067.449
21	0.047619	17.04762	5068.156
22	0.045455	17.04545	5068.8
23	0.043478	17.04348	5069.388
24	0.041667	17.04167	5069.927
25	0.04	17.04	5070.423
26	0.038462	17.03846	5070.88
27	0.037037	17.03704	5071.304
28	0.035714	17.03571	5071.698

The first approximation is 84 min = 5040 sec ~ 7 days 120 Sch rhythm

This is the lower bound

Second approx:
The most likely value of the Period of Schuster is 5059.5 ~ 13 days

The 28 day lunar × the 13 day Schuster = 364 days

☾ × ⊕ = ☉

D = days

$d = \frac{1}{D}$ = rec

17 + d = 17 + rec

$P_{SCH} = \frac{86400}{17+d}$ $\frac{\text{sec/day}}{\text{Sch/day}} = \frac{\text{sec}}{\text{Sch per}}$

Bio Rhythms
23d
28d
33d

CHON

NEWCHON3.WP6 March 11, 1996 Rev, April 11, 1996

EXPLORING CHON

Aristotle held that time was an inference of **motion**. But there appears to be a species of time that is not derived from motion. This time is associated with the **density** of matter and manifests as a zeitgeber that governs local clock rates. Its period is inversely proportional to the square root of the mass density. A familiar example is the Schuster Period, a bound on the period of an earth orbiting satellite when only gravitational and inertial forces are acting. This period of approximately 84 minutes is numerically related to the mean density of the earth and to the universal gravitational constant,G. In general the lower limit to orbiting periods is given by,

(1)

$$\tau = 2\pi \sqrt{\frac{R^3}{GM}}$$

Where R is a size parameter (radius) and M is a mass parameter. It is seen that equation (1) is a bounding case of Kepler's third law. For a spherical body, this boundary time, τ, in terms of the mean density ρ, is given by,

(2)

$$\tau = \sqrt{\frac{3\pi}{G\rho}}$$

Equations (1) and (2) are usually applied to astronomical bodies and since gravity is a force weaker than other forces by some 40 orders of magnitude, it seems quite inappropriate that these equations contain anything of significance for bodies where gravity plays no detectable role, in particular for micro objects such as atoms and sub-atomic particles. There is, however, nothing known that precludes the universal applicability of these equations. At first thought, when applied to objects on the atomic level, it would seem the results would be insignificantly small. Remembering, though, that we are dealing with time, not size or force, this is not the case. Coulomb times are of the order of 10^{-16} seconds. If the ratio of force strengths between coulomb and gravitatonal forces is of the order of 10^{40} then the ratio of gravitational times to coulomb times must be of the order of 10^{20} leading to atomic graviational times of the order of 10^{4} seconds.

As an example, take for size the Bohr radius, a_o, and for mass the proton mass, m_p. The time τ_H, turns out to be almost exactly 2 hours! Explicitly,

(3) $$\tau_H = 2\pi\sqrt{\frac{a_o^{\ 3}}{Gm_p}} = 7239.94\text{sec} = 2\,hours\ 40\,seconds$$

Another example is the Schuster time for an electron. Using r_e, the electron radius and m_e, the electron mass, the Schuster period is given by,

(4) $$\tau_e = 2\pi\sqrt{\frac{r_e^{\ 3}}{Gm_e}} = 0.121\text{sec}$$

which is about one-eighth of a second, again in the time frame of daily experience as this is an important time interval for human visual perceptions.

A third value of possible physiological interest is the time given by the Schuster period of the proton:

(5) $$\tau_p = 2\pi\sqrt{\frac{r_e^{\ 3}}{Gm_p}} = 2.813\ millisec$$

The time values given in equations 3), 4), and 5), since they are present in every atom or organic molecule, may play the role of zeitgebers in physiological processes.

Noting the near coincidence of the hydrogen gravitational time of two hours with twice the culturally employed time unit derived from the earth's rotation period, we are led to surmise that micro gravitational times may play some hitherto unsuspected role. On the basis of the result for atomic hydrogen it seems relevant to go further and inquire how equation(1) might be applied to other atoms.

The correct value to be used for mass in equation(1) is likely to be a function of the atomic weight of the atom. But the value to be used for the size (radius) in equation(1) is uncertain as we are dealing with gravitational rather than coulomb effects.

One approach is to note that the relation between density and mass for some larger bodies, planets, stars, etc., is that the density is roughly proportional to the reciprocal of the mass,

$$\rho \propto M^{-1}.$$

Alternate Assumption 1] We provisionally assume the same for atoms, that the density varies inversely with the mass. This is equivalent to $M^2 \propto R^3$. Substituting $(KGM)^2$ for R^3 in equation(1), we get,

(6) $$\tau = 2\pi\sqrt{\frac{(KGM)^2}{GM}} = 2\pi K^{3/2}\sqrt{GM}$$

That is, the period τ is approximately proportional to the square root of the mass. This leads to,

(7) $$\frac{\tau}{\tau_H} = \frac{2\pi K^{3/2}\sqrt{GM}}{2\pi K^{3/2}\sqrt{Gm_p}} = \frac{\sqrt{M}}{\sqrt{m_p}} = \sqrt{A}$$

where A is the atomic weight.
Using this result, $\tau_A = \tau_H\sqrt{A}$, we can construct the following table:

ELEMENT	ATOMIC WEIGHT	$\sqrt{A}$	SCHUSTER PERIOD
HYDROGEN	1.0080	1	2hr 0m 40sec = 1/12 day
CARBON	12.0112	3.47	6.98 hr
NITROGEN	14.0067	3.74	7.52 hr
OXYGEN	15.9994	4	8.04 hr

The values in the table are within less than half of a percent of 7 hours for carbon, 7.5 hours for nitrogen, and 8 hours for oxygen. These periods are closely commensurate with the rotation period of the earth as given in the second table.

ATOMIC COMBINATIONS	PERIODS
$24\tau_C$ = 168hr	7 days
$16\tau_N$ = 120hr	5 days
$3\tau_O$ = 24hr	1 day

It should be noted that the elements most abundant in and important to living organisms give rise to periods nearly commensurate with the earth's rotaton. Are the periods of these atoms in animal and human cells the zeitgebers for circadian rhythms?

A second possible approach to the question of the proper radius to employ for gravitational times is to assume that all atoms in ordinary state have the same gravitational potential. This assumption is equivalent to: size is proportional to mass.

14d

Alternate Assumption 2] Assume for atoms in organic molecules that size is proportional to mass, R = KGM. Substituting KGM for R in equation 1) gives,

$$\tau = 2\pi\sqrt{\frac{(KGM)^3}{GM}} = 2\pi K^{3/2}GM \tag{8}$$

That is, the period τ for ordinary matter is closely proportional to the mass, and since $\tau_H = 2\pi K^{3/2}Gm_p$,

$$\frac{\tau}{\tau_H} = \frac{2\pi K^{3/2}GM}{2\pi K^{3/2}Gm_p} = \frac{M}{m_p} = A \tag{9}$$

where A is the atomic weight. Using this result, $\tau_A = A\tau_H$, we can construct the following table:

ELEMENT	ATOMIC WEIGHT	SCHUSTER PERIOD
HYDROGEN	1.0080	2hr 0m 40sec = 1/12 day
CARBON	12.0112	24hr 9m 20sec = 1 day
NITROGEN	14.0067	28hr 10m 7sec = 7/6 day
OXYGEN	15.9994	32hr 10m 33sec = 4/3 day
POTASSIUM	39.102	78hr 38m 16sec = 13/4 day

Again the values in the table are (with the exception of potassium) close approximations to periods commensurate to common astronomical periods. Resulting values in days are given in the following table.

ATOMIC COMBINATIONS	PERIODS
$1\tau_C = 12\tau_H$	τ_{CH} = 1 day
$7\tau_{CH} = 6\tau_N$	τ_{CHN} = 7 days
$4\tau_{CHN} = 7\tau_O$	τ_{CHON} = 28 days
$13\tau_{CHON} = 112\tau_K$	τ_{CHONK} = 364 days *

Again we note that the elements most abundant in and important to living organisms give rise to the common periods of time derived from the earth's motions. *[More precisely, 366 1/3 days.]

NEWCHON2.WP6 October 26, 1995

CHON REVISITED

Replaces 1995 # 73

Aristotle held that time was an inference of **motion**. But there appears to be a species of time that is not derived from motion. This time is associated with the **density** of matter and manifests as a zeitgeber that governs local clock rates. Its period is inversely proportional to the square root of the mass density. A familiar example is the Schuster Period, a bound on the period of an earth orbiting satellite when only gravitational and inertial forces are acting. This period of approximately 84 minutes is numerically related to the mean density of the earth and to the universal gravitational constant,G. In general the lower limit to orbiting periods is given by,

(1)
$$\tau=2\pi\sqrt{\frac{R^3}{GM}}$$

Where R is a size parameter (radius) and M is a mass parameter. It is seen that equation (1) is a bounding case of Kepler's third law. For a spherical body, this boundary time, τ, in terms of the mean density ρ, is given by,

(2)
$$\tau=\sqrt{\frac{3\pi}{G\rho}}$$

Equations (1) and (2) are usually applied to astronomical bodies and since gravity is a force weaker than the other forces by some 40 orders of magnitude, it seems quite inappropriate that these equations have any significance for bodies where gravity plays no detectable role, in particular on micro levels, such as for atoms and particles. However, there is nothing known that precludes their universal applicability. We therefore make the assumption:

<u>Assumption 1</u>] Equations 1) and 2) may be meaningfully applied to any entity occupying space and possessing mass.

When applied to objects on the atomic level at first thought it would seem the results would be insignificant, but we are dealing with time, not force, and a surprising value emerges. As our example, we take for size the Bohr radius, a_o, and for mass, m_p, the mass of a proton. The time τ_H, turns out to be almost exactly 2 hours! Specifically,

(3)
$$\tau_H=2\pi\sqrt{\frac{a_o^3}{Gm_p}} = 7239.94\text{sec}$$

Spatially atomic phenomena are by size out of sight, but temporally the 10^{40} coulomb to gravity ratio brings atomic gravitational periods squarely into the time frame of daily experience. This need not be surprising since on the atomic scale we are accustomed to dealing only with coulomb times which are of the order of 10^{-16} sec. If the ratio of force strengths between coulomb and gravitational forces is of the order of 10^{40}, then the ratio of gravitational times to coulomb times must be of the order of 10^{20} leading to atomic gravitational times of the order of 10^4sec., as found in the above example of the hydrogen atom. Another example is the Schuster time for an electron. Using r_e, the electron radius and m_e, the electron mass, the Schuster period is given by,

(4)
$$\tau_e = 2\pi\sqrt{\frac{r_e^3}{Gm_e}} = 0.121\text{sec}$$

which is about one-eighth of a second, an important time in human visual perception.rhythms.

Next we note the near coincidence of the hydrogen gravitational time with a culturally employed time unit derived from the earth's rotation period. This leads us to suspect that micro gravitational times may play some hitherto unsuspected roles. On the basis of the result for atomic hydrogen it seems relevant to inquire how the Schuster equation could be applied to other atoms.

The correct value to be used for mass is likely to be the atomic weight of the atom. But what value should be used for the size (radius)? The size of an atom can be defined in alternate ways, but which way is correct for equation (1)? One approach is to note relations between mass and density. For larger bodies, planets, stars, etc., there is a rough correlation between the density of the body and the reciprocal of the mass, which is to say, $\rho \propto M^{-1}$. We provisionally therefore assume:

<u>Assumption 2</u>] For atoms ~~and~~ the mass varies inversely with the density.

This assumption is equivalent to $M^2 \propto L^3$. Substituting $(KGM)^2$ for L^3 in the time equation, we get,

(5)
$$\tau = 2\pi\sqrt{\frac{(KGM)^2}{GM}} = 2\pi K^{3/2}\sqrt{GM}$$

That is, the period τ for ordinary matter is closely proportional to the square root of the mass.

(6) $$\frac{\tau}{\tau_H} = \frac{2\pi K^{3/2}\sqrt{GM}}{2\pi K^{3/2}\sqrt{Gm_p}} = \frac{\sqrt{M}}{\sqrt{m_p}} = \sqrt{A}$$

where A is the atomic weight. Using this result, $\tau_A = \tau_H\sqrt{A}$, we can construct the following table:

ELEMENT	ATOMIC WEIGHT	$\sqrt{A}$	SCHUSTER PERIOD
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NITROGEN	14.0067	3.74	7.52 hr
OXYGEN	15.9994	4	8.04 hr

We now introduce a third assumption:

Assumption 3] Gravitational periods are to be combined according to the Diophantine rule, $n_1\tau_1 = n_2\tau_2$, where n_1 and n_2 are integers.

This assumption leads to the following values for the combined, or beat, periods:

ATOMIC COMBINATIONS	PERIODS
$24\tau_C$ = 168hr	7 days
$16\tau_N$ = 120hr	5 days
$3\tau_O$ = 24hr	1 day

We note that the elements most abundant in and important to living organisms give rise to the common periods of time derived from the earth's motions.

ZEITGEBR.WPW DISK:COSNUMBERS May 16, 1993

THE ZEITGEBERS

THE FERMIONIC CLOCKS

The general theory of relativity postulates the equivalence of space-time geometry and the dynamic or mechanical properties of matter. The equivalence of geometry and dynamics allows alternate descriptions of the world; the properties of space and time may be formulated in terms of the properties of energy and matter and vice versa. An example of this is the equivalence of mass densities and temporal periods. We have dimensionally,

(1) $$[T^2] = \left[\frac{R^3}{GM}\right]$$

More specifically, if **T** represents the fundamental temporal period associated with a spherical object of radius **R** and mass **M**, then

(2) $$T^2 = 4\pi^2 \frac{R^3}{GM}$$

where **G** is the Newtonian gravitational constant. Equation (2) is recognized as the Schuster period of a gravitating body, i.e. as the limiting case of Kepler's third law when the orbiting radius is equal to the object radius. Equation (2) may be rewritten in the form

(3) $$T = \sqrt{\frac{3\pi}{G\rho}}$$

where ρ is the mass density. It follows that the frequency associated with a mass is proportional to the square root of the mass density.

Three specific examples of equation (2) give us the fundamental periods of three universal clocks. The first of these is the *atom clock* based on the proton mass m_p and the Bohr radius a_o .

(4) $$\tau^2 = 4\pi^2 \frac{a_o^3}{Gm_p}$$

The second is the *baryon clock* based on the nuclear ~~electron~~ radius r_e and the proton mass m_p.

(5) $$T^2 = 4\pi^2 \frac{r_e^3}{Gm_p}$$

The third is the *lepton clock* based on the electron radius $\mathbf{r_e}$ and the electron mass $\mathbf{m_e}$.

(6) $$t^2 = 4\pi^2 \frac{r_e^3}{Gm_e}$$

Using the values [1]

$a_o = 5.291772\text{x}10^{-9}$ cm, $m_p = 1.672623\text{x}10^{-24}$ gm
$r_e = 2.817941\text{x}10^{-13}$ cm, $m_e = 9.109390\text{x}10^{-28}$ gm

The following values for periods and frequencies are obtained:

CLOCK	PERIOD	FREQUENCY
ATOM	7237.93 using m_H τ = 7239.94 sec m_p	0.000138 hz
BARYON	T = 0.0028134 sec	355.44 hz*
LEPTON	t = 0.120537 sec (55)	8.296 hz

* The frequency 355.44 hz lies between F (349.23) and F# (369.99) above middle C.

These values are approximately 2 hours and 40 seconds for the *atom clock,* 2.8 milliseconds for the *baryon clock*, and one eighth second for the *lepton clock.*

The ratios of the periods are given by:

$$\frac{T}{\tau} = \alpha^3, \quad \frac{t}{T} = \sqrt{\mu}, \quad \frac{t}{\tau} = \alpha^3\sqrt{\mu}$$

where α is the fine structure constant and μ is the ratio of the proton to the electron mass.
($\alpha = 7.297\ 353\ 08\text{x}10^{-3}$ and $\mu = 1.836\ 152\ 701\text{x}10^3$) [1]

THE BOSONIC CLOCKS

[1] Cohen, E.R. and B.N.Taylor The fundamental physical constants Physics Today, August 1992 p9ff

SCHUSBAS.W52 DISK: February 24, 1994

SOME SCHUSTER PERIOD BASICS

The basic programs

DIOPHEQ1.BAS ENTER THE SCHUSTER EXCESS, SECONDS OVER 84 MINUTES
DIOPHEQ2.BAS ENTER M1 AND M2
DIOPHEQ3.BAS ENTER THE DENSITY
DIOPHEQ4.BAS RANGE OVER VALUES OF DENSITY
DIOPHEQ5.BAS RANGE OVER VALUES OF TIME

$G = 6.5732 \times 10^{-8}$
Density, $\rho = 5.517 \pm 0.004$ gm/cm^3 ~ $\tau = 84\text{m} + 19.6095$ sec
$3\pi = 9.424778$

$$\tau = \sqrt{3\pi / G\rho}$$

DENSITY	PERIOD	No. of G-PERIODs	DAYS	ERROR
5.517	84m+19.609s	222	13	+33.3s
5.513	84m+21.445s	973	57	-14.3s
5.521	84m+17.776s	205	12	+44.1s
5.51733	84m+19.3495	222	13	+0.009s

FOR DENSITY = 5.517 THE G-PERIOD IS = 5059.609521579125

ERROR IN SEC	G-PERIODS	DAYS
[illegible]3.31378936767578	222	13
-53.50022888183594	2237	131
-20.18643760681152	2459	144
13.12735366821289	2681	157
46.44114303588867	2903	170
-40.37287521362305	4918	288
-7.059083461761475	5140	301
26.25470733642578	5362	314
59.56849670410156	5584	327

COMPLETE

DENSITY	PERIOD	No G-PERIOD	DAYS	ERROR
5.517	84m+19.609s	222	13	+33.3s
5.513	84m+21.445s	973	57	-14.3s
5.521	84m+17.776s	205	12	+44.1s
5.51733	84m+19.3495	222	13	+0.009s

GRAVCLOCK.WPD   Sept 7, 2006

Rough Draft
~~A. G.~~ Wilson
6/15/68

Restructure   no file

cf. Zeilgeber

$$T = \sqrt{\frac{R^3}{GM}}$$

$$T = \frac{GM}{c^3}$$

iii GRAVITATIONAL CLOCKS

The existence of a fundamental temporal bound associated with gravitating bodies has long been recognized in physics and astronomy. This is the minimum period, -T = *2HR 3/2 *IVG-M,* given in terms of a body's mass M and radius R with the dimensionality of time. It represents the circular velocity at the surface of the body and is a minimum period both in the sense that no satellite orbiting the body can have a smaller orbital period than '*T and the body itself cannot have a period of rotation less than *'T and remain stable. In effect the presence of gravitating mass establishes a local clock that "beats time" for all mechanical movement in the neighborhood of the body. *This'minimum period, also called the "Schuster Period," may be expressed in terms of the mean density p of the body:

greater

~~*p *T 3(*)Tf/G~~. $T = (G\rho)^{-1/2}$

rate of rotation is stable

$$\frac{GMm}{R^2} = \frac{mv^2}{R}$$

$$\frac{GM}{R} = v^2$$

If $v > \sqrt{\frac{GM}{R}}$ unstable

and v must be $> \sqrt{\frac{GM}{R}}$ for orbiting object

Its value for the earth is about 84 minutes, for the sun about 2 3/4 hours, and for the moon 108 minutes. Assuming a *-23 3 mean density of a galaxy of 10 *gm/cm *, the minimum period is of the order of 108 years, about the same as the period of rotation. ? redo

$$\oplus \sqrt{\frac{GM}{R}} = ?$$ 27 8

*AGW 2

Rot $v_\oplus$ use X time

$v = 5,898165$

The effects of the gravitational clock have been observed on all macroscopic scales from planets to the visible sample of the universe. Theoretically the gravitational clocks also are operative on a microscopic scale, but their effects are presumed submerged in the variety of effects resulting from the action of other forces, such as Coulomb forces. But is this really the case? The strength of the electric force is 10^40 times greater than that of gravitational force, but this per *se need not obscure the gravitational clock, since temporal effects rather than force effects are sought. In spite of the entirely negligible role of the gravitational force in microscopic structure, it may nonetheless be possible to detect on a macroscopic scale the gravitational clock of fundamental particles provided the basic period of the atomic gravitational clock is quite different from the basic period of any atomic electric clock, and provided that there is phase coherence so that the beat may be augmented by a factor proportional to the number of atoms.

The atom as an "electric clock" has many basic frequencies that are manifest in optical, X-ray and other spectra. An example of a basic electric frequency associated with the atom is the period of orbital revolution of an electron in the first Bohr orbit of a hydrogen atom. This time is 10*- 15.81822

seconds, and is equal to *2nao 1 where *ao is the radius
*OLC *2cR.
of the first Bohr *orbit;u is the fine structure constant; c,

the velocity of light; and R., the Rydberg constant.

*AGW 3

The basic gravitational frequency of the hydrogen atom

will be the minimum frequency

3/2

*T = *2Tra

0
*/Gm-p

where *mp is the mass of the proton.

Using the values in Table I (Cohen and *DuMond, *Rev. Modern Physics, v. 37, No. 4, Oct. 1965), we obtain for '*T the values in Table II using *mp or m H the equivalent mass of the hydrogen atom. These values are based on the unified scale of atomic weights, 12 C = 12. (The minimum period based
16 h *m *s

on the 0 = 16 scale of atomic weights is 1 59 43 *. 07.)
The gravitational period is seen to be completely different from electric periods, being 10 19.678 times as great as t0. This number factor is equal to the square root of S, the ratio between Coulomb forces and gravitational forces,

S e2 10 39.356
*Gmpme

The elemental binding forces in molecules, crystals, and the microcosmos in general are electric, dominating gravitational forces by a factor = S. Nonetheless the basic gravitational frequency may play a role in the organization of

*AGW 4

micro-structures, including living matter, through providing a clock with more convenient periods than the electric periods, since the basic period of a useful clock must be near to the *rythyms in movement and process required by organisms.

In order to calculate the values of other basic gravitational frequencies associated with various atoms, we must determine the proper "gravitational" radius corresponding to the masses of atoms of atomic weight greater than unity. The "gravitational" radius of these atoms is more likely to be determined in the same manner as that of large gravitating bodies, rather than being analogous to coulomb radii. Stable, non-degenerate gravitating bodies appear to possess a maximum potential bound that is the same for stars, galaxies, clusters of galaxies *(Ref. 2). This potential bound, b, is about 10*- 4 of the *Schwarzschild potential limit and may be written

GM < b
*c 2R

$\frac{GM}{c^2}$ = Schwarzschild radius

We assume that the atoms, being stable, are governed by a similar law, and that the "gravitational" radius, r, appropriate to any atom is related to the atomic weight, A, by the relation

*GA = k, a constant.
2

c r

*AGW 5

For the hydrogen atom

2*- *1
*Gm *s k.
*p

2
c a
0

Assuming this relation to hold true for all atoms, we have

r = a A

0 *-
*m
*p

and the gravitational period for an atom of atomic weight A

becomes

	=	*2,ffr	3/2	a	3/2	A	T A
*,uA							0 *-
		*GA		*Gm m			*m
				*p	*p		*p

A and m*p being in the same units. In the unified system of atomic weights, 12 C = 12, the proton mass, m 1.00727663. Hence,

*TA (seconds) = 7241.3675 (seconds)

1.00727663

For example, the atomic weight A for carbon is 12.01115. This

*s
gives 86348*.8249 or
A

h *m *s
23 59 8 *.8.

*AGW 6

h *m *s

For carbon 12, the value is 23 57 48 *. 7. The striking coincidence of these atomic gravitational periods with the earth's 24 hour period suggests that the carbon atom may be the *zeitgeber governing the *circadian *rhythym in most living organisms.

ORIGIN OF THE MONTH
CHON

The week is the fulcrum [place of symmetry] for the Schuster and the Hydrogen periods.

The Week
Minutes

$$10080 = 7 \cdot 24 \cdot 60 = 2^5 \cdot 3^2 \cdot 5 \cdot 7 = P \times N$$

If $P = P_H = 2^{h} = 120^m$, then $N = N_H = 84$

If $P = P_{\S} = 84^m$, then $N = N_{\S} = 120$

The Week > 84, 120^m Hydrogen periods

The Week > 120, 84^m Schuster periods

If $C = 12^h$ — $14\ P_c$ of 720^m = 1 week — or $C = 24^h$, 7 periods

$O = 16^h$ — $10.5\ P_o$ of 960^m = 1 week, 21 in 2 weeks — $O = 32^h$, 5.25 periods, 21 in 4 weeks

---

$N = 14^h = 840^m$, 12 periods in 1 week — if $28^h = 1680^m$, 6 periods in 1 week

---

60·12
7·12

In 1 week			days	periods
	Carbon	7 periods	28	28
	Hydrogen	84 periods	28	336
	Nitrogen	6 periods	28	24
	Schuster	120 periods	28	480

Oxygen 5¼ periods → 28 days, 21 periods

$\frac{C}{N} = \frac{7}{6}$ $\frac{C}{O} = \frac{4}{3}$

$\frac{N}{O} = \frac{8}{7}$

In H unit of 120m

$\S = \frac{7}{10}$

$C = 6$

$N = 7$

$O = 8$

In $\S$ Units of 84m

$H = \frac{10}{7}$

$C = \frac{60}{7}$

$N = 10$

$O = \frac{80}{7}$

activities, provide time to assist in practice "job interviews" and other activities, avail personal resources for students to have "hands-on" work experiences (let them work on my stuff), and SACRIFICE my hair so the cosmetology students can have a live model to practice on before taking the State License test.</DIV>
<DIV> </DIV>
<DIV>Most endeavors have resulted in great student success - e.g. - National winners in student leadership competitions, 98% plus passing rate in certificate programs (i.e.-cosmetology), etc.</DIV>
<DIV> </DIV>
<DIV>On the down side, personally, there have been a few electronic devices, truck transmissions, etc. that have not had the same high success rate.</DIV>
<DIV> </DIV>
<DIV>However, based on my personal belief and convictions for all student success - I want you to take a look at the attachment (jpeg) with its 9 separate photos and make a guess as to what my "New Summer Do" is!</DIV>
<DIV> </DIV>
<DIV>Hugs to all,</DIV>
<DIV>Charlie</DIV>
<DIV> </DIV>

——————— Headers ———————

Return-Path: <chwilson@wwdb.org>
Received: from rly-ye02.mx.aol.com (rly-ye02.mail.aol.com [172.18.151.199]) by air-ye01.mail.aol.com (v78_r3.8) with ESMTP; Tue, 12 Jun 2001 19:29:02 -0400
Received: from mail.effectnet.com (phxl3-imail-1.effectnet.com [63.214.171.40]) by rly-ye02.mx.aol.com (v78_r3.8) with ESMTP; Tue, 12 Jun 2001 19:28:20 -0400
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Message-ID: <00bd01c0f396$f6660920$30bc77d1@oemcomputer>
Reply-To: "Charles Wilson" <chwilson@wwdb.org>
From: "Charles Wilson" <chwilson@wwdb.org>
To: <Undisclosed-Recipient:;;>
Subject: New Summer Do
Date: Tue, 12 Jun 2001 18:25:18 -0500
MIME-Version: 1.0
Content-Type: multipart/mixed;
boundary="----=_NextPart_000_00B9_01C0F36D.0895E540"
X-Priority: 3
X-MSMail-Priority: Normal
X-Mailer: Microsoft Outlook Express 5.00.2014.211
X-MimeOLE: Produced By Microsoft MimeOLE V5.00.2014.211

TIMENOTS.P51 DISK: 3½ TIME January 31, 1991

Is the source of time built into all organisms, or are we really being driven by the earth clock outside us?
--Avini, Empires of Time p29

{[If CHON is the zeitgeber, can we then detect physical changes at the atomic and molecular levels having CHON periodicities? Any changes would have to be detected in individual atoms or molecules, because in aggregates it is highly improbable that the phases of the cycles would be the same. The statistical aggregation of random phases would wash out detectability of the cycles. For periodicities to be manifested in aggregates the atoms and molecules would have to be coherent, i.e. their individual periods would have to be in phase. However, there do exist molecular aggregates which manifest periodicities. We call these aggregates living organisms. We are led to the surmise, consistent with what we know about biological clocks, that the zeitgeber lies within every atom of the organism. We may further speculate that **coherence** of atomic zeitgebers is a property of living systems. When the coherence diminishes, ageing takes place and when it reaches a certain level of randomness, death occurs.

In living systems the zeitgebers are in phase, they exhibit coherence. In inanimate systems the zeitgebers are random.
The fountain of youth is the resynchronization of the zeitgebers.]}

Violating the 2° Law of Thermodynamics

White Noise Modulated by White Noise → Bell Curve, Gaussian

cf Gus Strombergs coherence of atoms at opposite limbs of a star

⇒ Star ~ Living systems

1993 #38

ZEITGEBR.WPW

THE ZEITGEBERS

The general theory of relativity postulates the equivalence of space-time geometry and the dynamic or mechanical properties of matter. The equivalence of geometry and dynamics allows alternate descriptions of the world; the properties of space and time may be formulated in terms of the properties of energy and matter and vice versa. An example of this is the equivalence of mass densities and temporal periods. Ww have dimensionally,

(1) $$[T^2] = \left[\frac{R^3}{GM}\right]$$

More specifically, if **T** represents the fundamental temporal period associated with a spherical object of radius **R** and mass **M**, then

(2) $$T^2 = 4\pi^2 \frac{R^3}{GM}$$

where **G** is the Newtonian gravitational constant. Equation (2) is recognized as the Schuster period of a gravitating body, i.e. as the limiting case of Kepler's third law when the orbiting radius is equal to the object radius. Equation (2) may be rewritten in the form

(3) $$T = \sqrt{\frac{3\pi}{G\varrho}}$$

where ϱ is the mass density. It follows that the frequency associated with a mass is proportional to the square root of the mass density.

Three specific examples of equation (2) give us the fundamental periods of three universal clocks. The first of these is the *atom clock* based on the proton mass m_p and the Bohr radius a_o .

(4) $$\tau^2 = 4\pi^2 \frac{a_o^3}{Gm_p}$$

The second is the *baryon clock* based on the electron radius r_e and the proton mass m_p.

(5) $$T^2 = 4\pi^2 \frac{r_e^3}{Gm_p}$$

ZEIT GEBR ~~WPW~~ COSNUM ~~05/16/93~~

The Fermionic clocks

The third is the *lepton clock* based on the electron radius $\mathbf{r_e}$ and the electron mass $\mathbf{m_e}$.

(6)
$$t^2 = 4\pi^2 \frac{r_e^3}{Gm_e}$$

Using the values [1]

$a_o = 5.291772 \times 10^{-9}$ cm, $m_p = 1.672623 \times 10^{-24}$ gm
$r_e = 2.817941 \times 10^{-13}$ cm, $m_e = 9.109390 \times 10^{-28}$ gm

The following values for periods and frequencies are obtained:

CLOCK	PERIOD	FREQUENCY
ATOM	τ = 7239.94 sec	0.000138 hz
BARYON	T = 0.0028134 sec	355.44 hz*
LEPTON	t = 0.120537 sec	8.296 hz

* The frequency 355.44 hz lies between F (349.23) and $F^\#$ (369.99) above middle C.

These values are approximately 2 hours and 40 seconds for the *atom clock*, 2.8 milliseconds for the *baryon clock*, and one eighth second for the *lepton clock.*

The ratios of the periods are given by:

$$\frac{T}{\tau} = \alpha^3, \quad \frac{t}{T} = \sqrt{\mu}, \quad \frac{t}{\tau} = \alpha^3\sqrt{\mu}$$

where α is the fine structure constant and μ is the ratio of the proton to the electron mass.
($\alpha = 7.297\ 353\ 08 \times 10^{-3}$ and $\mu = 1.836\ 152\ 701 \times 10^3$) [1]

[1] Cohen, E.R. and B.N.Taylor The fundamental physical constants Physics Today, August 1992 p9ff

ON CHON

AND THE BOUNDARIES OF TIME

Aristotle held that time was an inference of **motion**. But there appears to be a species of time that is not derived from motion. This time is associated with **density** and manifests itself as a bound to allowable periods and frequencies. A familiar example is the Schuster Period, a bound on the period of an earth orbiting satellite when only gravitational and inertial forces are acting. This period of approximately 84 minutes is numerically related to the mean density of the earth and to the universal gravitational constant,G. In general the lower limit to orbiting periods is given by,

(1) $$\tau=2\pi\sqrt{\frac{R^3}{GM}}$$

Where R is a size parameter (radius) and M is a mass parameter. For a spherical body, this boundary time, τ, in terms of the mean density ρ, is given by,

(2) $$\tau=\sqrt{\frac{3\pi}{G\rho}}$$

These equations govern gravitationally based temporal boundaries and are usually applied to astronomical bodies. Since gravity is a force weaker than the other forces by some 40 orders of magnitude, it seems quite inappropriate that these boundaries have any meaning for bodies where gravity plays an insignificant role, in particular on meso and micro levels. However, there is nothing known that precludes their universal applicability. We therefore make the assumption:

<u>Assumption 1</u>] Equations 1) and 2) may be applied to any entity occupying space and possessing a definite mass.

When applied to objects on the atomic level at first thought it would seem the results would be insignificant, but we are dealing with time, not force, and some surprising values emerge.

Taking for size the Bohr radius, a_o, and for mass, m_p, the mass of a proton, the time τ_H, turns out to be almost exactly 2 hours!

(3) $$\tau_H=2\pi\sqrt{\frac{a_o^3}{Gm_p}} = 7239.94\text{sec}$$

While spatially atomic phenomena are by size out of sight, temporally the 10^{40} coulomb to gravity ratio brings atomic gravitational periods into the time frame of daily experience. This need not be surprising since on the atomic scale we are accustomed to dealing only with coulomb times which are of the order of 10^{-16} sec. If the ratio of force strengths between coulomb and gravitational forces is of the order of 10^{40}, then the ratio of gravitational times to coulomb times must be of the order of 10^{20} leading to atomic gravitational times of the order of 10^{4}sec., as found in the above example of the hydrogen atom.

The near coincidence of this hydrogen gravitational time with a culturally employed unit derived from the earth's rotation period leads us to suspect that micro gravitational times may play some hitherto unsuspected roles. Another example is the Schuster time for an electron, using r_e, the electron radius and m_e, the electron mass, is given by,

$$\tau_e = 2\pi\sqrt{\frac{r_e^{\,3}}{Gm_e}} = 0.121\text{sec} \tag{4}$$

about one-eighth of a second, an important time in human visual perception. These gravitational times may supply the zeitgeber needed for various organic clocks and rhythms.

On the basis of the result for atomic hydrogen it seems relevant to inquire how the Schuster equations could be applied to other atoms. One approach to this question is based on gravitational bounds, of which there are two: The first bound is the so-called Schwarzschild Limit. This is a relativistic bound that limits the gravitational potential of all matter (except that in black holes). It applies to nuclear matter and macro objects such as neutron stars. It is given by,

$$\frac{GM}{c^2R} \le k \tag{5}$$

where k is a constant of the order of unity. The second bound governs all "ordinary" matter, that is matter composed of atoms and molecules. This potential limit is given by,

$$\frac{GM}{c^2R} \le \alpha^2 k \tag{6}$$

where α is the fine structure constant. We here introduce a second assumption:

Assumption 2] For all atomic and molecular matter the gravitational radius is proportional to the metric radius.

i.e. eq. 5 and 6 are universally true

The proper r to use for grav. clocks is the grav radius

The excess of c. 40 sec over 2 hours
may have to do with choosing $^{12}C \equiv 12$
and the mass of H = 1.007277

$$\frac{7239.94}{1.007277} = 7187.63$$

$$= 7200 - 13$$

This assumption, a statement that all matter in ordinary state lies along the α^2 potential bound, says that the gravitational radius, $GM/c^2 = k\alpha^2 R$, or that $R = KGM$, where K is a constant. Substituting KGM for R in equation 1) gives,

$$\tau = 2\pi\sqrt{\frac{(KGM)^3}{GM}} = 2\pi K^{3/2}GM \tag{7}$$

That is, the period τ for ordinary matter is closely proportional to the mass, and since $\tau_H = 2\pi K^{3/2}Gm_p$,

$$\frac{\tau}{\tau_H} = \frac{2\pi K^{3/2}GM}{2\pi K^{3/2}Gm_p} = \frac{M}{m_p} = A \tag{8}$$

where A is the atomic weight. Using this result, $\tau_A = A\tau_H$, we can construct the following table:

ELEMENT	ATOMIC WEIGHT	SCHUSTER PERIOD
HYDROGEN	1.0080	2hr 0m 40sec = 1/12 day
CARBON	12.0112	24hr 9m 20sec = 1 day
NITROGEN	14.0067	28hr 10m 7sec = 7/6 day
OXYGEN	15.9994	32hr 10m 33sec = 4/3 day
POTASSIUM	39.102	78hr 38m 16sec = 13/4 day

We now introduce a third assumption:

<u>Assumption 3</u>] Gravitational periods are to be combined according to the Diophantine rule, $n_1\tau_1 = n_2\tau_2$, where n_1 and n_2 are integers.

This assumption leads to the following values for the combined, or beat, periods:

ATOMIC COMBINATIONS	PERIODS
$1\tau_C = 12\tau_H$	$\tau_{CH} = 1$ day
$7\tau_{CH} = 6\tau_N$	$\tau_{CHN} = 7$ days
$4\tau_{CHN} = 7\tau_O$	$\tau_{CHON} = 28$ days
$13\tau_{CHON} = 112\tau_K$	$\tau_{CHONK} = 364$ days *

We note that the elements most abundant in and important to living organisms give rise to the common periods of time derived from the earth's motions. *[More precisely, 366 1/3 days.]

NEWCHON2.WP6 October 26, 1995

CHON REVISITED

Aristotle held that time was an inference of **motion**. But there appears to be a species of time that is not derived from motion. This time is associated with the **density** of matter and manifests as a zeitgeber that governs local clock rates. Its period is inversely proportional to the square root of the mass density. A familiar example is the Schuster Period, a bound on the period of an earth orbiting satellite when only gravitational and inertial forces are acting. This period of approximately 84 minutes is numerically related to the mean density of the earth and to the universal gravitational constant,G. In general the lower limit to orbiting periods is given by,

(1)
$$\tau = 2\pi\sqrt{\frac{R^3}{GM}}$$

Where R is a size parameter (radius) and M is a mass parameter. It is seen that equation (1) is a bounding case of Kepler's third law. For a spherical body, this boundary time, τ, in terms of the mean density ρ, is given by,

(2)
$$\tau = \sqrt{\frac{3\pi}{G\rho}}$$

Equations (1) and (2) are usually applied to astronomical bodies and since gravity is a force weaker than the other forces by some 40 orders of magnitude, it seems quite inappropriate that these equations have any significance for bodies where gravity plays no detectable role, in particular on micro levels, such as for atoms and particles. However, there is nothing known that precludes their universal applicability. We therefore make the assumption:

<u>Assumption 1</u>] Equations 1) and 2) may be meaningfully applied to any entity occupying space and possessing mass.

When applied to objects on the atomic level at first thought it would seem the results would be insignificant, but we are dealing with time, not force, and a surprising value emerges. As our example, we take for size the Bohr radius, a_o, and for mass, m_p, the mass of a proton. The time τ_H, turns out to be almost exactly 2 hours! Specifically,

(3)
$$\tau_H = 2\pi\sqrt{\frac{a_o^3}{Gm_p}} = 7239.94\text{sec}$$

$\tau_p = \alpha^{4/3}\,\tau_H =$ [illegible] sec

Spatially atomic phenomena are by size out of sight, but temporally the 10^{40} coulomb to gravity ratio brings atomic gravitational periods squarely into the time frame of daily experience. This need not be surprising since on the atomic scale we are accustomed to dealing only with coulomb times which are of the order of 10^{-16} sec. If the ratio of force strengths between coulomb and gravitational forces is of the order of 10^{40}, then the ratio of gravitational times to coulomb times must be of the order of 10^{20} leading to atomic gravitational times of the order of 10^{4}sec., as found in the above example of the hydrogen atom. Another example is the Schuster time for an electron. Using r_e, the electron radius and m_e, the electron mass, the Schuster period is given by,

(4) $$\tau_e = 2\pi\sqrt{\frac{r_e^{\,3}}{Gm_e}} = 0.121\mathrm{sec}$$

which is about one-eighth of a second, an important time in human visual perception.rhythms.

Next we note the near coincidence of the hydrogen gravitational time with a culturally employed time unit derived from the earth's rotation period. This leads us to suspect that micro gravitational times may play some hitherto unsuspected roles. On the basis of the result for atomic hydrogen it seems relevant to inquire how the Schuster equation could be applied to other atoms.

The correct value to be used for mass is likely to be the atomic weight of the atom. But what value should be used for the size (radius)? The size of an atom can be defined in alternate ways, but which way is correct for equation (1)? One approach is to note relations between mass and density. For larger bodies, planets, stars, etc., there is a rough correlation between the density of the body and the reciprocal of the mass, which is to say, $\rho \propto M^{-1}$. We provisionally therefore assume:

<u>Assumption 2</u>] For atoms ~~and~~ the mass varies inversely with the density.

This assumption is equivalent to $M^2 \propto L^3$. Substituting $(KGM)^2$ for L^3 in the time equation, we get,

(5) $$\tau = 2\pi\sqrt{\frac{(KGM)^2}{GM}} = 2\pi K^{3/2}\sqrt{GM}$$

That is, the period τ for ordinary matter is closely proportional to the square root of the mass.

(6) $$\frac{\tau}{\tau_H} = \frac{2\pi K^{3/2}\sqrt{GM}}{2\pi K^{3/2}\sqrt{Gm_p}} = \frac{\sqrt{M}}{\sqrt{m_p}} = \sqrt{A}$$

where A is the atomic weight. Using this result, $\tau_A = \tau_H\sqrt{A}$, we can construct the following table:

ELEMENT	ATOMIC WEIGHT	$\sqrt{A}$	SCHUSTER PERIOD
HYDROGEN	1.0080	1	2hr 0m 40sec = 1/12 day
CARBON	12.0112	3.47	6.98 hr
NITROGEN	14.0067	3.74	7.52 hr
OXYGEN	15.9994	4	8.04 hr

We now introduce a third assumption:

Assumption 3] Gravitational periods are to be combined according to the Diophantine rule, $n_1\tau_1 = n_2\tau_2$, where n_1 and n_2 are integers.

This assumption leads to the following values for the combined, or beat, periods:

ATOMIC COMBINATIONS	PERIODS
$24\tau_C$ = 168hr	7 days
$16\tau_N$ = 120hr	5 days
$3\tau_O$ = 24hr	1 day

We note that the elements most abundant in and important to living organisms give rise to the common periods of time derived from the earth's motions.

NEWCHON3.WP6 March 11, 1996 Rev, April 11, 1996

EXPLORING CHON

Aristotle held that time was an inference of **motion.** But there appears to be a species of time that is not derived from motion. This time is associated with the **density** of matter and manifests as a zeitgeber that governs local clock rates. Its period is inversely proportional to the square root of the mass density. A familiar example is the Schuster Period, a bound on the period of an earth orbiting satellite when only gravitational and inertial forces are acting. This period of approximately 84 minutes is numerically related to the mean density of the earth and to the universal gravitational constant,G. In general the lower limit to orbiting periods is given by,

(1) $$\tau=2\pi\sqrt{\frac{R^3}{GM}}$$

Where R is a size parameter (radius) and M is a mass parameter. It is seen that equation (1) is a bounding case of Kepler's third law. For a spherical body, this boundary time, τ, in terms of the mean density ρ, is given by,

(2) $$\tau=\sqrt{\frac{3\pi}{G\rho}}$$

Equations (1) and (2) are usually applied to astronomical bodies and since gravity is a force weaker than other forces by some 40 orders of magnitude, it seems quite inappropriate that these equations contain anything of significance for bodies where gravity plays no detectable role, in particular for micro objects such as atoms and sub-atomic particles. There is, however, nothing known that precludes the universal applicability of these equations. At first thought, when applied to objects on the atomic level, it would seem the results would be insignificantly small. Remembering, though, that we are dealing with time, not size or force, this is not the case. Coulomb times are of the order of 10^{-16} seconds. If the ratio of force strengths between coulomb and gravitatonal forces is of the order of 10^{40} then the ratio of gravitational times to coulomb times must be of the order of 10^{20} leading to atomic graviational times of the order of 10^4 seconds.

As an example, take for size the Bohr radius, a_o, and for mass the proton mass, m_p. The time τ_H, turns out to be almost exactly 2 hours! Explicitly,

(3) $$\tau_H = 2\pi\sqrt{\frac{a_o^3}{Gm_p}} = 7239.94sec = 2\,hours\ 40\,seconds$$

Another example is the Schuster time for an electron. Using r_e, the electron radius and m_e, the electron mass, the Schuster period is given by,

(4) $$\tau_e = 2\pi\sqrt{\frac{r_e^3}{Gm_e}} = 0.121sec$$

which is about one-eighth of a second, again in the time frame of daily experience as this is an important time interval for human visual perceptions. [About this value we switch from time to frequency]

A third value of possible physiological interest is the time given by the Schuster period of the proton:

(5) $$\tau_p = 2\pi\sqrt{\frac{r_e^3}{Gm_p}} = 2.813\ millisec$$

The time values given in equations 3), 4), and 5), since they are present in every atom or organic molecule, may play the role of zeitgebers in physiological processes.

Noting the near coincidence of the hydrogen gravitational time of two hours with twice the culturally employed time unit derived from the earth's rotation period, we are led to surmise that micro gravitational times may play some hitherto unsuspected role. On the basis of the result for atomic hydrogen it seems relevant to go further and inquire how equation(1) might be applied to other atoms.

The correct value to be used for mass in equation(1) is likely to be a function of the atomic weight of the atom. But the value to be used for the size (radius) in equation(1) is uncertain as we are dealing with gravitational rather than coulomb effects.

One approach is to note that the relation between density and mass for some larger bodies, planets, stars, etc., is that the density is roughly proportional to the reciprocal of the mass,

$$\rho \propto M^{-1}.$$

Alternate Assumption 1] We provisionally assume the same for atoms, that the density varies inversely with the mass. This is equivalent to $M^2 \propto R^3$. Substituting $(KGM)^2$ for R^3 in equation(1), we get,

(6)
$$\tau = 2\pi\sqrt{\frac{(KGM)^2}{GM}} = 2\pi K^{3/2}\sqrt{GM}$$

That is, the period τ is approximately proportional to the square root of the mass. This leads to,

(7)
$$\frac{\tau}{\tau_H} = \frac{2\pi K^{3/2}\sqrt{GM}}{2\pi K^{3/2}\sqrt{Gm_p}} = \frac{\sqrt{M}}{\sqrt{m_p}} = \sqrt{A}$$

where A is the atomic weight.
Using this result, $\tau_A = \tau_H\sqrt{A}$, we can construct the following table:

ELEMENT	ATOMIC WEIGHT	$\sqrt{A}$	SCHUSTER PERIOD
HYDROGEN	1.0080	1	2hr 0m 40sec = 1/12 day
CARBON	12.0112	3.47	6.98 hr
NITROGEN	14.0067	3.74	7.52 hr
OXYGEN	15.9994	4	8.04 hr

The values in the table are within less than half of a percent of 7 hours for carbon, 7.5 hours for nitrogen, and 8 hours for oxygen. These periods are closely commensurate with the rotation period of the earth as given in the second table.

ATOMIC COMBINATIONS	PERIODS
$24\tau_C$ = 168hr	7 days
$16\tau_N$ = 120hr	5 days
$3\tau_O$ = 24hr	1 day

It should be noted that the elements most abundant in and important to living organisms give rise to periods nearly commensurate with the earth's rotaton. Are the periods of these atoms in animal and human cells the zeitgebers for circadian rhythms?

A second possible approach to the question of the proper radius to employ for gravitational times is to assume that all atoms in ordinary state have the same gravitational potential. This assumption is equivalent to: size is proportional to mass.

Alternate Assumption 2] Assume for atoms in organic molecules that size is proportional to mass, R = KGM. Substituting KGM for R in equation 1) gives,

$$\tau = 2\pi\sqrt{\frac{(KGM)^3}{GM}} = 2\pi K^{3/2}GM \tag{8}$$

That is, the period τ for ordinary matter is closely proportional to the mass, and since $\tau_H = 2\pi K^{3/2}Gm_p$,

$$\frac{\tau}{\tau_H} = \frac{2\pi K^{3/2}GM}{2\pi K^{3/2}Gm_p} = \frac{M}{m_p} = A \tag{9}$$

where A is the atomic weight. Using this result, $\tau_A = A\tau_H$, we can construct the following table:

ELEMENT	ATOMIC WEIGHT	SCHUSTER PERIOD
HYDROGEN	1.0080	2hr 0m 40sec = 1/12 day
CARBON	12.0112	24hr 9m 20sec = 1 day
NITROGEN	14.0067	28hr 10m 7sec = 7/6 day
OXYGEN	15.9994	32hr 10m 33sec = 4/3 day
POTASSIUM	39.102	78hr 38m 16sec = 13/4 day

Again the values in the table are (with the exception of potassium) close approximations to periods commensurate to common astronomical periods. Resulting values in days are given in the following table.

ATOMIC COMBINATIONS	PERIODS
$1\tau_C = 12\tau_H$	τ_{CH} = 1 day
$7\tau_{CH} = 6\tau_N$	τ_{CHN} = 7 days
$4\tau_{CHN} = 7\tau_O$	τ_{CHON} = 28 days
$13\tau_{CHON} = 112\tau_K$	τ_{CHONK} = 364 days *

Again we note that the elements most abundant in and important to living organisms give rise to the common periods of time derived from the earth's motions. *[More precisely, 366 1/3 days.]

For all atoms $L = R = \frac{GM}{c^2}$, $T = \frac{[illegible]}{c^3}$, $t = \frac{R}{c}$ [w cultural $t = \frac{L}{c}$]

Kepler - Schuster $\tau = 2\pi\sqrt{\frac{R^3}{GM}}$ with $R = \frac{GM}{c^2}$, $\tau = 2\pi \frac{GM}{c^3} = 2\pi T$

For atoms M = atomic wt. A

$\tau = KA$

For τ_H , $K = \frac{7236.624}{1.00794} = 7179.618$

ATOM	Atomic #	Atomic Wt.	K·A	hours	rounded		DAY	W = 168^h	MONTH	YEAR
H	1	1.00794		2.010179	2	× 84 = W	12·H	84·H	336·H	
C	6	12.011		23.953993	24	× 7 = W	1·C	7·C	28·C	
N	7	14.0067		27.934094	28	× 6 = W	$\frac{6}{7}$ N	6·N	24·N	
O	8	15.9994		31.908211	32	× 3 = 40	$\frac{3}{4}$ O	$\frac{21}{4}$·O	21·O	
K	19	30.098		60.025585	60	× 4 = 100	2/5 K ~~K = 2.5 O~~	2.8·K		146K = 365
							$\frac{120}{7}$ ⊕			
					1.4	× 120 = W	10⊕ = 7H			
THE EARTH	$\log_{10} M =$	27.776243	$\tau = 2\pi\sqrt{\frac{L^3}{GM}}$	1.407487	84.449 m		20⊕ = N			
	$\log_{10} L =$	8.804694	or		84.307 m		120⊕ = 7C			
					84 m					

W = 7C = 120⊕

$\frac{120}{7}$ earth rotation safety factor

$$\tau_H = 2\pi\sqrt{\frac{a_0^3}{G(m_p + m_e)}}$$

$\log_{10}$ $a_0 = \frac{r_e}{\alpha^2} = -8.276398$ ✓

$\log_{10}[m_p + m_e] = -23.776610$ ✗

$\log_{10} \tau_H = 3.859536$

$\tau_H = 7236.624$ sec

$= 2^{hr}\ 36.6$ sec

$\tau_{m_p} = 2\pi\sqrt{\frac{r_e^3}{Gm_p}}$ = $\log_{10}$ -2.550973

~ 0.002812076 sec

~ 355.6 hz

$\frac{\tau_H}{\tau_{m_p}} = 257,347 = \log 6.41$

04-02-09

A final conclusion from the relation between the gravitational times of carbon, hydrogen, Oxygen, Nitrogen and those of the earth, is that such ***temporal resonance*** may be the explanation for the existence (and origin) of Life on Earth.

[It is suggested to NASA, not to look for earth-like life elsewhere but look for planets with ~~stust~~ shuster and rotational periods in temporal resonance with atomic gravitational periods. [not necessarily C, H, O, N]

i.e. Non Carbon Life could also exist

$\frac{3}{2} = 1.5$

$\frac{4}{3} = 1.33$

Redo CHON using $T = \frac{GM}{c^3}$ instead of $\tau^2 = \frac{L^3}{GM}$

Check beat frequency

	hr		
H	2.011 ✓		H N
84m ⊕	1.405 ✓		
C	6.98 ?	?	CO = 56
N	7.52 ?		
O	8.04 ?		N·O = 60
K			
Week	168		
D =	24		

hr

X	⊕	H	C	N	O	K
⊕	2.810	2.825	9.807	10.57	11.3	
H		4.044	14.07	15.12	16.17	
C			48.72	52.5	56.12	
N				56.55	60.46	
O					64.64	

÷	⊕	H	C	N	O	D	W
⊕	1	1.431	4.97	5.35	5.72	17.08	119.6
H		1	3.47	3.74	3.99	11.9	83.5
C			1	1.077	1.15	3.44	24.0
N				1	1.069	3.19	22.5
O					1	2.99	20.9
D						1	7
W							1

W = 120 ⊕ = (16 N) ⊕, 168.6 = 120 ⊕

C = 5·⊕

O = 4·H

D = 12·H = 3.0 = 17 ⊕

W = 24 C

D = 3 0

120 = 16 N

280 = 840

or Month =

13 D = 312 hr

222 ⊕ = 311.91 = 13 DAYS

⊕ not MAYAN

$$2q = 1.499426 \doteq \frac{3}{2}$$

$$q = \log_{10} \frac{GS}{C^3} = 0.749713 \doteq \frac{3}{4}$$

$$\bar{q} = \text{antilog} = \frac{GS}{C^3} = 5.619698$$

K for hours = 7179.618, for seconds $\check{K} = \frac{K}{3600}$

$= 1.994338$

$$\frac{2q \cdot A}{K \cdot A} = \cancel{\frac{2q \cdot 3600}{K}} =$$

$$\frac{\check{K}}{2q} = 1.330068 \doteq \frac{4}{3}$$

ATOM	#	A WEIGHT	q·A q·WT	2qA ×2	hours K·A	K·A/2qA				
H	1	1.00794	0.755666	1.5	2	4/3				
C	6	12.011	9.004803	18	24	4/3				
N	7	14.0067	10.501005	21	28	4/3				
O	8	15.9994	11.994958	24	32	4/3				
K	19	30.098	22.564862	45	60	4/3				

Does this legitimatize use of K for Atoms?

$$2\pi\sqrt{\frac{re^3}{G m_p}} = \log_{10} = -2.550923 \text{ sec}$$

$$2\pi\sqrt{\frac{a_0^3}{G(m_p+m_e)}} \log_{10} = +3.859735$$

CHON

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EASTER

$$\frac{l_0^3}{Gm_p} = \frac{l_0^3 S^{1/2}}{G(\alpha\mu)^{1/2} m_0} = \left(\frac{S}{\alpha\mu}\right)^{1/2} \frac{l_0}{Gm_0} l_0^2$$

$$m_p = \left(\frac{\alpha\mu}{S}\right)^{1/2} m_0$$

$$= \sqrt{\frac{S}{\alpha\mu}} \frac{G\hbar}{c^3} \cdot \sqrt{\frac{G\hbar}{c^3} G^2 \frac{G}{c\hbar}}$$

$$= \sqrt{\frac{S}{\alpha\mu}} \sqrt{\frac{G^2\hbar^2}{c^6} \frac{1}{c^4}} = \sqrt{\frac{S}{\alpha\mu}} \cdot \frac{G\hbar}{c^5} = \sqrt{\frac{S}{\alpha\mu}} t_0^2$$

19.114403
4.662199
23.776602

$$T_H = 2\pi\sqrt{\frac{a_0^3}{Gm_p}} = 7239.94 \text{ sec} = 2^{hr} 39.94^{s}$$

$$a_0 = \frac{(\alpha\mu S)^{1/2} l_0}{\alpha^2}$$

$$T_H = 2\pi\sqrt{\frac{(\alpha\mu S)^{3/2} l_0^3}{\alpha^6 G m_p}} = 2\pi\sqrt{\frac{(\alpha\mu S)^{3/2}}{\alpha^6} \frac{l_0^3}{Gm_p}} = 2\pi\sqrt{\frac{(\alpha\mu S)^{3/2}}{\alpha^6} \frac{S^{1/2}}{(\alpha\mu)^{1/2}} t_0^2}$$

$$= \frac{2\pi t_0}{\alpha^3}\sqrt{\alpha\mu S^2} = 2\pi \frac{\sqrt{\alpha\mu}}{\alpha^3} S t_0 =$$

0.798180 = 2π
3.061555
3.859735 → 7239.94 sec

instead of $\frac{c}{G^3} M$

$$2\pi\sqrt{\frac{M}{\alpha^5}} S t_0$$

$$\boxed{T_H = 2\pi \frac{\sqrt{\alpha\mu}}{\alpha^3} S t_0 = 2\pi\sqrt{\frac{a_0^3}{Gm_p}}}$$

$$T_H = 2\pi\sqrt{\frac{(\alpha\mu S)^{3/2}}{\alpha^6} \frac{l_0^3}{Gm_p}} = \frac{2\pi}{\alpha^3}\sqrt{(\alpha\mu S)^{3/2} \frac{m_0}{m_p} \frac{l_0^3}{Gm_0}} = \frac{2\pi}{\alpha^3} (\alpha\mu S)^{3/4} \left(\frac{m_0}{m_p}\right)^{1/2} t_0$$

$$\frac{l_0^3}{Gm_0} = t_0^2$$

$$\frac{m_0}{m_p} = \left(\frac{S}{\alpha\mu}\right)^{1/2}$$

$$T_H = \frac{2\pi}{\alpha^3} (\alpha\mu S)^{3/4} m_0^{1/2} t_0 \cdot (m_p)^{-1/2}$$

$$T_H = K \cdot m_p^{-1/2}$$

For fixed radius [$= a_0$] $\quad T = \frac{K}{\sqrt{M}}$

$\sqrt{\alpha\mu}$ vs $\sqrt{S}$

$N = \sqrt{S}$

$n = \sqrt{\alpha\mu}$

	n^0	n^1	n^2	n^3	n^4	n^5	n^6	n^7	n^8	n^9
10^{11}	216.45734	217.020877	217.584414	218.147951	218.711488	219.275025	219.838562	220.402099	220.965636	221.529173
10^{10}	196.7794	197.342937	197.906474	198.470011	199.033548	199.597085	200.160622	200.724159	201.287696	201.851233
N^9	177.10146	177.664997	178.228534	178.792071	179.355608	179.919145	180.482682	181.046219	181.609756	182.173293
N^8	157.42352	157.987057	158.550594	159.114131	159.677668	160.241205	160.804742	161.368279	161.931816	162.495353
N^7	137.74558	138.309117	138.872654	139.436191	139.999728	140.563265	141.126802	141.690339	142.253876	142.817413
N^6	118.06764	118.631177	119.194714	119.758251	120.321788	120.885325	121.448862	122.012399	122.575936	123.139473
N^5	98.3897	98.953237	99.516774	100.080311	100.643848	101.207385	101.770922	102.334459	102.897996	103.461533
N^4	78.71176	79.275297	79.838834	80.402371	80.965908	81.529445	82.092982	82.656519	83.220056	83.783593
N^3	59.03382	59.597357	60.160894	60.724431	61.287968	61.851505	62.415042	62.978579	63.542116	64.105653
N^2	39.35588	39.919417	40.482954	41.046491	41.610028	42.173565	42.737102	43.300639	43.864176	44.427713
N^1	19.67794	20.241477	20.805014	21.368551	21.932088	22.495625	23.059162	23.622699	24.186236	24.749773
N^0	0	0.563537	1.127074	1.690611	2.254148	2.817685	3.381222	3.944759	4.508296	5.071833
N^{-1}	-19.67794	-19.114403	-18.550866	-17.987329	-17.423792	-16.860255	-16.296718	-15.733181	-15.169644	-14.606107
N^{-2}	-39.35588	-38.792343	-38.228806	-37.665269	-37.101732	-36.538195	-35.974658	-35.411121	-34.847584	-34.284047
N^{-3}	-59.03382	-58.470283	-57.906746	-57.343209	-56.779672	-56.216135	-55.652598	-55.089061	-54.525524	-53.961987
N^{-4}	-78.71176	-78.148223	-77.584686	-77.021149	-76.457612	-75.894075	-75.330538	-74.767001	-74.203464	-73.639927
N^{-5}	-98.3897	-97.826163	-97.262626	-96.699089	-96.135552	-95.572015	-95.008478	-94.444941	-93.881404	-93.317867
N^{-6}	-118.06764	-117.504103	-116.940566	-116.377029	-115.813492	-115.249955	-114.686418	-114.122881	-113.559344	-112.995807
N^{-7}	-137.74558	-137.182043	-136.618506	-136.054969	-135.491432	-134.927895	-134.364358	-133.800821	-133.237284	-132.673747
N^{-8}	-157.42352	-156.859983	-156.296446	-155.732909	-155.169372	-154.605835	-154.042298	-153.478761	-152.915224	-152.351687
N^{-9}	-177.10146	-176.537923	-175.974386	-175.410849	-174.847312	-174.283775	-173.720238	-173.156701	-172.593164	-172.029627
N^{-10}	-196.7794	-196.215863	-195.652326	-195.088789	-194.525252	-193.961715	-193.398178	-192.834641	-192.271104	-191.707567
N^{-11}	-216.45734	-215.893803	-215.330266	-214.766729	-214.203192	-213.639655	-213.076118	-212.512581	-211.949044	-211.385507
N^{-12}	-236.13528	-235.571743	-235.008206	-234.444669	-233.881132	-233.317595	-232.754058	-232.190521	-231.626984	-231.063447

$(\alpha\mu S)^n$

$\left(\frac{\alpha\mu}{S}\right)^n$

ATOMIC, BIOLOGICAL AND COSMIC CLOCKS

T 11 B

T 10 B

T 10 M

INTRODUCTION

The definition and measurement of time ultimately depend on reduction to some cyclical phenomenon. Units of time are definable only in terms of a periodic motion such as the earth's rotation or annual motion, or in terms of electomagnetic vibrations. All clocks require for their operation and calibration a basic pulse such as provided by a pendulum, a piezzo elcetric crystal, a multivibrator, or some sort of molecular vibrations. Although both in physics and psychology we have the concept of a "linear flow of time" and usually represent time as a uniformly increasing variable operationally time must be derived from some sort of periodicity.

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Since the advent of the jet age we have become increasingly aware of the importance of biological clocks that regulate many of the physiological processes that take place in living organisms. Extensive experimental work on plants and animals shows that the clock that exists in all bio-organisms governs the life rhythms of the organism and its sub-components. It is reasonable to surmise that these biological clocks, like other clocks, must contain as oscillator that supplies energy or information having periodic components. A name frequently given to this oscillator is *zeitgeber* or time giver. The pulses provided by the zeitgeber can be sensed by the organism and used either to calibrate or to control directly other physiological processes.

The zeitgeber has two important properties: first, it appears to be universally accessible to all living organisms even down to individual cells. Second, it supplies periodic pulses whose fundamental frequencies or harmonics approximate basic biorhythms such as 24 hours or 28 days. The macroscopic properties of biological clocks do not unequivocally suggest whether the zeitgeber is endogenous or exogenous, i.e. whether the basic oscillator is contained in the organism and is independent of the environment or is entrained and enforced by environmental cycles. Most of the experimental results, however, can be accounted for by an endogenous clock that possesses periods equal to the principal geophysical and astronomical cycles to which life is tuned.

In this paper a zeitgeber satisfying these two prescriptions is proposed. It is an endogenous physical oscillator present in all matter and possessing periods corresponding to environmental cycles. Although neither the exact nature of this zeitgeber's pulse nor how a bio-organism senses or makes use of the pulse can be given at present, the requirements and implications of the herein proposed zeitgeber hypothesis are deveroped.

ATOMIC GRAVITATIONAL CLOCKS

Since the most exacting requirement to be placed on any zeitgeber hypothesis is the ability to reproduce accurately the quantitative values of the periods observed in bio-rhythms, success in this aspect should be taken as the first test for any model. Accordingly, the rationale adopted in this paper has been first to find an hypothesis

ROUGH DRAFT
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7/26/68

ATOMIC, BIOLOGICAL AND COSMIC CLOCKS

INTRODUCTION

The definition and measurement of time ultimately depend on reduction to some cyclical phenomenon. Units of time are definable only in terms of a periodic motion such as the earth's rotation or annual motion, or in terms of electromagnetic vibrations. All clocks require for their operation and calibration a basic pulse such as provided by a pendulum, a piezzo electric crystal, a multivibrator, or molecular vibrations. Although both in physics and psychology we have the concept of a "linear flow of time" and usually represent time as a uniformly increasing variable, operationally time must be derived from some periodicity.

Since the advent of the jet age we have become increasingly aware of the importance of biological clocks that regulate many of the physiological processes that take place in living organisms. Extensive experimental work on plants and animals shows that the clock that exists in all bio-organisms governs the life rythyms of the organism and its components. It is reasonable to surmise that these biological clocks, like other clocks, must contain an oscillator that supplies energy or information having periodic components. A name frequently given to this oscillator is the zeitgeber or "time giver." The pulses provided by the zeitgeber can be sensed by the organism and used either to calibrate or to control physiological processes.

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In this paper a zeitgeber satisfying these two prescriptions is proposed. It is an endogenous physical oscillator present in all matter and possessing periods corresponding to environmental cycles. Although neither the exact nature of this zeitgeber's pulse nor how a bio-organism senses or makes use of the pulse can be given at present, the requirements and implications of the here proposed zeitgeber hypothesis are developed.

ATOMIC GRAVITATIONAL CLOCKS

Since the most unequivocal requirement to be placed on any zeitgeber hypothesis is the ability to reproduce accurately the quantitative values of the periods of observed bio-rythyms, success in this should be taken as the first test for any model. Accordingly the rationale adopted in this paper has been first to find an hypothesis that satisfies the two overriding requirements of bio-clocks, their ubiquity in living matter and the generation of the prescribed periods. The quantitative success of a model of the zeitgeber would then justify a more detailed elaboration of the model.

The existence of a fundamental temporal bound associated with gravitating bodies has long been recognized in physics and astronomy. This bound is the <u>minimum</u> period,

$$\text{(1)} \qquad \check{\tau} = 2\pi R^{3/2}/\sqrt{GM},$$

given in terms of a body's mass M and radius R with G being the Newtonian gravitational constant. It corresponds to the ciruclar velocity at the surface of the body and is a minimum period both in the sense that no satellite orbiting the body can have a smaller orbital period than $\check{\tau}$ and the body itself cannot have a period of rotation less than $\check{\tau}$ and remain gravitationally stable. The period $\check{\tau}$ determines a basic "frequency" that governs dynamical behavior in the neighborhood of the gravitating body. For example, Kepler's Third Law in terms of τ is simply: (orbital period) = $(\check{\tau}/R^{3/2})\cdot$ (orbital semi-major axis)$^{3/2}$. In the above sense it may be said that the presence of a gravitating mass establishes a local clock that "beats time" for dynamical motions in the neighborhood of the body.

The minimum period, $\check{\tau}$, also called the "Schuster Period," may be expressed in terms of the mean density $\bar{\rho}$ of the body by, $\bar{\rho}\check{\tau}^2 = 3\pi/G$. Some approximate values of $\check{\tau}$ are: for the earth 84 minutes, for the moon 108 minutes, and for the sun 2 3/4 hours; assuming a mean density of the milky way of 10^{-23} gm/cm^3, the galactic minimum period is of the order of 10^8 years or about the same as its period of rotation.

The effects of this gravitational clock have been observed in the cosmic and of the time scale from planets to the largest known aggregates of matter in the universe. Are gravitational clocks also operative on a microscopic scale? Theoretically, the gravitational clock should be universal, associated with all matter, whatever its mass. The Schwarzschild solution to the field equations of general relativity establishes for all masses having spherical symmetry the relation $(R_s R_c{}^2/R^3)$ equal to a constant that depends on the density distribution; where R_s is the Schwarzschild radius, $2GM/c^2$, and R_c is the radius of curvature of space-time at the coordinate distance R from the center of the body ($R \geq$ the physical radius). Substituting the value of R_s gives, $(R_c/c)^2 \propto R^3/2GM$.

It is thus seen that a local time period is defined by the ratio of the local curvature of space to the velocity of propagation of light. This period is inversely proportional to the square root of the mean density of matter within the coordinate distance R. Hence a gravitational period -- equal to $\check{\tau}$ if the constant of proportionality is $8\pi^2$ -- should exist in the neighborhood of all masses regardless of the spatial scale of the mass aggregate involved. However, microcosmic gravitational effects are presumed submerged in the variety of effects resulting from the action of other dominating forces such as Coulomb forces. The elemental binding forces in molecules, crystals, and in the microcosmos in general, are electric. Although structural patterns are determined by these Coulomb forces, which are stronger than gravitational forces by a factor $S = e^2/Gm_p m_e = 10^{39.356}$ (e is the charge on the electron, G the gravitational constant, m_p the mass of the proton and m_e the mass of the electron), this need not per se obscure manifestation of the effects of microcosmic gravitational clocks whose temporal effects rather than force effects are sought. In spite of the negligible role played by gravitational force in microscopic structures, it may somehow be possible that the temporal effects of the gravitational clocks of fundamental masses are detectable on a macroscopic scale. Two conditions favorable to this would be for the gravitational periods of atoms to be completely different from their electric periods, and for there to be sufficient phase coherence that periodic atomic gravitational effects will not be lost in summation over random phases.

The atom as an "electric clock" has many frequencies that are manifest in optical, X-ray and other spectra. An example of a basic electric frequency associated with the atom is that corresponding to the period of orbital revolution of an electron in the first Bohr orbit of a hydrogen atom. This time interval is $10^{-15.81822}$ seconds, and is equal to $\frac{2\pi a_o}{\alpha c} = \frac{1}{2cR_\infty}$ where a_o is the radius of the first Bohr orbit; is the fine structure constant; c the velocity of light; and R_∞, the Rydberg constant.

The basic gravitational frequency of the hydrogen atom will be the frequency corresponding to the minimum period,

$$\check{\tau} = 2\pi a_o{}^{3/2}/\sqrt{Gm_p}.$$

Using the values in Table I (Cohen and DuMond, Rev. Modern Physics, v. 37, No. 4, Oct. 1965), we obtain for $\check{\tau}$ the first value in Table II. The mass values are based on the unified scale of atomic weights, $^{12}C = 12$.

It is somewhat surprising that the combination of fundamental constants whose c.g.s. values range from 10^{-23} to 10^{-6} define in exactly the manner of cosmic gravitational relationships a basic time period of almost precisely two hours. This fundamental gravitational period of the hydrogen atom, which we may designate by τ_H, is $10^{19.678} = \sqrt{S}$ times as great as the basic Coulomb period of the hydrogen atom. The value of τ_H is not located on the micro or cosmic ends of the temporal scale but falls in the very range of time periods that are characteristic of life processes. The existence of a ubiquitous oscillator - the hydrogen atom - having a temporal period commensurate with astronomical and biological periods suggests that the hydrogen atom might be playing some part in the zeitgeber of biological clocks.

In addition to the gravitational period, τ_H, associated with the neutral unexcited hydrogen atom, by means of Eq. (1), two other basic gravitational periods may also be calculated. One of these that has an order of magnitude suitable for temporal regulation of many shorter physiological processes is the "electron period" (τ_e) based on m_e and r_e, the mass and radius of the electron. The existence of a clock with a pulse period of about one-tenth of a second (Table II, second value) would be appropriate for calibrating processes such as heart beat, optic scanning, etc. For completeness, a third gravitational period, the "nuclear period" (τ_n), is taken to $\alpha^3\tau_H$ (Table II, third value).

A. G. Wilson, 6/11/68

III. GRAVITATIONAL CLOCKS

The Schwarzschild solution to the field equations of general relativity establishes for all physical bodies the relation

$$(1) \quad R_s\, R_c{}^2/R^3 = \text{constant}$$

between R_s, the Schwarzschild radius of the body, R_c the local radius of curvature of space, and R physical radius (Ref. 1). This expression implies the existence of a fundamental time period associated with every physical body. Substituting $2GM/c^2$ for R_s gives,

$$2GM \frac{R_c}{c}^{2} = kR^3.$$

This local basic time period τ is thus proportional to the ratio of the local radius of curvature of space to the velocity of light, or

$$\tau^2 = \frac{kR^3}{2GM} .$$

If the constant k is taken to be $8\pi^2$, the basic period τ becomes equal to the minimum gravitational period ,$\check{\tau}$, associated with gravitating bodies. This period,

(2) $\tau = \frac{2 R^{3/2}}{\sqrt{GM}}$

sometimes called the "Schuster Period" is the well known limiting minimum period for bodies orbiting about a spherical mass M of radius R. Eq. (1) also is the limiting rotation period for a gravitating body with dynamic stability.

Although for small distances the effects of gravitational forces are negligible with respect to other forces (Coulomb forces, for example, are 10^{40} times greater than gravitational forces), there is no reason to doubt the universal validity of Eq. (1) and its inference for the existence of a fundamental characteristic time associated with the local curvature of space. The effects of this "gravitational clock" are well known in the macrocosmos, governing dynamical motions of cosmic bodies. Is it possible to detect the effects of the gravitational clock associated with the small fundamental masses, the atoms or elementary particles? Certainly it is not possible to detect the gravitational <u>force</u> effects associated with entities whose structure is overwhelmingly determined by other forces, but it still may be possible to detect the <u>temporal</u> effects of the gravitational clock especially if the basic gravitation periods are markedly different from electric and other periods associated with the atom.

Rough Draft
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6/15/68

III GRAVITATIONAL CLOCKS

The existence of a fundamental temporal bound associated with gravitating bodies has long been recognized in physics and astronomy. This is the minimum period, $\check{\tau} = 2\pi R^{3/2}/\sqrt{GM}$, given in terms of a body's mass M and radius R with the dimensionality of time. It represents the circular velocity at the surface of the body and is a minimum period both in the sense that no satellite orbiting the body can have a smaller orbital period than $\check{\tau}$ and the body itself cannot have a period of rotation less than $\check{\tau}$ and remain stable. In effect the presence of gravitating mass establishes a local clock that "beats time" for all mechanical movement in the neighborhood of the body. This minimum period, also called the "Schuster Period," may be expressed in terms of the mean density $\bar{\rho}$ of the body:

$$\bar{\rho}\tau^2 = 3\pi/G.$$

Its value for the earth is about 84 minutes, for the sun about 2 3/4 hours, and for the moon 108 minutes. Assuming a mean density of a galaxy of 10^{-23} gm/cm^3, the minimum period is of the order of 10^8 years, about the same as the period of rotation.

The effects of the gravitational clock have been observed on all macroscopic scales from planets to the visible sample of the universe. Theoretically the gravitational clocks also are operative on a microscopic scale, but their effects are presumed submerged in the variety of effects resulting from the action of other forces, such as Coulomb forces. But is this really the case? The strength of the electric force is 10^{40} times greater than that of gravitational force, but this per se need not obscure the gravitational clock, since <u>temporal</u> effects rather than <u>force</u> effects are sought. In spite of the entirely negligible role of the gravitational force in microscopic structure, it may nonetheless be possible to detect on a macroscopic scale the gravitational clock of fundamental particles provided the basic period of the atomic gravitational clock is quite different from the basic period of any atomic electric clock, and provided that there is phase coherence so that the beat may be augmented by a factor proportional to the number of atoms.

The atom as an "electric clock" has many basic frequencies that are manifest in optical, X-ray and other spectra. An example of a basic electric frequency associated with the atom is the period of orbital revolution of an electron in the first Bohr orbit of a hydrogen atom. This time is $10^{-15.81822}$ seconds, and is equal to $\frac{2\pi ao}{\alpha c} = \frac{1}{2cR_\infty}$ where ao is the radius of the first Bohr orbit; α is the fine structure constant; c, the velocity of light; and R_∞, the Rydberg constant.

The basic gravitational frequency of the hydrogen atom will be the minimum frequency

$$\check{\tau} = \frac{2\pi a_o^{3/2}}{\sqrt{Gm\rho}}$$

where $m\rho$ is the mass of the proton.

Using the values in Table I (Cohen and DuMond, Rev. Modern Physics, v. 37, No. 4, Oct. 1965), we obtain for $\check{\tau}$ the values in Table II using $m\rho$ or m_H the equivalent mass of the hydrogen atom. These values are based on the unified scale of atomic weights, $^{12}C = 12$. (The minimum period based on the $^{16}O = 16$ scale of atomic weights is $1^h\ 59^m\ 43^s.07$.)

The gravitational period is seen to be completely different from electric periods, being $10^{19.678}$ times as great as t_o. This number factor is equal to the square root of S, the ratio between Coulomb forces and gravitational forces,

$$S = \frac{e^2}{Gm\rho m_e} = 10^{39.356}.$$

The elemental binding forces in molecules, crystals, and the microcosmos in general are electric, dominating gravitational forces by a factor = S. Nonetheless the basic gravitational frequency may play a role in the organization of micro-structures, including living matter, through providing a clock with more convenient periods than the electric periods, since the basic period of a useful clock must be near to the rythyms in movement and process required by organisms.

In order to calculate the values of other basic gravitational frequencies associated with various atoms, we must determine the proper "gravitational" radius corresponding to the masses of atoms of atomic weight greater than unity. The "gravitational" radius of these atoms is more likely to be determined in the same manner as that of large gravitating bodies, rather than being analogous to coulomb radii. Stable, non-degenerate gravitating bodies appear to possess a maximum potential bound that is the same for stars, galaxies, clusters of galaxies (Ref. 2). This potential bound, b, is about 10^{-4} of the Schwarzschild potential limit and may be written

$$\frac{GM}{c^2R} \leq b$$

We <u>assume</u> that the atoms, being stable, are governed by a similar law, and that the "gravitational" radius, r, appropriate to any atom is related to the atomic weight, A, by the relation

$$\frac{GA}{c^2r} = k, \qquad \text{a constant.}$$

For the hydrogen atom

$$\frac{Gm_\rho}{c^2 a_o} = \alpha^2 S^{-1} = k.$$

Assuming this relation to hold true for all atoms, we have

$$r = a_o \frac{A}{m_\rho}$$

and the gravitational period for an atom of atomic weight A becomes

$$\tau A = \frac{2\pi r^{3/2}}{GA} = \frac{2\pi a_o^{3/2}}{Gm_\rho m_\rho} A = \tau_o \frac{A}{m_\rho}$$

A and m_ρ being in the same units. In the unified system of atomic weights, $^{12}C = 12$, the proton mass, m = 1.00727663. Hence,

$$\tau_A(\text{seconds}) = \frac{7241.3675\, A}{1.00727663}. \text{ (seconds)}$$

For example, the atomic weight A for carbon is 12.01115. This gives $\tau_A = 86348^s.8249$ or

$23^h\ 59^m\ 8^s.8.$

For carbon 12, the value is $23^h\ 57^m\ 48^s.7$. The striking coincidence of these atomic gravitational periods with the earth's 24 hour period suggests that the carbon atom may be the zeitgeber governing the circadian rhythym in most living organisms.

Rough Draft
A. G. Wilson
6/17/68

ATOMIC, BIOLOGICAL AND COSMIC CLOCKS

I. BIOLOGICAL CLOCKS

A brief but fair summary statement of the essence of the experimental conclusions of work on biological rythyms and cyclical phenomena in living matter is that there exists a "Zeitgeker" that provides the pulse beat by which living organisms structure their temporal processes. Further, this Zeitgeker should 1) be universally available to every organism and its sub-components down to the level of the single cell; 2) possess certain intrinsic periods either as its fundamental or a harmonic - the principal biological periods being (a) the Circadian or 24 hour period, (b) the menstrual or 28 day period, and (c) a short period of the order of 1/15 second exhibited by many physiological processes.

The foregoing properties of the Zeitgeker do not permit a decision whether the clock is endogenous or exogenous. However, most of the experimental results could be accounted for by an endogenous clock possessing exogenous periods, i.e., periods corresponding to the principal geophysical and astronomical cycles to which life seems tuned.

In this paper a clock meeting these prescriptions is suggested. It is an endogenous clock, universally available with all of the correct periods. However, no theory of how an organism senses this clock or makes use of its periods can be given at present.

The elemental binding forces in molecules, crystals, and in the microcosmos in general, are electric. Although structural patterns are determined by these coulomb forces, which are stronger than gravitational forces by a factor $S = e^2/Gm_\rho m_e = 10^{39.356}$, this need not per se obscure manifestation of the microcosmic gravitational clock whose <u>temporal</u> effects rather than <u>force</u> effects are sought.

Living matter is composed largely of the four elements, Carbon, Oxygen, Nitrogen, and Hydrogen. About 96% of the human body by weight is distributed among these four elements. In Table III are given the fundamental gravitational periods of these basic organic elements.

The details of such a theory will depend on the answer to a question that has remained unanswered for 300 years -- what is gravity?

(B)

This basic gravitational period of approximately two hours is of the order of magnitude of characteristic times encountered in processes on the human scale. Such a frequency could therefore play a useful role in the organization of various systems, including living matter that require a metronome to govern their basic rhythyms and cyclical processes.

A second basic period that has an order of magnitude suitable for time control of many life processes is the "electron period" based on m_e and r_e, the mass and "radius" of the electron. The existence of a clock with a pulse period of about one-tenth of a second (Table II) would be useful for governing processes such as heart beat, optic imaging, etc.

Rough Draft
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7/23/68

ATOMIC, BIOLOGICAL AND COSMIC CLOCKS

I. INTRODUCTION

The definition and measurement of time ultimately depends on the existence of cyclical phenomena. Units of time are definable only in terms of some periodic motion such as the earth's rotation, annual motion, or the lunar cycle. Clocks require for their operation and calibration a basic beat such as provided by a pendulum, a piezzo electric crystal, a multivibrator, or molecular vibration. Although both in physics and psychology we have the concept of a "linear flow of time" and frequently represent time as a uniformly increasing independent variable, operationally time must always be inferred from periodicity.

Since the advent of the jet age we have become increasingly aware of the importance of the biological clocks that regulate many of the processes that take place in living organisms. Extensive experimental work shows that in all bio-organisms there exists a "clock" that allows the organism or its components to calibrate their temporal processes.

It is reasonable to surmise that these biological clocks, like other clocks, must include a basic component that supplies energy or information with a periodic content. The usual name given to this component is the zeitgeber or "time giver." The zeitgeber is some sort of oscillator whose periods can be sensed by the organism and used either to calibrate or to govern the organism's temporal processes. The zeitgeber appears to be universally accessible to organisms even to the level of a single cell. It supplies intrinsic fundamental or harmonic periods that are closely equal to biological rythyms such as 24 hours and 28 days. The macroscopic properties of the zeitgeber do not permit a decision whether the clock is endogenous or exogenous, i.e., whether its basic oscillator is independent of the environment or is conditioned by the environment. However, most of the experimental results could be accounted for by an endogenous clock possessing exogenous periods, i.e., periods corresponding to the principal geophysical and astronomical cycles to which life seems tuned.

In this paper a zeitgeber meeting these prescriptions is suggested. It is an endogenous physical oscillator present in all matter and possessing all of the correct periods. However, no theory of how a biological organism senses this oscillator or makes use of its periods can be given at present.

ATOMIC GRAVITATIONAL CLOCKS

The existence of a fundamental temporal bound associated with gravitating bodies has long been recognized in physics and astronomy. This bound is the minimum period, $\check{\tau} = 2\pi R^{3/2}/\sqrt{GM}$, given in terms of a body's mass M and radius R with the dimensionality of time. It represents the circular velocity at the surface of the body and is a minimum period both in the sense that no satellite orbiting the body can have a smaller orbital period than $\check{\tau}$ and the body itself cannot have a period of rotation less than $\check{\tau}$ and remain gravitationally stable. The period τ determines a basic "frequency" that governs dynamical behavior in the neighborhood of the gravitating body. For example, Kepler's Third Law in terms of $\check{\tau}$ is simply: (orbital period) = $(\check{\tau}/R^{3/2})$ (orbital semi-major axis)$^{3/2}$. In general, it might be said that the presence of a gravitating mass establishes a local clock that "beats time" for all mechanical movement in the neighborhood of the body.

The minimum period, $\check{\tau}$, is also called the "Schuster Period," and may be expressed in terms of the mean density $\bar{\rho}$ of the body by, $\bar{\rho}\check{\tau}^2 = 3\pi/G$. The value of $\check{\tau}$ for the earth is about 84 minutes, for the sun about 2 3/4 hours, and for the moon 108 minutes. Assuming a mean density of a galaxy of 10^{-23} gm/cm^3, the galactic minimum period is of the order of 10^8 years, about the same as the period of rotation.

The effects of this gravitational clock have been observed in macroscopic scales from planets to the visible sample of the universe. There is no theoretical reason these gravitational clocks should not also be operative on a microscopic scale, but the manifestation of their effects is presumed submerged in the variety of effects resulting from the action of other more dominant forces such as Coulomb forces. But is this really the case? The elemental binding forces in molecules, crystals, and in the microcosmos in general, are electric. Although structural patterns are determined by these Coulomb forces, which are stronger than gravitational forces by a factor $S = e\ /Gm\ m_e = 10^{39.356}$, this need not per se obscure manifestation of the microcosmic gravitational clock whose temporal effects rather than force effects are sought. In spite of the entirely negligible role of the gravitational force in microscopic structure, it may nonetheless be possible that the effects of the gravitational clock of fundamental particles are detectable on a macroscopic scale provided (1) the basic gravitational period of the atomic clock is quite different from the basic electric period of the atomic clock, and (2) provided that there is general <u>phase</u> <u>coherence</u> so that the intensity of pulse will be augmented by a factor proportional to the number of atoms.

The atom as an "electric clock" has many frequencies that are manifest in optical, X-ray and other spectra. An example of a <u>basic</u> <u>electric</u> <u>frequency</u> associated with the atom is that corresponding to the period of orbital revolution of an electron in the first Bohr orbit of a hydrogen atom. This time interval is $10^{-15.81822}$ seconds, and is equal to $\frac{2\pi a_o}{\alpha c} = \frac{1}{2cR_\infty}$ where a_o is the radius of the first Bohr orbit; α is the fine structure constant; c the velocity of light; and R_∞, the Rydberg constant.

The basic gravitational frequency of the hydrogen atom will be the frequency corresponding to the minimum period

$$\tau = \frac{2\pi a_o^{3/2}}{\sqrt{Gm_p}}$$

where m_p is the mass of the proton and a_o is the first Bohr radius. Using the values in Table I (Cohen and DuMond, Rev. Modern Physics, v. 37, No. 4, Oct. 1965), we obtain for $\check{\tau}$ the first value in Table II. The mass values are based on the <u>unified</u> scale of atomic weights, $^{12}C = 12$.

It is somewhat surprizing that the combination of fundamental constants whose c.g.s. values range from 10^{-23} to 10^{-6} define by analogy with macro gravitational relationships a basic time period of almost exactly two hours. This fundamental gravitational period of the hydrogen atom, which we may designate by τ_H, is $10^{19.678} = \sqrt{\mathfrak{F}}$ times as great as the basic Coulomb period of the hydrogen atom. The value of τ_H is not located on the micro or macro ends of the temporal scale but falls in the very range of time periods that are associated with life processes. The existence of a ubiquitous oscillator - the hydrogen atom - having a temporal period commensurate with astronomical and biological periods suggests that the hydrogen atom might possibly play a role of zeitgeber in biological clocks.

While the quantity $\tau = 2\pi R^{3/2}/\sqrt{GM}$ has the dimensionality of time and τ_H has an order of magnitude in the right range for providing beats useful for biological rythyms, the <u>overriding question is beats of what</u>. If it turns out that the τ periods of atoms are indeed the zeitgebers for biological clocks, then we are not only confronted with a basic biological phenomenon, but with a physical phenomenon having far reaching revolutionary implications.

In addition to the gravitational period, τ_H, associated with the neutral unexcited hydrogen atom, by means of formula ( ), two other basic gravitational periods may be derived. One of these periods that has an order of magnitude suitable for temporal regulation of many shorter physiological processes is the "electron period" (τe) based on m_e and r_e, the mass and radius of the electron. The existence of a clock with a pulse period of about one-tenth of a second (Table II,second value) would be appropriate for calibrating processes such as heart beat, optic scanning, etc.

A third gravitational period is the "nuclear period" (τ_n), which is equal to $\alpha^3\tau_H$ (Table II, third value). This periodicity may be appropriate for very short physiological processes, such as nerve impulses.

ROUGH DRAFT
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8/1/68

BIOLOGICAL AND CHEMICAL CLOCKS

INTRODUCTION

One of the products of the jet age has been the increasing awareness of the role of the internal 24 hour biological clock that regulates many basic human physiological processes. Jet travelers, after crossing several time zones in only a few hours lapsed time, frequently experience a fatigue or malaise that lasts for several days, while travelers making north-south trips of the same duration do not experience these symptoms[1]. This phenomenon is attributable to the effects of a change of man's internal clock phase with respect to the phases of some environmental cycle such as a light-dark, or tidal cycle[2].

Biological clocks similar to man's also exist in animals. For example, bees flown from Paris to America continued to go to feeding places on Paris time, showing that they possessed an internal 24 hour clock that operated independently of outside cues[3]. Extensive experiments[4] carried out on animals and plants show that there seems to exist internal clocks in all bio-organisms that serve either to calibrate or control the life rythyms of the organism and its components.

In addition to the 24 hour period, bio-clocks provide signals corresponding to other basic rythyms. The shortest of these periods is one and one-half to two hours and is observed in both humans and rats[5]. Human bodily activity, both sleeping and awake, has an approximate two hour cycle. Stomach contractions of hungry rats[6], rapid eye movement and dreaming patterns in humans all show a two hour cycle. Other longer bio-periods include the four day oestral and ovulation cycle in female rats; seven day cycles of certain illnesses in humans[7]; and an approximate nine day cycle[8]. The 28 day menstrual cycle is perhaps the best known human bio-rythym, but there are still longer periodicities associated with some diseases. Illnesses with periods of over 10 years have been recorded[9].

It is to be noted that many of the basic biological rythyms are nearly synchronous with important geophysical cycles -- such as the 24 hour solar day or 28 day lunar cycle. This suggests that the external period force-drives the oscillations of the bio-clock through the action of a periodic signal in some physical parameter such as temperature, light intensity, or pressure (a tidal effect). However, experimentally controlled elimination of variations in the intensity of known physical signals (such as light intensity[10], show that whatever the period, the clocks seem to be able to operate independently of external factors. One exception to this, of course, is gravity. The minute fluctuations in the gravitational pulls of the sun (24 hours) and moon (24 hours-50 minutes) cannot be eliminated in the laboratory. But since not all bio-rythyms are commensurate with geophysical cycles, it appears that the basic oscillator providing time signals to bio-clocks is endogenous and is capable of independently producing uniform self-sustained oscillations like the crystal in a crystal controlled clock.

A further important property of the bio-clocks is their apparent universal accessibility to all living organisms even down to single cells. The 24 hour clock, for example, is known to be present in man, mammals, plants, and in the unicellular organisms Euglena[11].

Before attempting a theory of bio-clocks, we should remind ourselves that the definition and measurement of time ultimately depend on some cyclical phenomenon. Our units of time are defined in terms of a periodic motion such as the earth's rotation or annual motion, or in terms of electromagnetic vibrations. All clocks require for their operation and calibration a basic periodic signal such as provided by a pendulum, a piezzo electric crystal, a multivibrator, or molecular vibrations. Although both in physics and psychology we have the concept of a "linear flow of time" and usually represent time as a uniformly increasing variable, operationally time must be derived from some periodicity. It is reasonable to surmise that biological clocks, like other clocks must contain an oscillator that supplies energy or information having periodic components. A name frequently given to this oscillator is zeitgeber or "time giver." The signals provided by the zeitgeber can be sensed by the organism and used either to calibrate or to control physiological processes.

A list of the conditions which must be satisfied by any model of the zeitgeber includes:

1) Zeitgebers must be endogenous, i.e., capable of auto-generation of constant frequency time signals.

2) Zeitgebers must be containable, and perhaps actually contained in every living cell.
3) The source of the basic oscillations must be able to produce in a consistent and systematic manner frequencies with quantitative correspondence to <u>all</u> of the observed bio-rythyms including the sub-set corresponding to the common geophysical cycles of the bio-environment.
4) The model should be based on known physical principles and concepts.

In this paper a model of zeitgebers satisfying these prescriptions is proposed. It is an endogenous physical oscillator present in all matter and possessing periods corresponding to the basic biological and environmental cycles. Though based on known physical concepts neither the exact nature of the zeitgeber's pulse nor how a bio-organism senses or makes use of the pulse can be deduced at present. To meet this deficiency, some implications and further requirements of the proposed hypothesis are developed.

ELEMENTAL GRAVITATIONAL CLOCKS

Condition 2), that the zeitgebers be a possible component of every living cell suggests the hypothesis that the basic oscillator is associated with one of the vibrations characteristic of individual molecules or atoms. If the biological clock within a cell in some way can sense, amplify, and transmit the time signals taken from oscillations generated by elemental particles, conditions 1), 2), and 4) that zeitgebers must satisfy would be met. However, the crucial condition for any hypothesis is 3). The most stringent requirement on any model of a zeitgeber is the ability to generate time signals with those periods -- and one might require only those periods -- that have values equal to the values of the various observed periods of bio-rythyms. The first hurdle, therefore, for a zeitgeber model is the ability to generate independently of outside factors time signals with periods of two hours, 24 hours, four days, seven days, 28 days, and other periods that have been observed in both healthy and diseased organisms.

Atoms and molecules possess many characteristic frequencies. Most of these are well known from studies of X-ray, optical, IR and other spectra. These frequencies are too high, however, to be of any use in generating time signals with periods such as two hours or one day. For example, the precession frequency of Ce 133 that is used for the "Cesium Clock" has a value of 9,192,631,770 cycles/second. The basic frequency of the hydrogen atom, that corresponding to the period of orbital revolution of an electron in the first Bohr orbit of a hydrogen atom, is $10^{-15.81822}$ seconds. This frequency is equal to $\frac{2\pi a_o}{\alpha c} = \frac{1}{2cR_\infty}$ where a_o is the radius of the first Bohr orbit; α is the fine structure constant; c the velocity of light; and R_∞, the Rydberg constant. These frequencies are "electric frequencies" and derive from the Coulomb forces that govern atomic and molecular structure.

Condition 3) cannot be satisfied by characteristic electric periods of atoms or molecules. However, there are other periods of time theoretically associated with all elemental particles and therefore satisfying conditions 1), 2), and 4). These are time intervals associated with mass rather than charge, with gravitational rather than Coulomb forces.

The existence of a fundamental temporal bound associated with gravitating bodies has long been recognized in physics and astronomy. This bound is the minimum period,

$$(1) \qquad \check{\tau} = 2\pi R^{3/2}/\sqrt{GM},$$

given in terms of a body's mass M and radius R with G being the Newtonian gravitational constant. It corresponds to the circular velocity at the surface of the body and is a minimum period both in the sense that no satellite orbiting the body can have a smaller orbital period than $\check{\tau}$ and the body itself cannot have a period of rotation less than $\check{\tau}$ and remain gravitationally stable.

The period $\check{\tau}$ determines a basic "frequency" that governs dynamical behavior in the neighborhood of the gravitating body. For example, Kepler's Third Law in terms of $\check{\tau}$ is simply: (orbital period) = $(\check{\tau}/R^{3/2})$. (orbital semi-major axis)$^{3/2}$. In the above sense it may be said that the gravitational field associated with any mass establishes a local clock that provides time signals for the dynamical motions in the neighborhood of the body.

The minimum period, $\check{\tau}$, also called the "Schuster Period," may be expressed in terms of the mean density $\bar{\rho}$ of the body by, $\bar{\rho}\check{\tau}^2 = 3\pi/G$. Some approximate values of $\check{\tau}$ are: for the earth 84 minutes, for the moon 108 minutes, and for the sun 2 3/4 hours; assuming a mean density of the milky way of 10^{-23} gm/cm^3, the galactic minimum period is of the order of 10^8 years or about the same as its period of rotation.

Since the effects of this gravitational clock have been observed on the cosmic end of the time scale from planets to the largest known aggregates of matter in the universe, we may logically ask: are gravitational clocks also operative on a microcosmic scale? Theoretically, the gravitational clock should be universal, associated with all matter, whatever its mass. The Schwarzschild solution to the field equations of general relativity establishes for all masses having spherical symmetry the relation $(R_s R_c^2/R^3) = k$, a constant that depends on the density distribution; where R_s is the Schwarzschild radius, $2GM/c^2$; and R_c is the radius of curvature of space-time at the coordinate distance R from the center of the body ($R \geq$ the physical radius).

Substituting the value of R_s gives,

$$(R_c/c)^2 \propto R^3/2GM.$$

From this relation it is seen that a local time period is defined by the ratio of the local curvature of space to the velocity of propagation of light and that this period is inversely proportional to the square root of the mean density of matter within the coordinate distance R. Hence a gravitational period -- equal to $\check{\tau}$ if the constant of proportionality is $8\pi^2$ -- should exist in the neighborhood of all masses regardless of the magnitude of the mass or of the spatial scale of the material aggregate involved.

It is usually assumed that microcosmic gravitational effects are submerged in the variety of effects resulting from the action of other dominating forces such as Coulomb forces. The binding forces in molecules, crystals, and in microcosmic structures in general, are electric forces which are stronger than gravitational forces by a factor $S = e^2/Gm_pm_e = 10^{39.356}$ where e is the charge on the electron, m_p the mass of the proton and m_e the mass of the electron. The fact that microcosmic structural patterns are determined by electric forces need not per se obscure macroscopic manifestation of the existence of microcosmic gravitational clocks where <u>temporal</u> effects rather than <u>force</u> effects are involved. In spite of the negligible role played by gravitational force in microscopic structures, it may nonetheless be possible that the that the temporal effects of microcosmic gravitational clocks of fundamental masses are detectable on a macroscopic scale provided some condition holds such as that there be sufficient <u>phase coherence</u> among the periodic atomic gravitational signals that they not be lost in summation over random phases.

The basic gravitational frequency of the hydrogen atom will be the frequency corresponding to the minimum period,

$$\check{\tau} = 2\pi a_o^{3/2}/\sqrt{Gm_p}.$$

Using the values in Table I[12], we obtain for $\check{\tau}$ the first value in Table II, $2^h0^m4/^s$. The mass values are based on the <u>unified</u> scale of atomic weights, $^{12}C = 12$.

It is surprising that the combination of fundamental constants whose c.g.s. values range from 10^{-23} to 10^{-6} define in accordance with universal gravitational relationships a basic time period for the hydrogen atom of almost precisely two hours. This fundamental gravitational period of the hydrogen atom, which we may designate by τ_H, is $10^{19.678}$ or $\sqrt{S}$ times as great as the basic Coulomb period of the hydrogen atom defined above. The value of τ_H not being located on the micro or cosmic ends of the temporal scale but falling in the very range of time periods that are characteristic of life processes suggests that basic gravitational periods may be the clue to satisfying condition 3). The existence of a ubiquitous self-contained oscillator -- the hydrogen atom -- having a temporal period equal to the shortest observed bio-rythym and biological periods suggests that the hydrogen atom might be one of the zeitgebers supplying time signals for biological clocks.

In addition to the gravitational period, τ_H, associated with the neutral unexcited hydrogen atom, two other basic gravitational periods that may be calculated by means of Eq. (1) should be mentioned here. One of these having an order of magnitude suitable for temporal regulation of many shorter physiological processes is the "electron period" (τ_e) based on m_e and r_e, the mass and radius of the electron (Table II, second value). Harmonics of a clock with a pulse period of about one-tenth of a second would be appropriate for calibrating such processes as heart beat and breathing while the fundamental has a period closely equal to that of the slowest α-waves in the brain (1/8 sec.). For completeness, a third gravitational period, the "nuclear period" (τ_n), is included (Table II, third value), being taken equal to $\alpha^3\tau_H$.

At this point in the development we recognize two important questions raised by the hypothesis that gravity associated with elemental masses is generating time signals.

The first question has to do with the "addition" of time signals. If periodic gravitational effects are associated with all masses, how are the basic periods and phases to be combined when masses are grouped in larger aggregates. This question will be taken up in the next section.

A second and even more basic question, concerns the physical nature of the time signals themselves. For certain quantitative purposes, such as meeting condition 3), we may speak simply of time signals and concern ourselves with the values of their periods without inquiry into their other physical properties. We may reasonable take the minimum or Schuster period as a fundamental time period associated with all mass. But if gravitation has periodicities, if there are time signals, we must inquire: periodicities and time signals in what. Success in satisfying conditions 1), 2), and 3), has now re-opened condition 4). There now appears to be not only a biological phenomenon to be modeled, but also a physical phenomenon. This general question will returned to in section 4.

TABLE I

Quantity	Value	$\log_{10}$
a_o	5.29167×10^{-9} cm	-8.276407
G	6.670×10^{-8} c.g.s.	-7.175874
m_p	1.67252×10^{-24} gm	-23.776629
m_e	9.10908×10^{-28} gm	-27.040525
r_e	2.81777×10^{-13} cm	-12.550094
α	7.29720×10^{-3}	-2.136844

TABLE II

Mass	Radius	$\log_{10} \check{\tau}$	$\check{\tau}$ in seconds	Equivalent
m_p	a_o	3.8598206	7241.3	$2^h\ 0^m\ 41^s$
m_e	r_e	-0.918761	0.120570	
m_p	r_e	-2.550770	0.00281339	

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While these relatively weak gravitational forces play no primary role in determining microscopic structural patterns, they may in some sense afford a minute perturbation in these structures. For example, a dimensional argument states that two forces (dimensionality $[ML/T^2]$), operating on the same masses over the same linear distances, as for example on atomic or molecular masses over atomic spacings, would possess temporal effects inversely proportional to the square root of the ratio between the magnitude of the forces. In the case of Coulomb and gravitational forces, the ratio of temporal effects should then be $S^{-1/2}$; that is, characteristic times associated with gravitational forces should be $10^{19.678}$ times as great as those associated with Coulomb forces. A hypothetical pertubative effect due to the operation of gravitational force in the hydrogen atom would accordingly have a basic period of $10^{19.678} \times 10^{-15.818} = 10^{3.860}$ seconds. This is equal to 7244 seconds or $2^h\ 0^m\ 44^s$. This value is of the right order of magnitude for the period of a basic oscillator useful in providing time signals for various bio-rhythms. Furthermore, its near commensurability with $24^h\ 0^m\ 0^s$ suggests it may indeed play some role in the oscillator mechanism for an endogenous circadian clock.

Rough Draft
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8/12/68

THE GRAVITATIONAL CLOCKS OF CHEMICAL ELEMENTS

The combining question may be formulated as follows: If there exists a fundamental time period associated with every mass, then when elemental masses are combined in aggregates whose structure is determined by nuclear, Coulomb, or gravitational forces, how is the gravitational period of the aggregate mass related to the gravitational periods of the constituent particles.

Cosmic bodies are held together by combinations of electric and gravitational forces. Their masses and sizes appear in most cases to lie within limits imposed by two types of bound: a bound on density and a bound on potential. While the aggregate mass is always closely equal to the sum of the masses of the constituent particles, the size of an aggregate may depend on mass in many ways. In an aggregate of N particles that is density bounded, the aggregate radius is equal to $\sqrt[3]{N}$ times the elemental radius. This leads to the equality of the aggregate and elemental gravitational periods. An aggregate of N particles subject to a bounded potential, on the other hand, requires that the aggregate radius be N times the elemental radius. This leads to densities inversely proportional to N^2 and to aggregate periods equal to N times the elemental period. Solid cosmic bodies such as planets are examples of the first type of size-mass relation; clusters, galaxies, clusters of galaxies are examples of the second type. Stars occur at the intersection of the density and potential limits and are structured according to both types of bound.

For the purpose of deriving the gravitational periods of heavier atoms, which of the two limiting types of combining of heavy nuclei from nucleons, if either, is applicable? This is not known a priori, but if we assume that atoms belong to the species of bodies that follow a bounded potential form of compounding, we are led to gravitational periods that correspond to observed macrocosmic rhythms.

For the hydrogen atom the gravitational potential is given by

$$\frac{Gm_p}{c^2 a_o} = \alpha^2 S^{-1}. \qquad \alpha^2 S^{-1}$$

$$\frac{GA}{c^2 r_A} = \alpha^2 S^{-1} = \frac{Gm_p}{c^2 a_o}$$

Assuming this value of potential to hold for all atoms, we have

$r_A = a_o \frac{A}{m_p}$ where r_A is a "gravity radius" and A is the atomic weight of the atom; A and m_p being in the same units. The gravitational period for an atom of atomic weight A then becomes

$$\tau_A = \frac{2\pi r_A^{3/2}}{\sqrt{GA}} = \frac{2\pi a_o^{3/2}}{\sqrt{Gm_p}\, m_p} A = \tau_H \frac{A}{m_p} .$$

In the unified system of atomic weights, $^{12}C = 12$, the proton mass, $m_p = 1.00727663$. Hence,

$$(2) \quad \tau_A(\text{seconds}) = \frac{7241.3675}{1.00727663}(A) = 7189.0554\ (A).$$

For example, for carbon 12, by Eq. (2) the value of τ_A becomes $23^h\ 57^m\ 48^s.7$. The proximity of this atomic gravitational period with the earth's 24 hour period suggests that the carbon atom may ineeed be the zeitgeber for the circadian rhythms in most living organisms.

There are several uncertainties in the definitions of the various gravitational periods that lead to slightly different values. For example, the use of the mass of the hydrogen atom, m_H, instead of the proton mass, m_p, in Eq. (1), leads to approximately a two second difference in the basic period of the hydrogen atom, $2^h\ 0^m\ 39^s$ (m_H) as against $2^h\ 0^m\ 41^s$ (m_p). For the carbon 12 isotope, this difference becomes larger, $23^h\ 56^m\ 38^s.2$ (m_H) as against $23^h\ 57^m\ 48^s.7$ (m_p). The former value is quite close to the earth's rotation period of $23^h\ 56^m\ 4^s.099$. In addition to uncertainty regarding the correct choice of mass for the basic unit, it must be remembered that the choice of base for the scale of atomic weights is arbitrary. This also affects the values of the periods. For example, using the previously adopted <u>physical scale</u> of 0 = 16.0000, in which the mass of the proton is 1.007593 and the weight of carbon 12.011, the carbon period is $23^h\ 58^m\ 40^s.7$, (m_p) as against a period of $23^h\ 59^m\ 8^s.9$, (m_p) for carbon = 12.01115 on the unified scale.

At this stage the question of higher precision is premature. After all the term circadian means only "around one day" and adequately describes the precision of our present knowledge of bio-rhythms. Translated into longitude differences, the uncertainties in periods correspond to two or three miles at temperate latitudes. There have been no observed bio-clock responses to local east-west movements of organisms of this order. However, the relatively small differences introduced by the choice of (m_H) or (m_p) or of the base for the scale of atomic weights may later prove important in the identification of the correct resonances between chemical and environmental periods. It may be important, for example, to decide between a sidereal and a solar period resonance. It might even someday prove useful to have a scale of atomic weights, based on one of these 24 hour periods.

While carbon is the fundamental element in living matter and the carbon clock may be expected to be the most important, other elements also are omnipresent in life processes and their clocks may either directly or through resonance periods with the carbon clock provide time signals for other bio-rhythms.

Living matter is composed primarily of Carbon, Oxygen, Nitrogen, and Hydrogen. For example, in the human body about 96% of the mass is distributed among these four elements. In Table III are given the fundamental gravitational periods of these basic organic elements as derived from Eq. (2), based on

(m_p) and the unified scale.

In part A of Table III, the gravitational periods are derived for the most abundant isotopes: Carbon 12, 98.89%; Nitrogen 14, 99.63%; and Oxygen 16, 99.76%. In part B of the table, the atomic weights used are not of particular isotopes but of the naturally occurring abundancies of all stable isotopes. The periods of other chemical elements and isotopes may be derived in a similar manner from Eq. (2).

It cannot be determined at the present whether the zeitgeber is a single atom or is the combined effect of many atoms whose signals are in phase. Under the first assumption, the values in Table III-A would obtain;under the second assumption, the values in Table III-B would be the meaningful ones to adopt (subject, of course, to the choice of the scale of atomic weights and (m_p) or (m_H) as the correct mass). In first approximation we may round off the values to Carbon, 24 hours, Nitrogen 28 hours, and Oxygen 32 hours, the errors being but a minute or two.

TABLE III

Part A

Isotope	Atomic Wt. (Unif.Scale)	$\log_{10} \tau$ sec	τ sec	Equivalent
^{12}C	12.00000	4.935853	86268.66	$23^h57^m48^s.66$
^{14}N	14.00307	5.002895	100668.85	$27^h57^m48^s.85$
^{16}O	15.99491	5.060654	114988.29	$31^h56^m28^s$ 29

Part B

Element	Atomic Wt.	$\log_{10}\tau$ sec	τ sec	Equivalent
Carbon	12.01115	4.936256	86348.82	$23^h59^m8^s.82$
Nitrogen	14.0067	5.003008	100694.94	$27^h58^m14^s.94$
Oxygen	15.9994	5.060776	115020.57	$31^h57^m0^s.57$

RESONANT PERIODS

The hypothesis of elemental gravitational clocks structured under the condition that the gravitational potential remains constant, leads for all elements to the proportionality of the period and the atomic weight of the element. Explicitly, from Eq. (2)

$$\tau_A = \tau_H \, a/m_p.$$

If for a pair of periods τ_{A_1}, τ_{A_2}, associated with two different elements, we can expect that beat type phenomena usually associated with oscillations will be present, then the synodic or resonance period, τ, of two elements with atomic weights A_1, and A_2 will be

$$\frac{1}{\tau_R} = \frac{1}{\tau_{A_1}} - \frac{1}{\tau_{A_2}} = \frac{m_p}{\tau_H} \; \frac{1}{A_1} - \frac{1}{A_2}$$

For the elements in Table III-A, to errors of less than three parts in ten thousand, the atomic weight A may be replaced by the nearest integer [A]. Since τ_H/m_p very closely equals two hours, we may then write

$$(3) \quad \tau_R = \frac{[A_1]\,[A_2]}{[A_2]-[A_1]} \; .2^h$$

The resonant periods by pairs among the basic organic elements, C, H, O, N, derived from Eq. (3), are given in Table IV. The carbon-nitrogen resonance is exactly seven days, the carbon-oxygen is four days, and the nitrogen-oxygen is nine and one-third days. In addition, these elements have a triple resonance of exactly 28 days, long recognized as a very fundamental bio-period.

It is of extreme interest that the four elements composing over 95% of organic material have a gravitational resonance period equal to a period that has been observed to play so important a role in life processes, both plant and animal. But it is most remarkable that this period nearly coincides with the sidereal period of the moon of 27.322 days (synodical month, new moon to new moon = 29.531 days). The periodic similarity between many life processes and the phases of the moon is well established but it has always been troublesome that a causal linkage has not been discovered. We may now say that there exist no "astrological" linkages. There is nothing causal between the moon and the life rhythms, the illusory linkage results from the coincidence of the lunar period and the organic elements resonance period. The endogenous chemical clocks can account for the observed 28 day rhythms without invoking the moon, just as the endogenous carbon clock can account for circadian rhythms without invoking the sun.

There may well be environmental - chemical resonances and the relative role of environmental clocks to endogenous clocks must be explored. But we at least have been able to provide a mechanism satisfying those observations that demand an endogenous source of time signals corresponding to observed rhythms and capable of independence of environmental clocks.

The phenomena of the coincidences of the periods of the chemical clocks and environmental clocks must not be ascribed to chance. There are too many "coincidences" (more to be developed later). It is most logical to assume that the elemental gravitational chemical clocks provide not only signals for regulating the rhythms in bio-organisms but also play a role in the morphogenesis of cosmic bodies. The cosmic periods also derive from the elemental gravitational clocks. We thus have the elemental gravitational clocks as a "first cause." Both bio-clocks and cosmic clocks derive their characteristic periods from the basic clocks. The observed coincidences of periods led to the surmises of astrology, but the causal linkage is not between the heavenly bodies and the affairs of man, but both the motions of the heavenly bodies and the rhythms of life spring from the common cause of the elemental gravitational clock.

TABLE III

Element	Atomic Wt. (Unif.Scale)	$\log_{10} \tau$ sec	τ sec	Equivalent
Hydrogen	1.00727663	3.859821	7241.37	$2^h 0^m 41^s.37$
Carbon	12.01115	4.936256	86348.82	$23^h 59^m 8^s.82$
Oxygen	15.9994	5.060776	115020.57	$31^h 57^m 0^s.57$
Nitrogen	14.0067	5.003008	100694.94	$27^h 58^m 14^s.94$

TABLE IV

Resonant Periods of C, H, O, N

	Hydrogen	Carbon	Nitrogen	Oxygen
H	-	$2^h 10^m 54^s.54$	$2^h 9^m 13^s.85$	$2^h\ 8^m\ 0^s$
C		-	$168^h = 7^d$	$96^h = 4^d$
N			-	$224^h = 9\ 1/3^d$
O				-

However, the 24 hour clocks of astronauts and cosmonauts seem to operate effectively in earth satellite orbits. Since the response of the orbiting vehicle to all gravitational fields is such as to neutralize for the astronauts any residual external gravitational signals, it appears that the zeitgebers operate independently of all external influences.

GRAVITATIONAL

TIME

O

ROTGRAV.W52 DISK:TIME February 17, 1994

SYNCHRONIZATION OF THE EARTH'S ROTATIONAL AND GRAVITATIONAL PERIODS

cf. 1991 #88
1994 #7
#15
#54
1995 #54

Four basic periods are associated with the earth: The revolution period of one year, the lunation period of one month, the rotation period of one day, and the gravitational (or Schuster)period of 84 minutes (plus a few seconds). Since these various periods have no simple integral multiples, there is the problem of commensuration, or finding the simplest ratios of their values. For example, since ancient times solutions to the problem of when the full moon will occur on the same calendric date have been sought. One answer was the Metonic Cycle of 235 lunations = 19 years. (235 synodical months = 6939.6882 days, while 19 years = 6939.6018 days, the difference being 2h 4m 24s) In the western hemisphere, the Mayans found that 81 moons = 2392 days before the moon appeared in the sky at the same phase at the same time.

The same problem arises in determining the synchronization of the mean solar day with the earth's G-period. To a first approximation the G-period of the earth is 84 minutes. This value synchronizes exactly with the 24 hour rotation period of the earth every seven days. That is 120 x 84 minutes = 7 x 24 x 60 minutes = 10080 minutes. Is it possible that this first approximation to G-period solar day synchronization could be the basis of the week? The question arising here is in what manner did ancient humans sense the G-period.

But the value of the G-period is not exactly 84 minutes. Using the present most probable value for the earth's density of 5.517 ± 0.004 gm/cm^3, the G-period is about 84 minutes and 19.61 ± 1.83 seconds. This means that there is not precise synchronization every seven days, but there is an error of approximately 120 x 20 = 2400 seconds (40 minutes)each week. This value is approximately half a G-period, so we would expect a better approximation to be a fortnight. Actually a minimum synchronization error of 33.4 seconds occurs in 13 days. But this error is accumulative so an exact synchronization, if any, will occur only at some much longer period.

The Mayans used a week of 13 days

To find synchronization periods it is necessary to solve the Diophantine equation

$$N_1 \times CYCLE_1 = N_2 \times CYCLE_2$$

where N_1 and N_2 are integers. For the choice of cycles, G-period and day, we get the following table:

III, GRAVITATIONAL CLOCKS

A. G. WILSON 06/11/68

The Schwarzschild solution to the field equations of general relativity establishes for all physical bodies the relation

$$R_s \, R_c^2/R^3 = \text{constant} \tag{1}$$

between R_s, the Schwarzschild or gravitational radius of the body, R_c, the local radius of curvature of space, and R the physical or metric radius (Ref. 1).

This expression implies the existence of a fundamental time period associated with every physical body. Substituting $2GM/c^2$ for R_s gives,

$$R_c^2/c^2 = kR^3/2GM = T^2$$

This local basic time period, T, is seen to be proportional to the ratio of the local radius of curvature of space to the velocity of light. The universal validity of Equation (1) infers the existence of a local characteristic time period associated with the local curvature of space. This provides a "gravitational clock" which governs the dynamical motions of all cosmic bodies.

If the constant k is taken to be $8\pi^2$, the basic period T becomes equal to the minimum gravitational period, τ, associated with gravitating bodies. This period,

$$\tau^2 = 4\pi^2 \, R^3/GM, \tag{2}$$

sometimes called the "Schuster Period", is the well known limiting minimum period for bodies orbiting about a spherical mass M of radius R. Equation (1) also is the limiting rotation period for a gravitating body with dynamic stability.

Although for small distances the effects of gravitational forces are negligible with respect to other forces (Coulomb forces, for example, are 10^{40} times greater than gravitational forces), Is it possible to detect the presence of the gravitational clock of small fundamental masses such as atoms and elementary particles? Certainly it is not possible to detect the gravitational force effects associated with these entities whose structure is overwhelmingly determined by coulomb, strong and weak forces, but it still may be possible to detect the <u>temporal</u> effects of the gravitational clock especially if the basic gravitation periods are markedly different from the coulomb periods associated with the atom.

NEWCHON1.WP6 October 7, 1995

ON CHON

See also 1993 #38

AND THE BOUNDARIES OF TIME

Aristotle held that time was an inference of **motion.** But there appears to be a species of time that is not derived from motion. This time is associated with **density** and manifests itself as a bound to allowable periods and frequencies. A familiar example is the Schuster Period, a bound on the period of an earth orbiting satellite when only gravitational and inertial forces are acting. This period of approximately 84 minutes is numerically related to the mean density of the earth and to the universal gravitational constant,G. In general the lower limit to orbiting periods is given by,

(1)

$$\tau = 2\pi\sqrt{\frac{R^3}{GM}}$$

Where R is a size parameter (radius) and M is a mass parameter. For a spherical body, this boundary time, τ, in terms of the mean density ρ, is given by,

(2)

$$\tau = \sqrt{\frac{3\pi}{G\rho}}$$

These equations govern gravitationally based temporal boundaries and are usually applied to astronomical bodies. Since gravity is a force weaker than the other forces by some 40 orders of magnitude, it seems quite inappropriate that these boundaries have any meaning for bodies where gravity plays an insignificant role, in particular on meso and micro levels. However, there is nothing known that precludes their universal applicability. We therefore make the assumption:

Assumption 1] Equations 1) and 2) may be applied to any entity occupying space and possessing a definite mass.

When applied to objects on the atomic level at first thought it would seem the results would be insignificant, but we are dealing with time, not force, and some surprising values emerge.

Taking for size the Bohr radius, a_o, and for mass, m_p, the mass of a proton, the time τ_H, turns out to be almost exactly 2 hours!

(3)

$$\tau_H = 2\pi\sqrt{\frac{a_o^{\,3}}{Gm_p}} = 7239.94\text{sec}$$

use m_H not m_p → 7237.97

c. 2 sec less

54b

O

The general theory of relativity predicts that the rate at which a clock runs varies as the strength of the gravitational field at the location of the clock. The stronger the field, the slower the clock rate. An atom in a strong gravitational field, for example, will radiate at a lower frequency than the same atom in a weak field. This is manifested as the gravitational red shift. If we designate the period of time that increases with gravitational field strength by T, and the field M/R by Φ, then $T = T(\Phi)$ such that if Φ increases T will increase.

On the other hand the time that we designate by τ which is proportional to $\rho^{-1/2}$, varies as $R/\sqrt{\Phi}$, decreasing as Φ increases. If T is the basic period operating in a gravitational field of strength Φ, how is τ to be interpreted? What sort of time does τ measure? If atoms march to T, what marches to τ? T may be a "bridge time" between photons and hadrons, while τ governs the time table for larger material bodies. *

The properties of both T and τ have been observationally confirmed. T through comparisons of clock rates at different terrestrial field strengths and τ through planetary and binary star motions. And from the above with one time increasing with field strength and the other decreasing, we must conclude that there are at least two independent kinds of time. ?

Recent observational determinations of Hubble's parameter have led to an age of the universe that is less than the age of oldest stars. This paradox possibly has its resolution in the existence of different times. In the region of star formation the density is large and therefore τ is small. If star formation marches to a local τ rather than to a global T, then as viewed locally, there would be ample time for the evolution of the stars, even though the observer's clock suggests a paradox. The entire matter hinges on the proper interpretation of the time τ.

$\Phi = \frac{M}{R}$ as $\Phi \uparrow$ T dialates

$\rho = \frac{M}{R^3}$ as $\rho \uparrow$ τ shortens

In absolute units

$\tau \equiv T_P$!

Times converge at P

diverge from P

$T =$

Resonance ?

is the decrease of the Kepler (Schuster, Density) time τ solely attributable to the dialation of the unit of time, T as $\Phi \uparrow$ & $\rho \uparrow$? Or are both effects independent ? Or what is their functional relation?

* How is the transition from quantum ontology to meso ontology involved?

III, GRAVITATIONAL CLOCKS

A. G. WILSON 06/11/68

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Although for small distances the effects of gravitational forces are negligible with respect to other forces (Coulomb forces, for example, are 10^{40} times greater than gravitational forces), Is it possible to detect the presence of the gravitational clock of small fundamental masses such as atoms and elementary particles? Certainly it is not possible to detect the gravitational force effects associated with these entities whose structure is overwhelmingly determined by coulomb, strong and weak forces, but it still may be possible to detect the <u>temporal</u> effects of the gravitational clock especially if the basic gravitation periods are markedly different from the coulomb periods associated with the atom.

TIMEGRAV.WP6 October 6, 1994

MORE ON GRAVITATIONAL TIME

also 1995 #54

Since Aristotle our physical notions of time have been derived primarily from motion. This is true of Newton's contributions to the subject and also of Einstein's (up through special relativity). However, Newton's modification of Kepler's Third Law including the role of mass, introduced a notion of time based on the density of matter rather than derived from motion. Specifically,

$$\tau = \frac{2\pi R^{3/2}}{\sqrt{GM}} \quad or \quad \tau = \sqrt{\frac{3\pi}{G\rho}}$$

where τ is the time period associated with a domain of radius R and of mass M, (here assumed to be spherical), and ρ is the mean density within the domain, G being the gravitational constant. In these two equations motion is not explicitly present. The period of the "beat of the clock" is determined by the density of the system. This is a gravitational clock, time being manifested as a result of the presence (density) of matter rather than the motion of matter.

The current Big Bang Theory of the origin of the universe, tells us that the universe came into being with a high density concentration of energy which immediately began to expand. Very quickly, through the appearance of particles, the universe acquired mass. While the size of the universe continues to increase, whether mass is bounded or still increasing is uncertain. In either event, the mean density seems to be decreasing. But before we can effectively discuss changes in size, mass, density, clock rate, etc. we have to be clear on the meaning of our units. The problem is like the problem of comparing purchasing power over the years in inflationary economics. One has to convert earlier dollars to today's dollars, today's wages, etc. in order to obtain meaningful comparisons.

If we assume that the fundamental physical constants, G, c, and h, are really constant, (G=Newton's gravitational constant, c=the velocity of light, h=Planck's constant), then we are provided with "absolute" units of extension, mass, and duration. Explicitly,

$$R_P = \sqrt{\frac{Gh}{c^3}}, \qquad M_P = \sqrt{\frac{hc}{G}}, \qquad T_P = \sqrt{\frac{Gh}{c^5}}$$

R_P, the unit of length has a cgs value of 4.051×10^{-33} cm
M_P, the unit of mass has a cgs value of 5.456×10^{-5} g
T_P, the unit of time has a cgs value of 1.351×10^{-43} sec

From these we can derive a unit of density, $\rho_P = \dfrac{c^5}{G^2 h}$ with a cgs value of 5.157×10^{93} g/cm^3.

MUSPHERS.WPD
~~UNIVWAVL.WPD~~ O January 2, 2000

MUSIC OF THE SPHERES PART I

It has been shown that the basic frequency associated with the Hubble universe is given by,

$$\nu_U = (\alpha\mu S)^{-3/2} / t_o$$

where t_o is the Planck time, α is the fine structure constant, μ is the proton/electron mass ratio, and S is the coulomb/gravity force ratio. The wavelength associated with this frequency is

$$\lambda_U = c / \nu_U = (\alpha\mu S)^{3/2} l_o = 10^{27.932889}\ \mathrm{cm}$$

where l_o is the Planck length = $10^{-32.791545}$ cm. The sizes and masses of various objects, from sub-atomic particles to clusters of galaxies, are given as sub-harmonics in the following table. (Values are $\log_{10}$) ; (3m = 2n) cf. Pythagoras $\left(\frac{3}{2}\right)^n$

	#	n	$(\alpha\mu S)^n$	m	$\lambda^m = (\alpha\mu S)^n l_o$ cm	$M = c^2/G\ \lambda^m$ gm	
	1	3/2	60.724434	1	27.932889	56.062236	Fifth
7/6	2	5/4	50.603694	5/6	17.812149	45.941496	Cl Gal
	3	6/5	48.579547	4/5	15.788002	43.917349	Gal
	4	9/8	45.543324	3/4	12.751779	40.881126	whole tone G Cl
	5	1	40.482955	2/3	7.691410	35.820757	Tone ☆
	6	9/10	36.434660	3/5	3.643115	31.772456	
Third 4/5	7	3/4	30.362217	1/2	-2.429328	25.700019	fourth
	8	3/5	24.289773	2/5	-8.501772	19.627575	
2/5	9	1/2	20.241477	1/3	-12.550068	15.579261	= p
1/6	10	0	0	0	-32.791545	-4.662198	= e

-23

Notes:

- The values in the mass column are given by two equations,
  $\lambda^m c^2/G$ or $(\alpha\mu S)^n m_o \Rightarrow Gm_o/\lambda^m c^2 = (\alpha\mu S)^{-n}$

- As in music, the even harmonics are repetitive while the odd harmonics represent innovations. Thus "octave" frequencies are not likely to manifest, only odd harmonics may support existence.

- Row 1. The values in this row are those of the Hubble universe. The fundamental wave length of 27.932889 cm is based on the characteristic time 17.456057 sec which is corresponds to a value of the Hubble parameter of 71.977 km/sec/mpc.

- Row 2. One light year = 17.975932 cm. This object is close to 1 l.y. in size (all sizes are those of Schwarzschild radii) and has a mass of 12.642 solar masses. (One solar mass = 33.299 gm) This mass suggests a galaxy.

- Row 3. Size is of the order of 100 astronomical units (1 A.U. = 13.174927 cm) Mass is of the order of 10^{10} solar masses. Globular cluster?

- Row 4. This value of λ is close to the minor axis of the orbit of Mercury, which is equal to 12.753373. Apophasis involved here?

- Row 5. The value of λ in this row is of the order of the size of a neutron star. Mass is of the order of 100 solar masses.
  M= 35.820757, 120× $\odot_m$ = 35.378 δ = 0.443

- Row 6. Size < a kilometer, mass ~ earth like. Dark matter candidate?

- Row 7. An "octave"; probably non existant.

- Row 8. This value of λ approximates that of the Bohr radius, a_o=-8.276399

- Row 9. This value of λ is precisely equal to that of the electron radius, r_e. The value of the mass is anomalistic.

- Row 10. This is the Planck particle with $m_o\lambda = \hbar/c$ and $m_o/\lambda = c^2/G$.

A PYTHAGOREAN KOAN

In Zen monasteries chelas are given koans such as "What is the sound of one hand clapping". These are exercises in how to escape conventional and traditional patterns of thinking, usually by positing absurdities or impossibilities. We can imagine that in the Pythagorean Academy about 500 B.C.E. something similar was done to enable the apprentices to attain greater freedom of thought. But more likely a Pythagorean koan, rather than being a logical absurdity or impossibility, had to do with a geometrical visualization, for example:

Visualize a prolate spheroid. Allow this spheroid to spin rapidly about one of its minor axes. What will be the resulting apparent "outer" figure? After reflecting the apprentice comes up with: The outer figure would be an oblate spheroid having the diameter of the prolate spheroid's major axis. Very good. Now visualize an oblate spheroid and allow it to spin rapidly about one of its major axes. What will be the apparent outer figure? The apprentice answers more quickly: The result would be a sphere with its diameter equal to the oblate spheroid's major axis. Good again.
Now tell me what would be the apparent "inner" figure in each case?

Here the apprentice hesitates. What is the difference between outer and inner? Hmmm. The outer represents the portion of space occupied by the spheroid <u>part</u> of the time. It flickers giving a ghostlike semi-transparent image, like the spherical image in the spinning oblate spheroid case. Now what is the inner? The inner is the portion of space occupied by the spheroid <u>all</u> of the time. Its image appears to be solid and constant, not flickering like the outer image. OK, so what is the inner image of the spinning prolate spheroid? It is a sphere having a diameter equal to the minor or spin axis of the prolate spheroid. And what is the inner image of the spinning oblate spheroid? It would have to be a prolate spheroid with major axis equal to the major or spin axis of the oblate spheroid and with minor axis equal to the minor axis of the oblate spheroid.

Now, what can you say about the apparent images as related to the rates of spin? Well, off hand I would say that the faster the spin rate the less flicker and the more solid the outer image would appear. At some high rate of spin the inner image might even be obliterated. But it is hard to say at what rate of spin the inner image would be most enhanced. Most likely at a much slower rate than the optimum for the outer image.

You are leaving out an important factor in all of these perceptions. What are you ignoring? The apprentice is perplexed, reviews the visualizations, then hits on: How about the existence of some basic subjective frequency internal to the observer that leads to what is considered to be a fast or slow spin rate?

Very good! Now explain the relation between perception and reality.

EARTHCYC.WPD November 28, 2010

EARTH CYCLES

I. CYCLES > 1 YEAR

ORBITAL ECCENTRICITY CYCLE	93,408 ANOMOLYSTIC YEARS
OBLIQUITY OF THE ECLIPTIC 23° 27' 8.26"	40,032 YEAR INCLINATION CYCLE
PRECESSION OF EQUINOXES	25,725 YEAR CYCLE
ZERO CHECK CYCLE	4,668 YEARS (LAST LINE UP 1437)
4 PULSE	556 YEARS (LAST 1996)
SOTHIC CYCLE	1,461 YEARS
DIONYSIAN CYCLE	532 YEARS
METONIC CYCLE	235 LUNATIONS = 19 YEARS
SAROS	223 LUNATIONS = 18.03 YEARS = 6585.33 DAYS

2times4.w52 disk:TIME February 15, 1994

Motion Time and Density Time

Given a velocity and a distance, a travel time is derived by

travel time = distance/velocity

If a universal rate is postulated, such as the velocity of light, c, then a general concept of time is derived as

light time = distance/c

These travel or motion times support a "linear" concept of time. [Some motion times: light travel from sun = 499.012 seconds; light travel time of the earth's orbit = 3135.383sec = 52 minutes]

check: [illegible] = 2π

A second concept of time derives from the dimensional analysis of a function of density

time = k/ √density

This kind of time supports a "cyclical" concept of time. For the earth, for example, density time is approximately 84 minutes, while motion time, 2πR/c is 0.137 seconds (~ frequency of 7.3 hertz).

These two times become numerically equal for bodies on the Schwarzschild Limit.

$$GM/c^2R = 1$$

For bodies with $GM/c^2R < 1$, which includes everything but black holes, density time exceeds motion time.

The formulae relating motion and density time derived from physical theory are as follows:
From the definition of density time

(1)
$$\tau = \sqrt{\frac{4\pi^2 R^3}{GM}}$$

And the definition of motion time

(2)
$$t = \frac{2\pi R}{c}$$

We derive

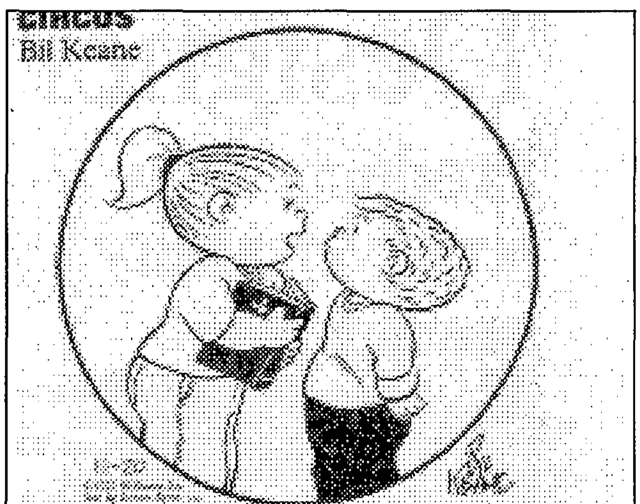
(3)
$$\tau = \sqrt{\frac{c^2 R}{GM}}\, t \quad ; \quad \tau = \frac{c}{R}\sqrt{\frac{3}{4\pi G\rho}}\, t$$

As stated above, when $GM = c^2R$, the body is on the Schwarzschild Limit and $\tau = t$. Or possibly the Schwarzschild Limit is the result of a resonance condition resulting from $\tau = t$. If the Schwarzschild Limit is the fundamental, we question how or whether higher harmonics are manifested.

DENSITY	PERIOD	No. G-PERIOD	DAYS	ERROR
5.517	84m+19.609s	222	13	+33.3s
5.513	84m+21.445s	973	57	-14.3s
5.521	84m+17.776s	205	12	+44.1s
5.51733	84m+19.3495	222	13	+0.009s

5,5148

The density value of 5.51733, differing very slightly from the most probable value, gives an almost exact synchronization of the day and G-period every 13 days. With this value the maximum error in the 13 day cycle occurs on the seventh day. So, the new twist would be that synchronization does not occur on the seventh day as it would if the G-period were exactly 84 minutes, but that the times get most out of synch on the seventh day. God in creating the world realized that the synch error was increasing every day, and at the end of the sixth day He felt things were getting out of hand, so decided to take the next day off. Things began to improve on the eighth day, but we aren't sure what God did in the second week.



"God created the world in 6 days and on the 7th day he was arrested."

Another basic question is, how is density time properly interpreted? It is not age, it is not related to motion or travel time. It is cyclical, it manifests itself physically in satellite orbital times and dynamical rotational limits. Is it a synchronization signal? A temporal pulse that preserves coherence of the body or system? Is it possibly a universal zeitgeber?

Is it the minimum time for global "synchronization"?

MAYAN.WPD JULY 29, 2000

STILL EVEN MORE ABOUT THE WEEK

see also 1991 #88; 1994 #7, #13, #15; 2000 #22

It was shown in Scrap 2000 #22 that the relation between the earth's rotation period (the 24 hour solar day) and the earth's Schuster period, $T=2\pi\sqrt{(R^3/GM)}$, could be taken as the basis for the seven day week.[1]

		Value in seconds[2]	$\log_{10}$ value in seconds
T	The earth's Schuster Period	5060.24	3.704171
D	The mean solar day	86400.00	4.936514
H	The Hydrogen Period	7239.07	3.859683

First note the ratio:

$$\frac{\log T}{\log D} = 0.750361 \cong 3/4$$

Indicating that to within about 4 parts in 10^4 the ratio of the logarithms of the Schuster period to the day is 3 to 4. In other words, $(5060.24)^{1/3} = 17.168$ and $(86400)^{1/4} = 17.145$, $\Delta = 0.023$ or $(5060.24)^4 = 655{,}668{,}714 \times 10^6$ and $(86400)^3 = 644{,}972{,}544 \times 10^6$; whose ratio is 1.0166 or $(5060{,}24)^{4/3} = 86875$ and $(86400)^{3/4} = 5039.48$; Hence $T^4 \cong D^3$.

For seven days, assuming 120 Schuster periods, 7 x 86400 = 604800 seconds and 120 x 5060.24 = 607229 seconds, an error, $\Delta = 2429$ seconds (48 m 40s) in seven days. Possibly a basis for a seven day week.
However,
For thirteen days, assuming 222 Schuster periods, 13 x 86400 = 1123200 seconds and 222 x 5060.24 = 1123373.28 seconds, an error, $\Delta = 173$ seconds (2 m 53s) in 13 days. A very good case for a thirteen day week.

And where has there been a thirteen day week? The ancient Maya used a basic thirteen day period and from their vigesimal number system of base 20 derived a sacred "year" of 260 days. [TZOLKIN] We know that the Maya were good astronomers deriving a calendric year more accurate than our present Gregorian year. So maybe they were also good geophysicists recognizing the relation between the earth's Schuster period and the earth's solar rotation period.

360 Day = TUN
365 day = haab

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[1]The Schuster period is determined by the mass M and radius R of the earth and is the time period in which a satellite would circle a spherical earth at its surface were there no atmosphere or other obstructions.

[2]These values are derived from a mean earth radius 6.371000×10^8 cm and Earth mass of 5.9737×10^{27} g [Cox, Astrophysical Quantities 1999] ; and $G = 6.674215 \times 10^{-8}$ cm^3/g s^2 [Physics Today July 2000 p 21]

EVEN MORE ON THE ORIGIN OF THE WEEK

Nine hundred million [9×10^8] years ago the length of the day was 18 hours. In subsequent time the tides, largely lunar, have gradually slowed the turning rate of the earth increasing the length of the day to the present 24 hours. To balance the resulting decrease in the earth's angular momentum, the angular momentum $\{MR^2/T\}$ of the earth-moon system has changed. This has resulted in the moon moving further away from the earth at a rate of about 3.82 ± 0.07 cm/year.[1] Observations [eg radar ranging of the lunar distance] and calculations [eg records of times and places of ancient eclipses] indicate that the rate of increase in the length of the day has been:

2.43 ± 0.07 milliseconds per century from 390 BCE to 948 AD. and
1.40 ± 0.04 milliseconds per century from 948 AD to 1800 AD [2]

In addition to the rotation period, [length of day], a second important period associated with the earth is the so called "Schuster Period", the time it would take for an artificial satellite to orbit the earth at its surface if the earth were an airless smooth sphere. This period, τ, is a function of the mean density of the earth, ρ, and is given by, $\tau = (G\,\rho)^{-1/2}$, where G is Newton's gravitational constant

Table I gives the values of the Schuster period in seconds corresponding to the best estimates of the earth's mean density in gm/cm^3.

TABLE I

DENSITY	5.513	5.517 ± 0.004	5.521
PERIOD 84m +	21.439 s	19.609 ± 1.83 s	17.779 s

Using the present most probable value for the earth's density of 5.517 gm/cm^3, the Schuster period is close to 84 minutes and 19.61 seconds. If we take this value as being constant over millions of years, we ask at what dates in the past or in the future will the ratio of the rotation period to the Schuster period have small rational values. That is, what are the smallest integers N_D and N_S that are solutions of the Diophantine equation,

$$N_D \times (\text{Length of Day}) = N_S \times (\text{Schuster Period})$$

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[1] K. R. Lang, ASTROPHYSICAL FORMULAE Vol II p. 80

[2] Ibid p. 80

DAYS OF THE WEEK

ENGLISH	SAXON	GERMAN	LATIN	FRENCH	SPANISH
SUNDAY	SUN'S DAY	SONNTAG	DIES SOLIS	DIMANCHE	DOMINGO
MONDAY	MOON'S DAY	MONTAG	DIES LUNAE	LUNDI	LUNES
TUESDAY	TIW'S DAY	DIENSTAG	DIES MARTIS	MARDI	MARTES
WEDNESDAY	WODEN'S DAY	MITWOCH	DIES MERCURII	MERCREDI	MIERCOLES
THURSDAY	THOR'S DAY	DONNERSTAG	DIES JOVIS	JEUDI	JUEVES
FRIDAY	FRIGG'S DAY	FREITAG	DIES VENERIS	VENDREDI	VIERNES
SATURDAY	SETERNE'S DAY	SAMSTAG	DIES SATURNI	SAMEDI	SABADO

RUSSIAN	JAPANESE	ITALIAN	GREEK
ВОСКРЕСЕНЬЕ	日		
ПОНЕДЕЛЬНИК	月		
ВТОРНИК	火		
СРЕДА	水		
ЧЕТВЕРГ	木		
ПЯТНИЦА	金		
СУББОТА	土		

O

TIMWEEK2.W52 DISK:TIME January 31, 1994

MORE ABOUT THE WEEK

In TIMWEEK1.P51, (1991-#88), several properties of the Schuster period were mentioned. To those reported there should be added the very important property of equatorial fragmentation. The Schuster period is the limiting rotational period for a rotating earth not to disintegrate. For the earth to rotate with a period shorter than 84 minutes, centrifugal force at the equator would exceed ~~the~~ gravitational pull, and the planet would become unstable with mountains flying off into space. But the good news is that we have a considerable "spin safety factor" against that occurring. One rotation period is 1440 minutes, the Schuster period is 84 minutes, giving a safety factor of

$$\frac{1440}{84} = \frac{120}{7} = 17\,1/7$$

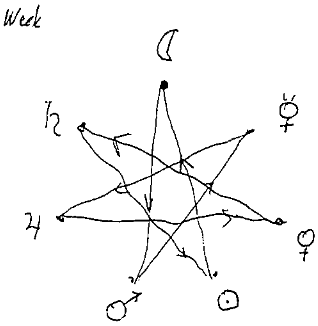
This ratio of 120/7 is also the ratio of Schuster periods to days in a week. Hence the earth's spin safety factor is implicit in the seven day week.

We have seen that the week is the smallest number of earth rotation periods with an integral number of Schuster periods. But also of interest are the "beat periods" between the Schuster cycle and the rotation cycle. Beat frequencies, f_b, are given by

$$f_s \pm f_r = f_b$$

where f_s and f_r are the Schuster and rotational frequencies respectively. Substituting 5/7 hours and 1/24 hours, we get beat periods of $1^h\ 29^m\ 12^s$ and $1^h\ 19^m\ 22^s$. These values are very close to 3/2 hour and 4/3 hour, which divide the 24 hour day into 16 and 18 intervals respectively. It seems that again the ancients were in touch with something we have lost. The division of daylight time into 9 "hours" was an ancient practice. (Still reflected in the Prime, Terce, Sext, None of the monastic day) Did this division of time into nine instead of twelve periods come from subtle or overt experience of ~~the~~ Schuster beat periods?

LATIN	DIA = Order in the Week
Solis	Sunday
Lunae	Monday
Martis	Mardi
Mercurii	Mercredi
Jovis	Jeudi
Veneris	Vendredi
Saturni	Saturni



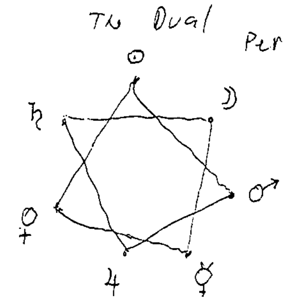
THE WEEK AS CELEBRATION OF THE 7 PLANETS

Peri = Order in Sky (sidereal Period)
☽ = 30d
☿ = 88d
♀ = 225
☉ = 365 (☉ ⟷ ⊕)
♂ = 687
♃ 4333
♄ 10759

DIA SKY ORDER

The Dual

Peri: Week Order



CYCLES – WIDTHS OF NOW

4times1.W52 DISK:TIME February 16, 1994

DIMENSIONAL TIMES

On the basis of dimensional considerations there are four species of time: Motion + Gravitational

t Motion or Radar time

$$t = 2\pi\frac{R}{c} \qquad t = f(R) \qquad t = \frac{h}{E}$$

τ Density or Kepler time

$$\tau = \frac{2\pi R^{\frac{3}{2}}}{\sqrt{GM}} = \sqrt{\frac{3\pi}{G\rho}} \qquad \tau = f(\rho)$$

Time and Energy are complementary ? ∃ {his}?

T Energy time

$$T = \frac{h}{Mc^2} \qquad T = f(M)$$

calculate each for e

$\mathcal{T}$ ~~**K**~~ **Gravitational time**

also $\frac{GM}{c^3} = \mathcal{T}$

$$\mathcal{T} \; \cancel{K} = \frac{hR}{GM^2} \qquad \mathcal{T} = f\left(\frac{R}{M^2}\right) = f(R, M)$$

Complementary to each of these four times are four energies given by (action/time) in each case. (h has the dimensions $[ML^2/T]$ of action)

Motion energy

$$E_m = \frac{hc}{2\pi R} \sim \hbar\nu$$

Is there an RM time?

Density energy

$$E_\rho = \frac{h\sqrt{GM}}{2\pi R^{\frac{3}{2}}} = \sqrt{\frac{h^2 G\rho}{3\pi}}$$

Normalize with e energy

Total energy

$$E_t = Mc^2$$

Gravitational energy

$$E_g = \frac{GM^2}{R}$$

Additional times $\mathcal{T}_e = \frac{\hbar^3}{m_e e^4} = [T]$

In electric time

Electrical times?

$$\Upsilon = \sqrt{\frac{MR^3}{e^2}}$$

$$\Upsilon = \sqrt{\frac{hc}{e^2}}\, T = \frac{T}{\sqrt{\alpha}} \; ; \qquad \Upsilon = \sqrt{\frac{M^2 G \tau^2}{e^2}} = \frac{M\sqrt{G}}{e}\tau$$

$\times 4\pi^2$?

$$\Upsilon = \frac{M}{\sqrt{\rho}}\, e$$

TEMPDYAD.W52 DISK:TIME February 17, 1994

TEMPORAL DICHOTOMIES

PHYSICAL TIMES

MOTION	DENSITY
ARISTOTELEAN	KEPLERIAN
	2nd $T \propto R^2$
	3rd $T^2 \propto R^3$
LIGHT TIME	GRAVITATIONAL TIME
FAST	SLOW
INFORMATION	MATTER/ENERGY
COMMUNICATION	TRANSPORTATION
SPECTRAL LINES	G-ATOMIC
LEPTON TIME	BARYON TIME

BIOLOGICAL TIMES

NEURON TIMES	MUSCULAR TIMES
CIRCADIAN RHYTHMS	MONTHLY RHYTHMS
SUBJECTIVE TIME	OBJECTIVE TIME

CULTURAL TIMES

CHRONOS	KAIROS
SECULAR	LITURGICAL
SOLAR	LUNAR
IMPERFECTIVE	PERFECTIVE

CONCEPTUAL TIMES

LINEAR	CYCLICAL	
EVOLUTIONARY	REPETITIVE	
INOVATIVE Sp?	ITERATIVE	
HISTORICAL	ARCHETYPAL	
TEMPORAL	PRIMORDEAL	
FREQUENCY	PERIOD	
CONTINUOUS	DISCRETE	
OPEN	CLOSED	
SEQUENTIAL		ETERNITY
PITCH	METER	

Creativity must have two frames of reference.--Craik

Information must have a faster rate than matter.

Is Kairos associated with density time? Both are cyclical.
Is Chronos associated with motion time? Both are linear.

BASIC TIMES AND FREQUENCIES

ITEM	FORMULA	LOG_{10} VALUE	SECONDS	HERTZ
electron	$2\pi\sqrt{(r_e^3/Gm_e)}$	-0.918814	0.120555	8.294954
baryon	$2\pi\sqrt{(r_e^3/Gm_p)}$	-2.550769	0.002813	355.442210
hydrogen	$2\pi\sqrt{(a_o^3/Gm_p)}$	+3.859735	7239.9405	0.0001381
earth Schuster	$2\pi\sqrt{(R_e^3/GM_e)}$	+3.704223	5060.8446	0.0001976
earth Schumann	$2\pi R_e/c$	-0.874433	0.133526	7.489158
earth Schwarz..	GM_e/c^3	-10.829925	1.479364×10^{-11}	6.759662×10^{10}
orbit Schumann	$2\pi(A.U.)/c$	+3.496286	3135.3498	0.0003189
earth rotation ⊙		+4.9365137	86400	1.157407×10^{-5}
earth rotation ☆		+4.9353263	86164.09054	1.160576×10^{-5}
earth geosync*	$2\pi\ R_g/c$	-0.052906	0.885307	1.12955
neutron star	$\alpha\mu S\ t_p$	-2.785412	0.001639	610.1154
sun Schuster	$2\pi\sqrt{(R_s^3/GM_s)}$	+4.000163	10003.7539	0.00009996
sun Schumann	$2\pi R_s/c$	+1.163661	14.576760	0.068602
Sun Schwarz..	GM_s/c^3	-5.307523	0.000004926	203012.6031
Univ Schuster	$\sqrt{(R_u^3/GM_u)}$	+17.456065	9.056 gyr *	
Univ Schumann	R_u/c	+17.456065	"	
Univ Schwarz...	GM_u/c^3	+17.456065	"	

* This is the Schumann period at the distance R_g, = 42241 km (26,247 miles) for synchronous satellites in equatorial orbits.

Notes:
(earth Schuster)^4 = (earth rotation ⊙)^3 , 14.817 = 14.810 $\Delta = 0.007$
(earth Schuster)/(hydrogen) = 0.699017 or 7/10 $\Delta = 0.001$
(log day) = (log hydrogen) x (log 19) 4.9365 = 4.9357 $\Delta = 0.0008$
(log hydrogen) = (log earth Schuster) x (log 11) 3.860 = 3.858 $\Delta = 0.002$

⇒ (log day) = (log earth Schuster) x 1.3368 or $\frac{4}{3}$

Middle C 520 hz

* including 2π gives

~~geo x electron = 9.57~~

$\log_{10}$ 18.254245 sec

log 10.755133 year

log 1.755133 Byr

56.902 Byr