Diurnal

Researched and Composed by Adam “Old School” Knowlden

Abstract

As is the case with numerous additional progressive fields of scientific inquiry, the examination of biological rhythms has begun to experience substantial growth.

Commencing in all forms of life, from fungi and plants, to birds and mammals, to molecules and cells, to organisms and populations, diurnal patternizations dictate the intricate cycles of life on earth. Per se, research based on circadian regularities has begun to advance at full velocity. The sport of hypertrophic expansion in relation to this field is no exception.

Diurnal relates to a task that occurs in a 24-hour, or daily, period. Such is the case with the all-encompassing circadian rhythm. Manipulating body temperature and metabolism, blood pressure and eating configurations, this universal, chronobiological timepiece controls all rhythmic functions. In nature the endocrinal clock provides a calendar controlling such aspects as migration, hibernation, fattening, and fur growth, which are all adaptations to winter; while the annual rut of large animals and the summer population explosion of smaller ones are all cued, months in advance, by the change in day length. Indeed, the design of the circadian rhythm’s role in the environment and ecosystem is truly awe- inspiring.

This journal entry will endeavor to compile the latest theoretical insights into this topic and correlate those findings for association to anaerobic training, and more directly into training for optimal time under tensions and other such protocols as they relate to the sport of bodybuilding. This discipline of science is still in its earliest stages of comprehension, and is subject to change as newer findings present themselves. As such, The Journal of Hyperplasia Research will stay on the brink of this novel research with all intents and purposes of providing the subscribing athlete with every available weapon for attaining a more ideal physique.

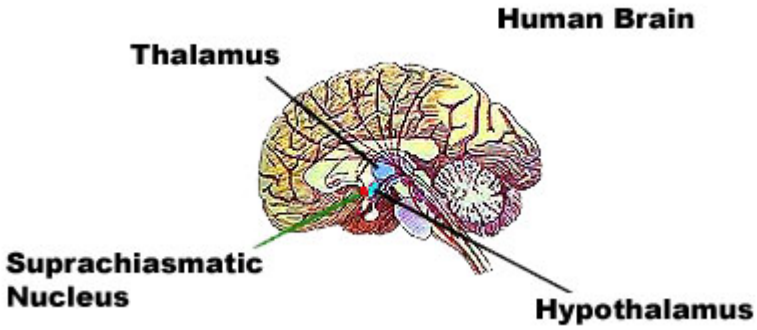
Chronobiology

Every day each of us encounters resolute alterations in our mental and physical state; both body and brain oscillate amidst conditions of intermittent cycling patterns.

These fluctuations encompass phases of activity of various intensities throughout the day, followed by subsequent rest, recovery, and renovating during nightly slumber.

Life sequences are not an inert reaction to the world around us; they are biological, driven by an organic chronometer.

The principal essence of the clock is found in the suprachiasmatic nuclei (SCN), a cluster of about 10,000 neurons positioned on either side of the midline above the optic chiasma, approximately 3 cm behind the eyes.



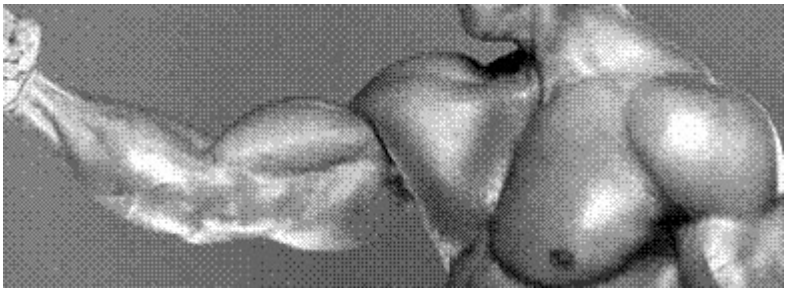
If these nuclei are damaged during experimentation, such as on animals or by disease in humans, the ability to utter any overt circadian rhythms is ruined. The temporal programmer of behavior and physiology is rendered chaotic (13).

Studies have demonstrated (23) that, in spite of prolonged episodes of isolation and deprivation of external time cues, subjects of the experiments continue to display daily cycles of core temperature, sleepiness, and alertness.

The regulator energizing this cycling is slightly adaptable; therefore, the measurable rhythms free run with periods of slightly less than or greater than one solar day, hence the term *circadian*, meaning approximately a day (14).

Due to the SCN (also called the “master pacemaker of the circadian rhythm”) and its dispensation of the environmental cues (2) that it obtains, there is a natural partiality to sleep when it is dark and to be active when it is light.

Athletic Endeavors



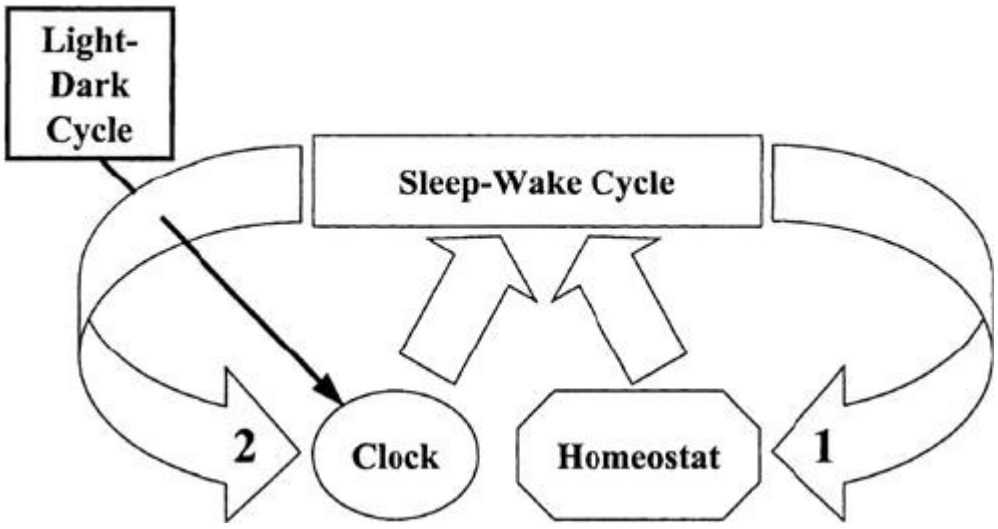
Chronobiological pulses have an effect on both physiological aspects and motor skills (23).

The physiological factors (7) affected consist of power, speed, strength, and endurance. Influenced motor skills include coordination and reaction time.

In addition to those physical factors, a trough in one's chronobiological rhythm can have the undesired effect (7, 36) of decreased levels of concentration, focus, motivation, mental toughness, and threshold for pain.

The sleep-wake cycle (30) is not simply driven by the circadian pacemaker found in the SCN, but also (13) through interactions of circadian rhythmicity, known as the homeostatic component.

The homeostatic component consists of a sleep-wake oscillatory process as well as circadian photoreception (see: Analysis of The Two-Process Model Of Sleep).



"Fig. 1. *A circadian pacemaker (clock), presumably located in the suprachiasmatic nuclei (SCN), and a sleep homeostat, presumably located outside the SCN, are two major determinants of the timing of the human sleep-wake cycle and sleep structure. The oscillation of the sleep homeostat is strongly, and maybe exclusively, determined by the sleep-wake cycle (arrow 1). Light input to the circadian clock is mediated by circadian photoreception. The sleep-wake cycle is a major determinant of light input to the clock (arrow 2).* (7)"

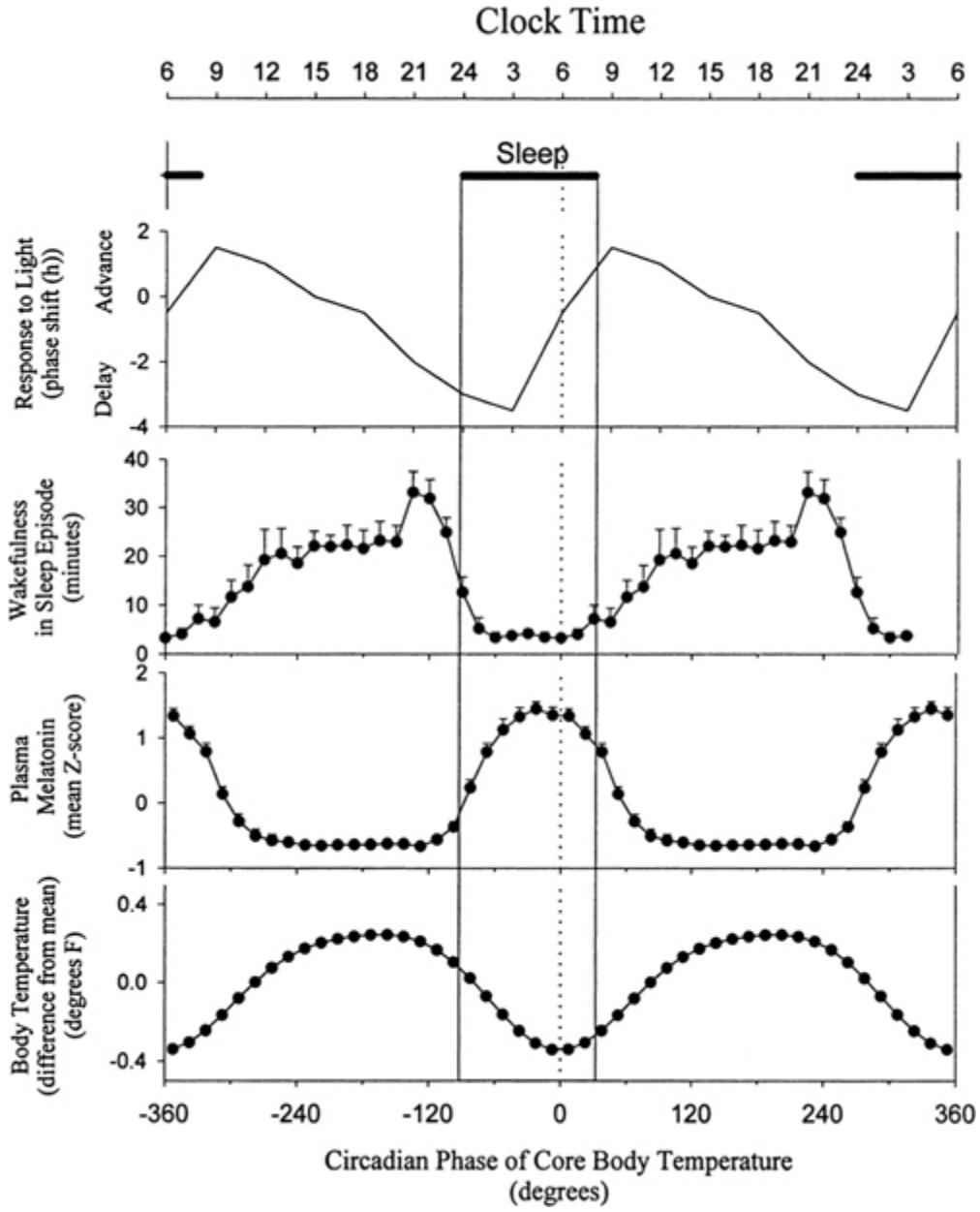


Fig. 2. ***"****Schematic representation of the timing of the habitual sleep episode in young adults relative to the circadian rhythm of core body temperature, plasma melatonin, wake propensity, and the responsiveness to light. The circadian variation*

in the responsiveness to light is a schematic representation (see Refs. 31 and 60 for review). Note that the maximum of the melatonin rhythm is located ~2 h before the nadir of the circadian temperature rhythm. Sleep disruption (wakefulness within scheduled sleep episodes) is maximal when sleep is scheduled just before the rise of melatonin. [Based on data published in Ref. 40.] Dijk, DJ, Duffy JF, Riel E, Shanahan TL, and Czeisler CA. Ageing and the circadian and homeostatic regulation of human sleep during forced desynchrony of rest, melatonin and temperature rhythms (7)."

The concept of a variation throughout the solar day of physiological and psychological variables is not a recent invention. Daily alteration in body temperature was first noted in 1778 (7), and observation of circadian rhythms in plants was noted hundreds of years ago by (11) French astronomer Jacques d'Ortuous de Marian.

These time-reliant variances are called circadian rhythms. These psycho-physiological utilities demonstrate maximum and minimum phases throughout the day, many of which can have a profound effect on preeminent sports performance (22).

A plethora of evidence supports late afternoon/early evening training times between 1500-1900 hours (11, 12, 15, 16, 22, 25, 28, 29, 31).

The most recent evidences (5) would seem to solidify the occurrence of a circadian rhythm in anaerobic power and capacity, as well as isotonic and isokinetic strength measures of the upper and lower extremity, with a peak in the late afternoon that is independent of gender.

Case in point, Melhim, A.F. (29) concluded,

The Wingate anaerobic cycle test was performed at 4 times of the day—0300, 0900, 1500, and 2100 hours—all on the same day. Peak and mean power were measured. A statistically significant difference was found for peak power, **with the highest mean occurring at 1500 hours as compared with 0300 and 0900 hours**. Significance was found for mean power as well, with the highest means occurring at 1500 and 2100 hours as compared with 0300 hours.

Cable, N.T., and T. Reilly (4) announced in their study, "Influence of circadian rhythms on arm exercise"

> During maximal exercise, time to exhaustion showed statistical significance with a peak at 1650 hours, which coincided with the highest body temperature mean. An afternoon (1653 hours) peak of heart rate during maximal exercise occurred as well. **Relative VO_2max, VCO_2, respiratory exchange ratio, minute ventilation, and VE/VO_2 ratio all had significant afternoon peaks.**

Hill and Smith (15) also arrived at the late afternoon conclusion for maximum performance from anaerobic exercise:

> Work resistance was preset at 5.5 kg and was the same for all subjects. Peak power, as defined by the highest power output in a given 5-second period, and anaerobic capacity, defined by the total external work during the 30-second period, were measured. Significant differences were found in peak power between the 0900- and 2100-hour means. Significant differences were also found in anaerobic capacity between the 0300- and 1500-hour means. The results suggested a peaking pattern for power output and anaerobic capacity as measured by the modified Wingate test, **with slow increases from early morning to a peak in the time span of 1600–2200 hours.**

Another experiment by Hill (16) revealed similar findings:

> The subjects were assigned in a random order to exercise in a morning session (0730–0900 hours) and an afternoon session (1600–1730 hours). Time to exhaustion was measured for each testing session. The results revealed a statistically significant difference, **with afternoon-session exhaustion times greater than those of the morning session.**

Again, Hill (17) along with D.O. Borden, K.M. Darnaby, D.N. Hendricks, and C.M. Hill

studied all-out cycle exercise to determine a possible time of day effect on total work, time to exhaustion, anaerobic work, aerobic work, and aerobic power.

Six women and 8 men of college age exercised at a maximal rate to exhaustion. A constant, preset workload of 5 $W \cdot kg^{1}$ for women and 6 $W \cdot kg^{1}$ for men was used for the tests. Two identical, randomly ordered work sessions were conducted at 0700–0900 and 1600–1730 hours. Total work, time to exhaustion, aerobic power, anaerobic work, and aerobic work were all significantly greater in the afternoon sessions than in the morning sessions (5).

Evidence of a time of day effect on isotonic and isokinetic strength measures of the

upper and lower extremity has been demonstrated in the lab as well as is the case

with Lundeen (28) et al., and the earlier case presented from Cable, N.T., and T.

Reilly (4).

Lundeen (28) et al. observed 21 women and 25 men of college age. Measures of maximal strength, maximal speed of contraction, and muscle power of the quadriceps were reached by utilizing an isotonic ergometer.

Noteworthy differences in maximal quadriceps strength, speed of contraction, and muscle power were established in the afternoon measures compared with the morning measures.

Wyse et al. (35) undertook an additional study that examined leg strength and time of day differences.

Their study used isokinetic strength measures of knee flexion and extension.

> Nine college-age male athletes performed isokinetic exercise at 0800–0900 hours, 1300–1400 hours, and 1800–1900 hours on 3 separate days. Four maximal voluntary contractions were performed at velocities of 60°·s^{1} and 180°·s^{1}. Peak torques of the knee extension and flexion movements were determined. A peak torque ratio between knee flexion and extension was also determined. **Significant time of day differences were found for all measures between the session at 1800–1930 hours and the 2 earlier sessions at both measured velocities.**

The researchers came to the unwavering conclusion that the optimum phase for maximal isokinetic leg strength measures transpired among 1800–1930 hours.

One astounding proclamation of their research stated that sensible comparison of maximal isokinetic leg strength should be done only between data obtained at similar times of the day, with a margin of ±30 minutes, boldly stating their reaffirmation of the validity of their findings.

A general consensus of the major studies surrounding this topic reveals the following conclusions (*tables provided by the Journal of Strength and Conditioning Research*):

Provided below is a table showing the consensus of the aforementioned research.

			Time of day
	Dependent variable exhibiting		coinciding with
Reference	time-of-day effect	Exercise mode	peak effect (h)
Hill et al. (10)	Morning, trained VE	Cycling	0600–0800
	Afternoon, trained VE		1530–1800
Torii et al. (28)	VO2 max improvements	Cycling	1500–1530
	Recovery heart rate improvements		1500–1530
	Blood lactate response		1500–1530
Hill et al. (9)	Rating of perceived exertion above	Cycling	0600–0900
	ventilatory threshold		
Lundeen et al. (18)	Maximal quadricep strength	Isotonic ergometer	1144–1536
	Maximal quadricep contraction speed		0856–1808

	Quadricep muscle power		1204–1352
	Grip strength	Hand dynamometer	1400–1516
	Manual dexterity		0920–1048
	Plasma cortisol levels		0912–0920
	Beta endorphin levels		0544–0732
	Catecholamine levels		1624–1712
Wyse et al. (30)	Isokinetic peak torque for knee	Isokinetic dynamometer	1800–1930
	extension and flexion		
	Isokinetic peak torque ratio		1800–1930
Hill and Smith (13)	Peak power output	Wingate cycle test	1600–2200
	Anaerobic capacity		1600–2200
Hill et al. (7)	Maximal exercise time	Cycle	1600–1730
Hill et al. (8)	Maximal exercise time	Cycle	1600–1730
	Anaerobic work		1600–1730
	Aerobic work		1600–1730
	Aerobic power		1600–1730
	Total work		1600–1730
Reilly and Down (23)	Power output	Margaria stair run test	1700–1800
	Broad jump distance		1700–1800
Melhim (19)	Peak power	Wingate cyle test	1500
	Mean power		2100
Cable and Reilly (3)	Maximal arm exercise	Arm ergometer	
	Time to exhaustion		1650
	Heart rate		1653
	VO_2max		1353
	Respiratory Exchange Rate (RER)		2111

	VE		1653
	VE / VO2 ratio		1750
Reilly and Brooks (22)	Mean body temperature	Cycle	1709
	Mean skin temperature		1651
Hill et al. (12)	VO2max	Cycle	1530–1800
	VO2submax		1530–1800
Zahorska-Markiewicz	Exercuse at 50% VO2max	Cycle	
et al. (31)			
	Heart rate		1200–1800
	Metabolic rate		1200
	Rectal temperature		1200–1800
Reilly and Garrett (24)	Self-paced exercise	Cycle	
	0–20 minute power output		1730
	20–60-minute power output		830

Relative Training Time

Note, however, that the preferred or recommended range prescribed by these studies is not absolute. For example, studies performed by Hill et al. and Torii et al. (18, 34) come to these same conclusions of afternoon training.

> The subjects were assigned randomly to a morning (0900–0930 hours), early afternoon (1500–1530 hours), or evening (2000–2030 hours) exercise group. The subjects then trained 4 days per week at durations and intensities identical to the pre- and posttest conditions. **These included controlled environmental conditions.**

However, note possible shortcomings (5) in the controls that were utilized in these two studies.

Afternoon-specific improvements in VO_2max, recovery heart rate, and blood lactate response as seen in the study by Torii et al. (34), and blood lactate response as seen in the study by Torii et al. (34) seem to suggest that endurance training would best be undertaken in the afternoon.

Some shortcomings of this study (5), however, include a somewhat short, four-week exercise curriculum of relatively low to moderate intensity with amateur and inexperienced subjects. A longer, more intense program with trained subjects may produce more varied results. The study provided by Hill et al.(18) was also managed with a relatively stunted training agenda, however with an adequate intensity level to mimic the bodybuilding training style.

Other limitations of these types of investigations include (5): small sample sizes, performance of all testing on the same day, which could result in an ordering or learning effect, and nonfunctional exercise patterns and speeds.

As such, and noted in the abstract, these findings are far from absolute, and are

subject to change as newer and more improved research presents itself to the

scientific community.

Another illustration of this includes a study done by Hill, D.W, K.J. Cureton, and M.A. Collins in which they (20) concluded:

> Two maximal graded exercise tests were performed on the same day. **The tests were conducted between 0600–0900 hours and 1530–1800 hours.** The RPE was measured using the 15-point Borg scale every minute during the test. O_2max and ventilatory threshold were determined from the test data. The results showed no significant differences in maximum heart rate, ventilatory threshold, and RPE at the ventilatory threshold between the AM and PM exercise sessions. O_2max was significantly lower as measured during the AM sessions compared with the PM sessions. The RPE at intensities below the ventilatory threshold showed no significant differences between the AM and PM exercise sessions. However, RPE measures at intensities above the ventilatory threshold proved to be significantly lower in the AM sessions than in the PM exercise sessions.

The results of this study give the impression that at cycling intensities above the ventilatory threshold, there is a time of day difference for RPE. Observe that this result did not continue into maximal exercise. These results are in disagreement with two preceding studies (10, 22).

These studies showed a significant difference in RPE during maximal exercise, with the maximal ratings occurring in the afternoon or evening.

If the RPE difference above the ventilatory threshold in the a.m. is actually due to lower ventilatory demands in the morning, then hypothetically this lower ventilatory demand should cause maximal exercise to be perceived as less strenuous as well (5).

A possible shortcoming of this research is the ordering effect of performing both investigations on the same day without random task.

Other physiological aspects such as heart rate and body temperature could be a factor to the differences in the alleged exertion, and these could need to be concentrated on in juxtaposition with perceived exertion to attempt to establish a connecting relationship.

Further direct research is necessary in the aspect of “exercise and time of day,” principally to alleviate the contradictory results (10, 20, 22) of the studies cited and to clarify the possible physiological factors that could contribute to differences in superficial exertion. Nonetheless, the circadian rhythm has been shown to have a profound effect on maximal training stimulation.

However, indirectly, it has been publicized that habitual sleeping pattern “types” such as lark or owl prototypes can dramatically affect the circadian rhythm and thus should logically be considered when establishing individual training times. See: Analysis of The Two-Process Model Of Sleep -

Some evidence (19) suggests sleeping patterns can also effect optimal training time and should be factored into future studies and investigated. A few studies have attempted to find a direct relationship between these two factors, but to little avail (5).

Penny Wung Burgoon, George J. Holland, Steven F. Loy, and William J. Vincent (3) conducted one such study:

> Twenty-six healthy, untrained men (23.3 ± 4.4 years) were determined to be morning, intermediate or evening chronotypes **using the 1976 Horne and Ostberg questionnaire**. Each individual underwent a series of two maximal treadmill tests (Bruce protocol) at two different times of day: 7:30–8:30 a.m. (morning or M test), and 7:30–8:30 p.m (evening or E test). The M and E tests were administered a minimum of 48 hours apart using a randomized counter-balanced design. Heart rate, ventilation, oxygen consumption, carbon dioxide production, respiratory exchange ratio, rating of perceived exertion and total exercise time were monitored at each test session.
>
> While performance differences during maximum exercise were not detected between chronotypes, **further study with submaximal exercise intensity and variable duration should be conducted.**

However, it is important to note, the questionnaires (21) used in these studies are suggested by some researchers to be faulty (32), which may make the research somewhat unreliable.

Countering such like findings are studies that give evidence that chronotypes can have an effect on the physical pattern of the circadian rhythm.

Population samples fluctuate in their diurnal preference for the timing of action and slumber, and this partiality is paralleled in their physiology.

In morning varieties studies show body temperatures lowest point occurs at earlier clock times than in evening types. This is truly fascinating. With these types of finds, the evidence for relativistic training times becomes more and more tangible as the optimal time for training.

Three major circadian types or chronotypes have been defined (21), using means such as the Horne-Ostberg Morningness-Eveningness Scale. This scale is a subjective tool that has been correlated with body temperature and other physiological factors (note as stated above, however, not all researchers accept this scale as reliable, though it is generally accepted and thus will be looked at in this entry as a credible source).

The three types are "morning/lark," "evening/owl" and "indifferent" or "mid-range" (21).

> The first two categories each represent approximately 15% to 20% of the human population and the "indifferent" or "mid-range" category applies to the majority (60% to 70%) of humans.
>
> A morning-type individual, or "lark," is defined as one whose circadian rhythms are skewed about two hours (or more) earlier than the norm for the human population as a whole. That is, larks naturally awaken between 4:00 a.m. and 6:00 a.m. and are ready for sleep by 8:00 p.m. to 10:00 p.m. To a lark, midnight is perceived as the middle of the night. Conversely, an evening-type individual, or "owl," is defined as one whose circadian rhythms are skewed about two hours (or more) later than the norm for the population. That is, owls naturally awaken between 8:00 a.m. and 10:00 a.m. and do not find themselves feeling sleepy until the midnight-to-2:00 a.m. time frame.

Sleep deprivation studies (26) have indicated that the homeostatic aspect of sleep regulation is not markedly different between morning and evening types.

Moreover, differentiation in the timing of circadian melatonin and core body temperature rhythms persevere under constant routine, signifying that such differences are not an exact effect of tainted sleep-wake timing (9).

Upon examination of the quantifiable phase interactions between the sleep-wake cycle and circadian rhythms, a rather paradoxical conclusion was discovered that showed that morning “types,” who wake up at an earlier clock time, awaken later relative to the circadian cycle of temperature and melatonin!

In once instance Duffy JF, Dijk DJ, Hall EF, and Czeisler CA (9) discovered the following:

> We investigated the association between circadian phase, the phase relationship between the sleep-wake cycle and circadian rhythms, and morningness-eveningness, and their interaction with aging. In this circadian rhythm study, 68 young and 40 older subjects participated.
>
> > RESULTS: Among the young subjects, the phase of the melatonin and core temperature rhythms occurred earlier in morning than in evening types and the interval between circadian phase and usual wake time was longer in morning types. **Thus, while evening types woke at a later clock hour than morning types, morning types actually woke at a later circadian phase**. Comparing young and older morning types we found that older morning types had an earlier circadian phase and a shorter phase-wake time interval. The shorter phase-waketime interval in older "morning types" is opposite to the change associated with morningness in young people, and is more similar to young evening types. CONCLUSIONS: **These findings demonstrate an association between circadian phase, the relationship between the sleep-wake cycle and circadian phase, and morningness-eveningness in young adults**. Furthermore, they demonstrate that age-related changes in phase angle cannot be attributed fully to an age-related shift toward morningness. These findings have important implications for understanding individual preferences in sleep-wake timing and age-related changes in the timing of sleep.

The reverse would be true for evening types.

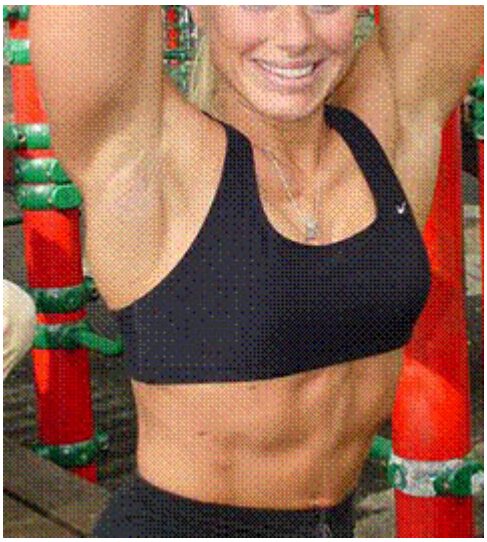
This relationship has been found to be true from numerous studies.

Duffy JF, Rimmer DW, and Czeisler CA revealed in another investigation, "*Association of intrinsic circadian period with morningness-eveningness, usual wake time and circadian phase"*:

> The biological basis of preferences for morning or evening activity patterns ("early birds" and "night owls") has been hypothesized but has remained elusive. …**compared with evening types, the circadian pacemaker of morning types was entrained to an earlier hour with respect to both clock time and wake time**. The present study explores a chronobiological mechanism by which the biological clock of morning types may be set to an earlier hour. Intrinsic period, a fundamental property of the circadian system, was measured in a month-long inpatient study. A subset of participants also had their circadian phase assessed. Participants completed a morningness-eveningness questionnaire before study. Circadian period was correlated with morningness-eveningness, circadian phase, and wake time, **demonstrating that a fundamental property of the circadian pacemaker is correlated with the behavioral trait of morningness-eveningness.**

These and copious other subsequent studies reveal the traditional chronobiological mapping as demonstrated earlier is not absolute. Some relativism appears to be essential when determining optimal training time. Certainly, owl and lark prototype parallels are a contributing factor.

One apparent fact (18) is that habitual exercise patterns are optimal for continuous improved enhancement of bodybuilding training protocols.



A particularly interesting study (33) came out of Stanford University's Sleep Disorders Clinic. They looked at 25 years worth of results from the National Football League for potential advantages of West Coast versus East Coast teams with the circadian rhythm being the chief control factor.

The scientists reviewed “Monday Nite” Football games, which have always begun at 9:00 p.m. Eastern Standard Time.

What they found was extremely remarkable. Smith noted that West Coast teams win considerably more often and by radically more points per game than East Coast teams.

- West Coast teams won 63.5% of games, while East Coast teams won only 36.5% of games.
- West Coast teams won by an average of 14.7 points per game, whereas East Coast teams won by an average of 9.0 points per game.
- West Coast teams won 59.3% of the home games through the years, while winning 71.0% of Monday Nite Football games.
- East Coast teams won 56.5% of their home games, but only 43.8% of Monday Nite Football home games.

Overall, West Coast team records are 4.4 percentage points better than East Coast team records since 1970. However, when West Coast teams play East Coast teams for Monday Nite Football, West Coast team records are 27.0 percentage points better than East Coast team records.

Jet lag was disregarded as a potential interfering control, as this effect should be virtually equal or to the advantage of an East Coast team traveling westward.

The study concluded this advantage probably relates to the fact that West Coast teams are competing closer to the time that they typically train each day.

This, among other research, exhibits that training at the same time daily, while perhaps impractical, is likely the most favorable.

It also demonstrates that when preparing for a contest, training times should be scheduled at approximately the same time as stage time is expected to occur.

Along with maintenance of a regularly scheduled training program, it is important to remember that disruption in the sleeping pattern can certainly disturb the circadian rhythm and thus optimal training time (7).

Alcohol also disrupts the circadian rhythm, another reason to avoid this poison in any form (8).

Practical Applications

From an overview of the latest studies a general training time recommendation can be given of 1500-1900 hours, or 3PM to 7PM, for body building specific protocols.

However, a personalized circadian rhythm can skew this time frame, and the figures in the practical application guideline should be recalibrated to the athlete's individualized chronotypes.

As an illustration, a lark (one who naturally awakens between 4-6am) whose circadian rhythm and homeopathic components are timed for sleep at 8:00PM would not fall into the general pattern type of 3PM to 7PM.

In the aforementioned studies, late afternoon/early evening workouts were favored, however sleep prototypes were not considered.

In reviewing the current research on Chronobiology, it is the opinion of the author that the above figures could be distorted by 1-3 hours depending upon chronotypes.

Concerning a lark, one possible variable work out time could be between 12PM-4PM, while an owl would range between 5PM-9PM.

Sleep duration patterns of the athlete are another factor that should be considered when calibrating advantageous training phases.

If a bodybuilder has a traditional sleeping pattern of 10 hours per night, his or her optimum training time would be skewed as measured by an athlete who requires but 8 hours per night.

It is important to keep these variables in mind when applying the practical application strategies.

1. Increased body temperature during later afternoon/earlier evening exercise, from enhanced peak times of circadian rhythm, should be accounted for when scheduling maximal intensity programs. See: Effect of Plasma Volume on Myofibril Hydration, Nutrient Delivery, and Athletic Performance

2. Increased warm-up before morning exercise should be initialized to ensure proper physiological readiness for intense exercise. See: Mobility Training and the Application of Proper Warm-Up for Bodybuilders. An additional 5-10 minutes of aerobic conditioning and dynamic stretching is recommended.

3. Training and competition should be synchronized to the same time of day. If this is impractical, the athlete may be able to adjust the sleep/wake cycle so that the performance time will coincide with the adjusted peak times for a particular rhythm. This is in agreement with the recommendations of Winget et al. Winget, C.M., C.W. DeRoshia, and D.C. Holley in "*Circadian rhythms and athletic performance.*" *Med. Sci. Sports Exerc.* 17:498–516.

4. While circadian rhythms continue in the absence of time cues, light imparts the primary external stimulus for sleep-wake schedule in normal environmental conditions. The retina sends signals to the SCN when light weakens. The SNC, in turn, signals the pineal gland, which converts tryptophan into melatonin, causing sleepiness and a decline in body temperature. Concurrently, the brain halts production of histamine, norepinephrine, and serotonin (neurotransmitters associated with arousal). Due to photic reception stimuli of the SNC, training area should be well lit, particularly during night training.

5. AM/PM split trainers would be advised to execute their first session in the AM, utilizing more emphasized warm up protocols, and succession of the second session in the earlier PM (5-7pm), as opposed to late PM (8-11pm).

6. The evidence points to training for enhanced aerobic capacity during the late afternoon. Traditional cardiovascular training or HIIT style training could best be exploited during these hours.

7. Studies utilizing RPEs, or Ratings of Perceived Exertion, are influenced by time of day and these factors should be considered when interpreting the data. In the previously referenced study, the afternoon was the favored time, but data conflicts in this area.

8. Optimal time under tension training should be performed in the mid-afternoon/early evening when neuromuscular and motor skills are a peak state.

9. High intensity body building style programs should be completed in the mid- afternoon/early evening to realize maximum performance. This is the

time when metabolic functions are at the utmost. This statement is independent of gender.

10. Lark and Owl prototypes need be considered when using maximal exercise or measuring/executing VO_2 max. Once the established stereotype is matched to the athlete, workouts, training programs, or competitions can be scheduled accordingly. Again, a detailed training journal is recommended for careful tracking analysis.

11. 7-8 hours upon awakening, or approximately 12 hours from the middle of the athlete's night's sleep, is generally a non-optimal time period to workout. Increased episodes of drowsiness and lapses in concentration are likely (see: Z-Factor II - The Slumber Dynamic).

Peak times for certain performance variables are generally subject to individual differences and will need experimentation by the athlete to find the optimum performance time for these variables. **JHR** recommends a detailed training journal with an emphasis on describing energy, emotional, and physiological states during the drill timeframe to better hone in on personalized training times.

Circadian Rhythm and Post-Workout

The SCN coordinates multiple circadian oscillators, which include variables such as temperature, sleep, melatonin, cortisol, and thyroid stimulating hormone (TSH).

Melatonin increases in the evening, plateaus during the night, and decreases in the morning, causing the natural tendency to fall asleep. Cortisol increases rapidly in the early morning, typically between 6am-8am, and gradually decreases throughout the day (recall that based upon personality types, i.e. lark or owl, these times may be skewed (6).

Although zeitgebers may manipulate the intensities of these variables, these rhythms are endogenous.

Take, for instance, core body temperature. This factor may be influenced by external cues such as training and sleep, but the temperature has a clear circadian rhythm even in candidates of experiments whom are at bed rest and sleep deprived for over 24 hours.

Body temperature progression is the most universally studied circadian variable. Circadian rhythms possess a manifest impact on sleep. Alterations to circadian

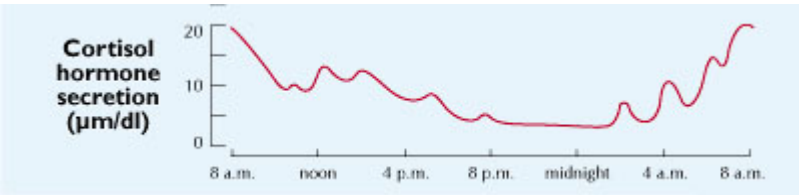
rhythms can cause sleep deprivation, early morning awakening, or disproportionate sleep.

Circadian rhythms are generally (research is showing that this may not necessarily be the case 100% of the time, but this is the current consensus) coupled and have a steadfast phase relationship.

Case in point, temperature and sleep are coupled, with sleep experienced during the low temperature depression. However, under some circumstances these rhythms may be become uncoupled.

Cortisol behaves on specific intracellular receptors with impacts in manifold physiologic systems, some of which include immune function, glucose counter-regulation, vascular tone, substrate utilization, and bone metabolism.

Cortisol levels ensure an ACTH-dependent circadian rhythm with peak levels in the early morning and a lowest point at night (6).



Increased amounts of ACTH and cortisol are also secreted independently of the circadian rhythm in response to physical and psychological stress (24).

In 2003, the following was concluded (27) from salivary cortisol testing and its patternizations to the circadian rhythm:

DISCUSSION

The major finding of this study was that resistance training significantly increases the amount of cortisol present in saliva immediately following exercise, though it does not affect cortisol patterning of the circadian rhythm.

CONCLUSIONS

This study demonstrated that heavy resistance exercise had a significant effect on cortisol release immediately post exercise, but did not significantly affect the waking circadian rhythm in women.

From these findings it can be concluded that cortisol levels rise in response to bodybuilding training independent of the circadian rhythm. As such, the prescribed post-workout protocol assigned in **JHR** is recommended to bring cortisol levels under control.

Optimal Training Duration

Intensity and its relationship to overtraining perform a large part in prescribing actual workout time frame.

Moreover, cortisol release is related to intensity, see Scientific Investigation into the Rationality of Carbohydrate Consumption Criterions in Correlation to Post-Training Anaerobic Depletion Patterns: A series of sub-divisional essays.

Dean Jacks in his study, "*Effect of Exercise at Three Exercise Intensities on Salivary Cortisol*", The Journal of Strength and Conditioning Research: Vol. 16, No. 2, pp. 286–289, concluded:

> Cortisol, the principal glucocorticoid in humans, is known to play a major role in metabolism and immune function (5, 15). It is considered catabolic in nature because of its effects on protein and carbohydrate metabolism (21, 24). **Stimulation of gluconeogenesis by cortisol spares blood glucose and reduces protein stores. Such diminution of stored protein may lead to a wasting of the skeletal muscle (21).**
>
> **With (emphasis added) heavy resistance training, even short bouts of exercise stimulate cortisol elevations (7, 10, 11).**

Hormone manipulation is but one of many variables to consider when attempting to answer this question.

The following is an excerpt from How To Shock Your Body Out Of the Comfort Zone Part One.

> There are 3 basic training principles: overload, variation, and specificity.
>
> Overload is concerned with providing a proper stimulus for eliciting a desired physical, physiological, or performance adaptation. Overload is exercise and training that goes beyond normal levels of physical performance. An overload stimulus will have some level of strength (intensity), frequency, and duration of application. Thus, all stimuli will have a level of intensity, relative intensity (percentage of maximum), frequency, and duration (volume).
>
> The intensity of training is associated with the rate of performing work and the rate at which energy is expended; the volume of training is a measure or estimate of how much total work is performed and the total amount of energy expended. Intensity (and relative intensity) is provided by the amount of weight lifted, and the volume of training is related to the number of repetitions and sets per exercise; the number and types of exercises used (large- versus small-muscle mass); and the number of times per day, week, month, and so on that these exercises are repeated. Volume load (repetitions

×the mass lifted) is the best estimate of the amount of work accomplished during training.

[K.C. Pierce, G.G. Haff, A.J. Koch, B.K. Schilling, and R.L. Johnson. Periodization: Effects of manipulating volume and intensity—Part 1. Strength Conditioning. 21:56–62. 1999.]

[H.S. O'Bryant, K.C. Pierce, G.G. Haff, A.J. Koch, B.K. Schilling, and R.L. Johnson. Periodization: Effects of manipulating volume and intensity—Part 2. Strength Conditioning. 21:54–60. 1999.]

[Stone, M.H., S. Plisk, M.E. Stone, B. Schilling, H.S. O'Bryant, and K.C. Pierce. Athletic performance development: Volume load—1 set vs multiple sets, training velocity and training variation. Strength Conditioning. 20(6):22–31. 1998.]

The application of training intensity and volume can be considered both in terms of the overall workout (i.e., all exercises performed during a specified period) or in terms of individual exercises. An understanding of overload factors can aid in the choice of exercises and equipment. Although programming (i.e., sets and repetitions) for a specific exercise is independent of exercise mode, the resulting total work (accomplished per session, week, month, etc.) is not independent.

Variation is concerned with appropriate manipulation in training intensity, speed of movement, volume, and exercise selection. Appropriate variation is an important consideration for the prolongation of adaptations over continuous training programs. Furthermore, appropriate sequencing of volume, intensity, and exercise selection, including speed–strength exercises, in a periodized manner can lead to superior enhancement of a variety of performance abilities.

[Kraemer, W.J. A series of studies: The physiological basis for strength training in American football: Fact over philosophy. J. Strength Conditioning Res. 11:131–142. 1997.]

[Kramer, J.B., M.H. Stone, H.S. O'Bryant, M.S. Conley, R.L. Johnson, D.C. Nieman, D.R. Honeycutt, and T.P. Hoke. Effects of single versus multiple sets of weight training: Impact of volume, intensity and variation. J. Strength Conditioning Res. 113:143–147. 1997.]

Specificity of exercise and training is the most important consideration when selecting appropriate equipment for resistance training, especially if performance enhancement is a primary goal. Specificity includes both bioenergetics and mechanics of training. This discussion will be concerned with mechanical specificity.

The transfer-of-training effect deals with the degree of performance adaptation that can result from a training exercise and is strongly related to specificity. Mechanical specificity refers to the kinetic and kinematic associations between a training exercise and a physical performance. This includes movement patterns, peak force, rate of force development, acceleration, and velocity parameters. The more similar a training exercise is

to the actual physical performance, the greater the probability of transfer.

This is why poses must be observed, examined, and molded during training.

[Sale, D.G. Neural adaptation to strength training. In:. Strength Power in Sport. P.V. Komi, ed. London, Blackwell Scientific. 1992.pp. 249–265.]

[Saunders, M.T. A comparison of two methods of training on the development of muscular strength and endurance. J. Orthop. Sports Phys. Ther. Spring:210–213. 1980.]

[R.A. Motor Learning Performance. Champaign, IL: Human Kinetics, 1991.]

Siff and Verkhoshansky refer to transfer-of-training effect as “dynamic correspondence”; that is, the basic mechanics, but not necessarily the outward appearance, of training movements should be similar to those of the athlete's sport performance. They suggest a number of considerations and performance criteria that can be used in selecting training modes (and methods) that can maximize the transfer-of-training effect.

[Siff, M.C., and Y.V. Verkhoshansky. Supertraining: Strength Training for Sporting Excellence. (3rd ed.). Johannesburg, South Africa: University of the Witwatersrand. 1998.]

In terms of performance, the criteria are as follows: accentuated regions of force production, amplitude and direction of movement, dynamics of effort (i.e., static versus dynamic characteristics of the movement and appropriate power output), rate and time of maximum force production, and regime of muscular work (eccentric versus concentric muscle actions).

The fourth criterion, dealing with rate of force production, is especially important in selecting exercises for the training of explosive athletic movements. Mechanical specificity has been extensively studied as it affects strength-training exercise.

Upon completing 1-1.5 hours of training, if intensity is high, it is most optimal to cease training; however, conditioning, as well as mitochondrial density can be factored into this equation and greater detail of this topic will be discussed in the future.

General recommendation is to train for an hour and, if higher volume is desired, split up the training quantity into an AM/PM split. This would also be optimal for recovering depleted glycogen levels and other factors which will be discussed in the future of **JHR**.

However, in keeping with the focus of this entry, from the perspective of the circadian rhythm *in general*, a four hour timeframe during mid-afternoon/early evening is the most advantageous time for training. If one was to workout at 1800 hours, a one-hour workout that would not surpass the 1900 mark would be ideal, so as to stay in the favorable training time.

Training for the duration of this four hour interval would be more relaxed as far as the biological clock vantage point; however, glycogen depletion and increased catabolic states needs to be considered for bodybuilding-specific training.

Time and the Universe

The title of this journal entry, **Diurnal**, has dealt extensively with the concept of time and its rhythmic vacillations.

The Universe itself is a circadic component adhering to cosmic fluctuations.

Composed of three elements--*time, space, and matter*--the universe exhibits a combination of a triune creation.

The following is a dissertation from Dr. D. James Kennedy on the concept of time and the doctrine of the trinity:

> *"Let's consider for a moment what the Trinity is not…they are not three gods and not three beings. They are three distinct persons; yet, they are all one God. Each has a will, can speak, can love, and these are demonstrations of personhood. They are in absolute perfect harmony consisting of one substance. They are co-eternal, co-equal, and co-powerful. A further point of clarification is that God is not one person, the Father, with Jesus as a creation and the Holy Spirit is a force. Neither is He one person who took three consecutive forms, for example, the Father, became the Son, who became the Holy Spirit. Nor is God the divine nature of the Son, where Jesus had a human nature perceived as the Son and a divine nature perceived as the Father. Nor is the Trinity an office held by three separate gods.*
>
> *Often people will attempt to explain the trinity utilizing false analogies such as comparing the trinity to a piece of pie. Claiming, if you cut a pie into three pieces, you still have one pie, yet three distinct pieces. But the Bible does not teach that the Father is a third of God, and the Son is a third of God and the Holy Spirit is a third of God. The Bible teaches that the Father is all of God,*

and the Son is all of God, and the Holy Spirit is all of God. So that just will not work. Then there are those that teach, "Well you see the Father is God, and the Son is God, and the Holy Spirit is God, and there are three separate Gods! There must be because obviously one plus one plus one doesn't equal one, it equals three (1 + 1+ 1 = 3), obviously!"

Yet the Bible very clearly teaches that there is but One God. As the Jews were so fond of saying, "Hear oh Israel, the Lord our God is ONE!" It is worth noting that, one times one times one equals one (1 x 1 x 1 = 1), not three!

Is there a correct analogy that we can use to illustrate the trinity? Yes there is. And the answer is all around us.

Universe comes from the Latin words, Uni and verteri-- To turn into one! That all things with their manifold differences turn and form one single Universe. And we will find, if we examine this Universe, that it consists as any scientist will tell you, of space, time and matter. Those three, no more. Furthermore, it is not possible in this Universe which we know, to have any two of those without the other. This Universe always exists of space, time, and matter. This Universe cannot exist as we know it in any other way, but with all three of them. Take away any one of them and you have no Universe.

Now if that isn't striking enough, let's turn our microscope up a little higher, and look at each one of those in its turn and we'll discover that each one of those elements of this triniverse, is itself triune!

For example, take the first one, SPACE! Space is made up of longitude, latitude and altitude. Length, breadth and height. These three, no more. Furthermore, it is not possible in the physical Universe to have anything that doesn't contain all three. Everything that we know of in the physical Universe, always under all circumstances contains length, breadth and height. And if you take away any one of those, it ceases to exist. You cannot have one without having all.

Dr. D. James Kennedy, A.B., M.Div., M.Th., D.D.,
D.Sac.Lit., Ph.D., Litt.D., D.Sac.Theol., D.Humane Let.

Let's move on from space to time. Time, as everyone knows, is composed of the past, the present and the future. These three, no more. And in this world as we know it, you cannot have time, without having all three. Furthermore, from some perspective, all time is at one point all future. In the beginning, when God started time, all time was future. And at the end of time, when God reaches out and

lays His hand upon the turning wheel of time and stops it as the angels swore that time shall be no more-- in that hour at that moment all time will be past. And yet, from our existential experience we see that all time is present. And the fact of the matter is, we can existentially know time in no other way, but the present... and this is a remarkable thing."

Keeping those concepts in mind, let us now turn to Dr. Nathan Wood, formerly the President of Gordon College, and read an excerpt from a book he authored, entitled the Secret of the Universe.

This first paragraph may stretch one's cranial capacity, but read carefully and the revelation of the trinity will soon be exposed,

The Future is the source! The Future is unseen, unknown, except as it continually embodies itself and makes itself visible in the Present. The Present is what we see and hear and know. It is ceaselessly embodying the Future, day by day, hour by hour, moment by moment. It is perpetually revealing the Future, hitherto invisible. The Future is logically first! But NOT chronologically first. For the Present exists as long as time exists, and was in the absolute beginning of time.

The Present has existed as long as time has existed. Time acts through and in the Present! It makes itself visible only in the Present. The Future acts and reveals itself through the Present. It is through the Present that time , that is that, the Future enters into union with human life. Time and humanity meet and unite in the Present. It is in the Present that time, that the Future becomes a part of human life, and so is born and lives and dies in human life.

The Past in turn, comes from the Present. We cannot say that it embodies the Present, on the contrary, time in issuing from the Present into the Past becomes invisible again. The Past does not embody the Present, rather it proceeds silently, endlessly and invisibly from it. The Present therefore, comes out from the invisible Future. The Present perpetually and ever newly embodies the Future in visible audible livable form and returns again into the invisible time in the Past. The Past acts invisibly. It continually influences us in regard to the Present. It casts light upon the Present. That is its great function. It helps us to live in the Present which we know, and with reference to the Future which we expect to see!"

Now again re-read this paragraph, but this time the following words will be replaced in the same article,

GOD will now replace the word TIME
FATHER will now replace the word FUTURE
SON will now replace the word PRESENT
HOLY SPIRIT will now replace the word PAST

Now replacing those words read the same paragraph,

"The Father is the source! The Father is unseen, except as He continually embodies Himself and makes Himself visible in the Son. The Son is what we see and hear and know. He is ceaselessly embodying the Father, day by day, hour by hour, moment by moment. He is perpetually revealing the Father, hitherto invisible. The Father is logically first! And yet, NOT chronologically first. For the Son exists as long as God exists, and was in the absolute beginning of God.

The Son has existed as long as God has existed. God acts through and in the Son! He makes Himself visible only in the Son. The Father acts and reveals Himself through the Son. It is through the Son that God , that the Father enters into union with human life. God and humanity meet and unite in the Son. It is in the Son that God, that the Father becomes a part of human life, and so is born and lives and dies in human life.

The Spirit in turn, comes from the Son. We cannot say that He embodies the Son, on the contrary, God in issuing from the Son into the Spirit becomes invisible again. The Spirit does not embody the Son, rather He proceeds silently, endlessly and invisibly from the Son. The Son therefore, comes out from the invisible Father. The Son perpetually and ever newly embodies the Father in visible, audible, livable form and returns into the invisible God in the Spirit. The Spirit acts invisibly. He continually influences us with regard to the Son. He casts light upon the Son. That is His great function. He helps us to live in the Son which we know, and with reference to the Father which we expect to see!"

"That is not a simile or metaphor. That is an exact geometric analogy. And furthermore, it is the divine Hand of the Triune Jehovah: Father, Son and Holy Ghost."

The above display is a perfect representation of the Trinity and God's fingerprint upon the facet of time.

The evidence for the trinity abounds in the universe. Therefore it would be logical to conclude that anything that operates functionally on the concept of time is a direct creation from the Holy Trinity, in such case the concept of the biological rhythm.

The circadian rhythm is a complex nano-technology that is only now being slightly understood.

Yet, unscientific explanations of its origins abound with the underlying assumption that somehow this technology horizontally evolved. As such, subscribers of **JHR** frequently study further into the topics given in these entries, many of which are linked to journals, which have a firm belief in evolutionism.

When conducting further research in these topics, the authors of **JHR** recommend a method we call, *"chewing up the meat and spitting out the bones".* This entails the ability to recognize legitimate scientific research amidst affirmed evolutionary religious zeal, and learning to omit such linguistics.

Often the evolutionary paradigms overshadow scientific papers. However, it is possible in such research papers, for legitimate science to be detailed. We recommend, subscribers of **JHR** learn how to "*spit out the bones,*" so to speak.

As such, I felt it necessary to show some basic flaws in the analytical reviews given by such scientists in their subsequent journal entries. The successive statements are taken from ***"****Circadian rhythms in a nutshell."* The following dialogue will entail an imaginary reactionary conversation between the author of this journal entry and myself. The author begins by giving a brief description of the circadian rhythm, followed by his explanation of its origins. The conversation will be taken up at this point.

"But how did clock mechanisms arise?"

From the onset we see the paradigm indoctrination. There is no scientific reasoning, as we shall see, that the mechanism "arose" yet it is referred to as a verb usage of past tense as matter of fact, with no ulterior possibility.

*Learn to instantly recognize this standard mentality when reviewing such papers.

"Again we can only speculate."

…Speculation, which is based on nothing tangible to current observable evidence.

Speculation, although permissible to consist of somewhat vague parameters, does require some initial logical flow from which predictions can be made, none withstanding to the following absurd scenario.

"A *hint may be offered by the conserved molecular logic underlying circadian oscillators. As noted above, compelling evidence strongly suggests that all circadian clocks are based on periodic oscillations in contrast to a more hourglass-type of mechanism that has to be turned over every day. It is possible that primitive cells exhibited "spontaneous" oscillations in the levels of macromolecules, perhaps driven by changing rates of synthesis and destruction."*

Notice the indoctrinated vantage point:

1. Primitive cells that exists only in the imagination. Discussion of irreducible complexity of the cell will not be investigated at present, due to relevance to the topic of hand, but nonetheless is an intricacy that dictates the complexity of the cell and renders the combining of the terms “primitive” and “cell” an oxymoron. The cell and its mind-boggling intricacy is a mockery of the word *primitive*.

2. However, we do observe that even cells succumb to the circadian rhythm, yet these functions are already fully in place. So that even the simplest of cells already exert these complex functions. And the speculation of the evolutionary perspective is devoid of one shred of evidence for the rhythms “arise”.

The author then continues creating make-believe scenarios based around completely fantastic circumstances that have no basis in reality.

Oscillation in relation to the circadian rhythm encompasses brain regions or organs where endogenous rhythms are generated, and the rhythm is then transferred to the rest of the body either by neuronal or hormonal means, the description of which is another entry by itself. But the author describes the observable features of the current cellular circadian rhythms in their obvious state of rythmatic organization, and then refers to the primitive cellular development of these functions as essentially spontaneous?!

“Whatever the early driving force(s), from our present vantage point it appears that the most critical property of circadian clocks under natural conditions is that they can be reset by external time cues.”

Note that evolution is always “driven” by a “force” (it is also often described as “designing”), like some unseen law of the universe that “creates”. Yet in reality it is an intangible force that is based on “just-so” stories of impeccable timing and borderline dementia. The author’s delusions of grandeur are overwhelming.

Does this mean the biological clock is not adaptable? Of course not; zeitgebers are evidence against that. But adaptability of an existing organized utility does nothing for the explanation of its original assimilation from a previous state of nothingness. (See: Analysis of the Two-Process Model Of Sleep)

“This property was not merely selected so that we could avoid perpetual jet lag following transmeridian flight. Rather, the ability to anticipate environmental changes enables organisms to organize their physiology and behavior such that they occur at biologically advantageous times during the day”

Again, evolution is given “god-like” creative powers. The above paragraph only states the purpose of the biological rhythm, not at all how it originated or self-organized. And this is a notorious outflow of their conjectures. Evolutionist will often propose the purpose of a function, as evidence of their predictions, as though that is confirmation to substantiate their outrageous genesis stories.

In other words, the best evidence for evolution is: *"it exists, that proves it evolved!"*

That is not how scientific predictions are calculated and formed.

"In addition, a second function that is widely regarded as important is that these endogenous timekeeping devices also serve to impose internal alignments between different biochemical and physiological oscillations."

Once again, the importance of the rhythm is explained, with absolutely no relevance to its proposed origin.

Scanning electron micrograph of a mutant fruit fly with leg antennae

"With this in mind we can appreciate why circadian rhythms are observed at all levels of cellular organization."

All that is appreciated is that vertical evolution, or the addition of new genetic information from a previous state of non-existence, is unfounded. And again, the author notes the universal attributes of the rhythm at all levels of life, yet can give no explanation to the origins of such devices!

Even in the fruit fly, mutations of the genes responsible for its circadian rhythm can either speed up or slow down the clock, giving flies with days of 20 or 28 hours. Alternatively, mutations can destroy altogether the ability of a fly to be rhythmic.

A fly's body therefore consists of a series of independent clocks, which must in life be synchronized by endocrine, neural, and other linkages. Recent studies (1) have revealed the intricacies of this biological timing mechanism in mammals, and questions arise such as whether every cell in the body has the potential to be a circadian clock. And if so, how do they talk to each other (as you can see we are only now touching the vast complexity of this specialized system!)?

Yet, chance mistake mutations are what are attributed to the primal driving force of vertical evolution.

"There are daily oscillations in the levels of enzymes and hormones that affect the timing of cell function, division, and growth. Physiological parameters such as body temperature, immune responses, digestion, susceptibility to anesthesia, and dental pain threshold (the best time to go to a dentist is in the afternoon) all undergo cyclic changes peaking at fixed times during the day. Our visual and mental acuity fluctuate during the day, affecting complex behaviors."

Translation- The circadian rhythm is absolutely vital to all levels of life. Without it daily functioning of life is impossible. Yet, it arose from a state of nothingness, defying all observation, empirical evidence, and basic logic.

"...Conclusions
Incredible progress has been made in understanding the molecular and cellular bases of circadian rhythms, and this is sure to continue at a rapid pace."

And yet no understanding of how it evolved is given.

"The further we peer into the clockworks of a growing number of model organisms, the more we are struck by two seemingly opposing viewpoints; namely, within the apparent constraints of striking similarities are embedded radical differences. Whether this reflects divergent or convergent evolution (or something else editors note: i.e., Intelligent design) is a discussion for another time."

"However, understanding the molecular logic underlying the differences in these oscillatory networks will give us insights into how different species adapted to life on our rotating planet."

...The author then goes on to describe horizontal adaptation, which is observable, and is completely reliant upon the already in place, biological rhythm, devoid of providing any material evidence for evolutionism.

The proof of the Triune God's handiwork is scattered throughout the universe, with the chronobiological clock being just one such phenomena amidst the literal billions, so that, *"since the creation of the world God's invisible qualities--his eternal power and divine nature--have been clearly seen, being understood from what has been made, so that men are without excuse."* Rom. 1: 20.

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