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Articles

Departments

Haec Credimus

For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested on the seventh.—Exodus 20:11

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Magnetic Orbital Decay of Solar-Type Binaries and Creation Implications

Ronald G. Samec, Amber Olsen, Christopher Gray, Ropafadzo Nyaude, James Kring, Jeremy Clark, T. Shebs, and Heather Chamberlain

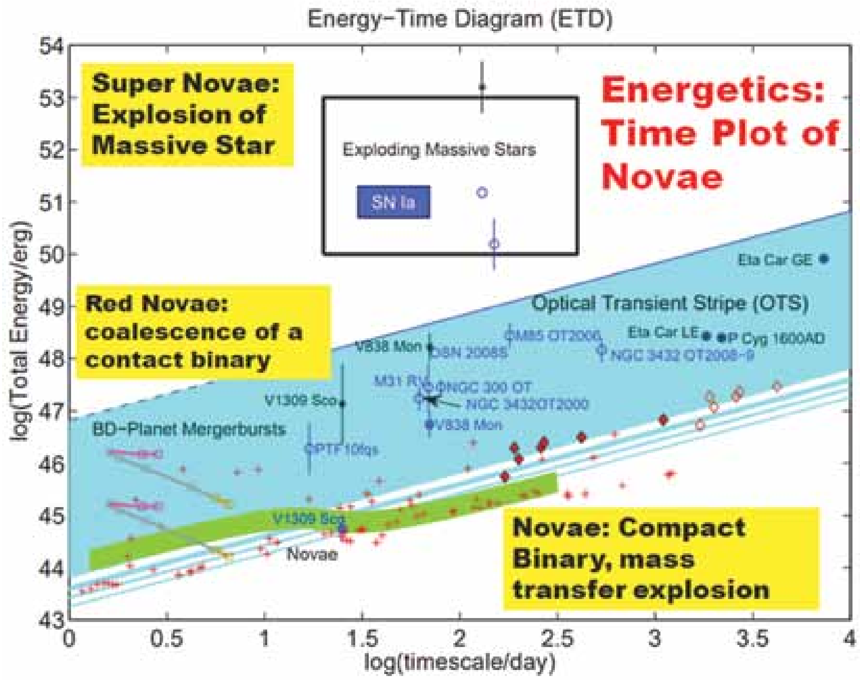
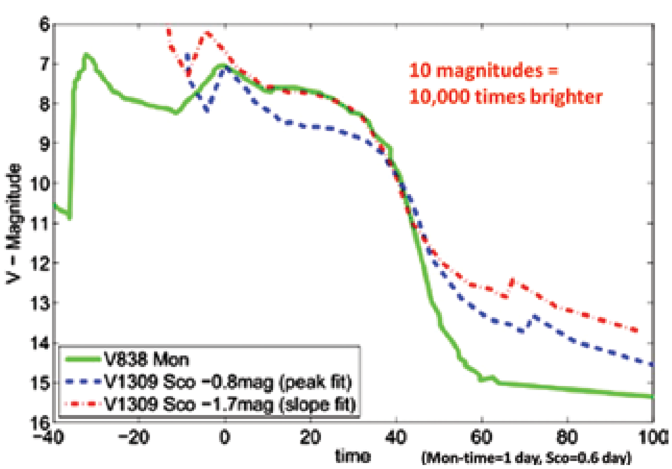
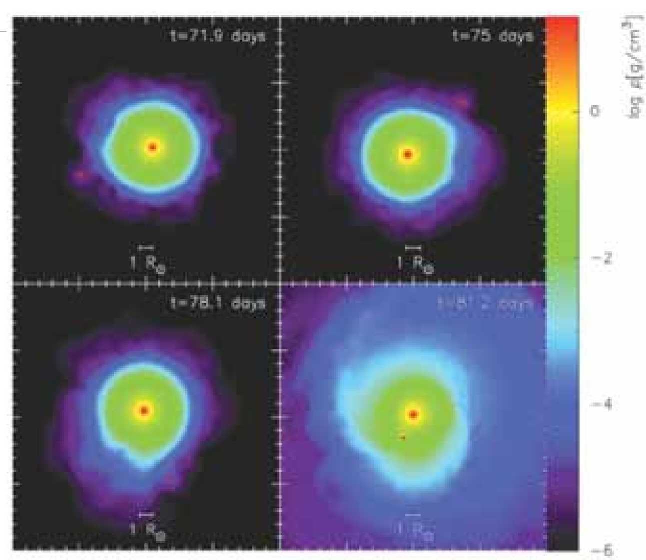


Figure 34 *(above)*. Energetics Time Plot of Novae comparing Super Novae, Red Novae, and Classical Novae. Note the energetics and the duration. (Kashi and Soker, 2010)

Figure 35 *(below left)*. The Observed Light Curve. Mon-time=1 day, Sco=0.6 d., arXiv:1011.1222, Amit Kashi, Noam Soker.

Figure 36 *(below right)*. The progression of a red novae. Follow left to right and up-down (explained in the text). (Nandez, Ivanova, and Lombardi, Jr., 2014)





Abstract

This study spins off the previously funded project from the Creation Research Society (CRS) entitled "The Apparent Age of the Time Dilated Universe: Gyrochronology, Magnetic Orbital Decay of Close Solar-Type Binaries" and the CRS undergraduate research initiative, allowing undergraduate mentors and their research students to request research grants from the society research committee. Our project involves answering the creation *time-dilation* cosmology question, "What maximum apparent age should be used to characterize the universe?" The basis for this part of the study centers on eclipsing binaries undergoing a clearly decaying orbit indicative of magnetic braking. This gives dP/dt (days/year) term where P (days) is the orbital period of the binary. From this, and the initial period of the binary, a *decay age* estimate is possible. Systems included in this study include eight recently analyzed by students, include the binary systems, V1695 Aquilae, NSVS 1083189, NSVS 10541123, V530 Andromedae, NSVS 5066754, FF Vulpeculae, GSC 3208 1986, V573 Pegasi, V1187 Herculis, GQ Cancri, and MT Camelopardalis. In addition, evidence of binary star coalescence into single stars and the subsequent and violent production of *red novae* will be reviewed. Young Earth Creation implications will be explored.

Introduction

This study spins off the previously CRS funded project, "The Apparent Age of the time Dilated Universe: Gyrochronology, Magnetic Orbital Decay of Close Solar-type Binaries" (Samec, 2016—hereafter referred to as Paper 2; Samec and Figg, 2012—hereafter referred to as Paper 1). In *Samec*-2, it was determined that binary evolution is taking place nearly 400 times faster than what was theorized. Observations have continued as a part of the CRS undergraduate research initiative, allowing undergraduate mentors and their research students to request research grants from the society research committee. Our project involves answering the creation *time-dilation* cosmology question, "What maximum apparent age should be used to characterize the universe?" The basis for this part of the study centers on eclipsing binaries undergoing a clearly decaying orbit indicative of magnetic braking. This gives dP/dt (days/year) term where P (days) is the orbital period of the binary. If an initial period of the binary is assumed, a *decay age* estimate is possible.

In paper 2, we extended the study to include longer-period solar-type binaries that were still undergoing continuous orbital decay (Samec et al., 2012a, 2012b, 2013, 2014, 2015). As a result, it was assumed that 5 days was the initial period for binaries that now have periods of 0.2–0.5 days. Furthermore, we assumed 8 days as the initial period for binaries that now have periods of 0.5–0.8 days, 10 days as the initial period for binaries that now have periods of 0.8–1.5 days, 15 and 20 days as the initial period for binaries that now have periods of 1.5–9.3 days. However, the periods of all of the binaries in this particular study are within the range of 0.3–0.6 days, intimating that we are only working with the short period end.

In a recent paper (Rucinski, 2017), a study was made of solar-type binaries of the OGLE project in Baade's Window. He found that the cut off of W Ursae Majoris (W UMa) type binaries (in this context, those undergoing angular momentum loss as well as other characteristics of this group) extend only

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to periods of ~1.5 days while the longer period types are a different group of binaries. In paper 2, plots and information from the benchmark paper (Guinan and Bradstreet, 1988) on these systems theorized that ~5 days was the limiting period for magnetic braking. In addition, Yildiz (2013) found in his "Origin of W UMa-type contact binaries…" study that the initial period of these binaries is less than about 4.45 days. Thus, the estimates of ages given in paper 2 could be regarded as an upper limit. I note that these papers again verify the assumption that these binaries are ancient. Mean ages of these contact binaries are found as 4.4 and 4.6 Gyr respectively. From kinematic studies, these ages are given as 4.5 and 4.4 Gyr respectively. The kinematic ages have to do with the space motions (velocity dispersions increase with age) and the other has to do with normally accepted stellar evolutionary treatments, such as the evolution on the H-R diagram. We have no problems with the kinematic interpretation save the long ages, which again are substantiated by accepted stellar ages (please see "Solar Age Condition" [the prevailing assumption of a 4.603 x 10^9 years or 4.603 Gyr age Sun] in paper 2).

Magnetic Braking

This is only a brief review. For a more extensive explanation, see papers 1 and 2. Solar-type stars (roughly type F-V to M-V) have deep convective envelopes made up of swirling plasmas that are magnetic in nature with strong dipole magnetic fields and magnetic phenomena, notably star spots. Stellar plasma winds escape the North and South poles out to the Alfven radius of the stars (about 15–30 solar radii Goelzer et al., 2014). This allows the transport of charged mass particles on stiffly rotating magnetic field lines spinning with increasing radii, with increasing angular momentum into space, L=mvr. This continuously removes angular momentum, ΔL, from the binary causing angular momentum loss (AML). This effectively torques the star, $\tau = \frac{dL}{dt}$. For a single star (see Figure 2), it causes the the rotation to slow, finally leaving a slowly rotating star (from periods of a few days to about a month) like our present sun. For a solar-type *binary* system (two stars co-orbiting about a center of mass or barycenter), the same magnetic braking occurs but the orbital radius shrinks and, by Kepler's third law, the orbital period shortens (see Figure 3). When the atmospheres of the stars touch, the stars are called contact binaries. The stars continue to coalesce until they violently form, by a *red novae event* (discussed later in this paper), fast-rotating single stars such as A-type stars or subgiants, similar to the spotted FK Comae stars in globular clusters. The orbital period P_{orb} (days) is related to the stars' angular momentum by the relationship, $L_{orb}=1.242 \times 10^{52}\, q(1 + q)^{-2}(M_1+M_2)^{5/3}\, P_{orb}^{\ 1/3} cm^2 gm/s$, where q is the mass ratio M_1/M_2 of the primary star (more massive, M_1) and secondary star (less massive, M_2), each expressed in Solar units (Guinan and Bradstreet, 1988). We used such angular momentum loss to determine star ages in paper 1.

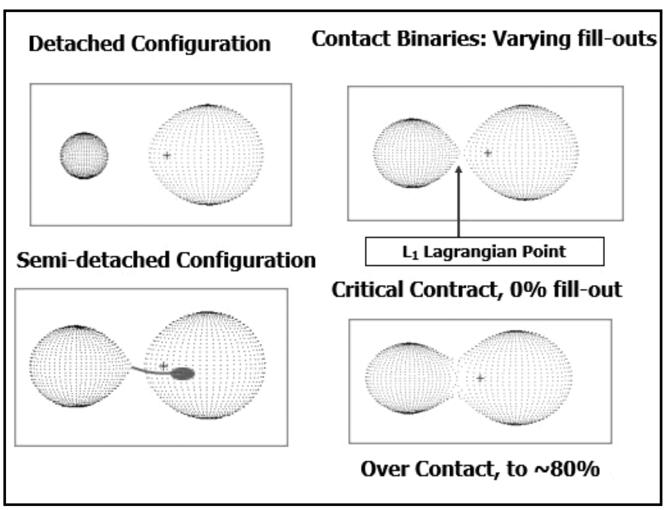

Figure 1. Some of the configurations of eclipsing binaries. The Ellipsoidal configuration is not shown (where no eclipse takes place but a light curve variation is present regardless as the binary rotates due to the non-sphericity of the stars). In the semi-detached configuration, a stream can arise from the so-called L_1 *point* to stream to the other star creating a hot stream spot.

Configurations (Definitions)

Binary stars may be found in various configurations. We will describe them in the context of magnetic braking. The stars begin separated as depicted in the upper left picture of Figure 1. As the binaries approach each other, one star will fill its Roche-lobe (bottom left). However, in normal evolution, the more massive star will fill its Roche-lobe first (the opposite is occurring in Figure 1). This configuration is one of the *semi-detached* states. This is also called a V1010 Oph configuration (after its prototype). Stars expand as they burn their nuclear fuels. When the stars have undergone two episodes of mass exchange (the Algol Paradox) due to normal nuclear evolution, the larger component has filled its Roche-Lobe and the smaller star is finally near filling its own lobe. This is also a semi-detached situation which is called an *Algol* configuration.

When contact is just made by both stars, the configuration is in critical contact, which is simply called a *contact binary*. As the degree of contact (defined as *fill-out* which may go from 0 to ~80%) increases, it is called an *over-contact binary* (also called *W UMa binaries*). In these cases, the mass ratio M_1/M_2 becomes more extreme, tending to smaller and smaller values. When the mass ratio drops to about 1/5, this configuration is an *extreme mass ratio binary*. Light curves of this type have certain characteristics (see Recent Work sections).

The Age of the Binary

In this paper, as in paper 2, we have decided to use the simpler, but more accurate, approach using the period and the dP_{orb}/dt rather than the L_{orb} and the dL_{orb}/dt. The quantity $Q=dP/dE$ is determined as a matter of course in period studies from the calculated quadratic *ephemeris* equation:

$$T\ (HJD)= -QE^2 + PE + T_0. \qquad (1)$$

This equation predicts the next eclipse timing T in Heliocentric Julian Days (HJD), which happens after so many epochs, or orbits, E, added to the initial eclipse timing, T_0, with a quadratic term, Q (the "deceleration" term in days/epoch/epoch or d/E^2), and P is the orbital period in days. "Helocentric" means that light time corrections were made to correct the observed times so that observation times are measured from the *center of the Sun*. There is a light time correction of up to ~16 minutes due to the fact that the time for light to travel from the earth (the observer's position) to the sun is ~8 minutes. In this paper, the ephemeris is given for each system analyzed and a plot is also given depicting the orbital period decrease. And this is related Q to dP/dt by the formula:

$$Q= \frac{dP}{dE} = \frac{1}{2}\frac{dP}{dt} \cdot \frac{P}{365.24} \qquad (2)$$

This equation converts days/epoch (dP/dE) to "normal units," (dP/dt) days/year. The method only assumes that the chosen systems have a continuous, quadratically decreasing period as the observations show during the observational interval. The quantity, ΔP, is the difference in the present orbital period of the binary minus its initial period. The quantity, dP/dt, is the rate of change in the period, = $\dot{P}$, equation (2). The age, Δt, of the binary system is then given by

$$\Delta t = \frac{-\Delta P}{\dot{P}} \qquad (3)$$

Recent Work (This Paper)

In 2015–2019 (publication dates), we have continued this work. During this interval of study, some 80% of the solar-type systems

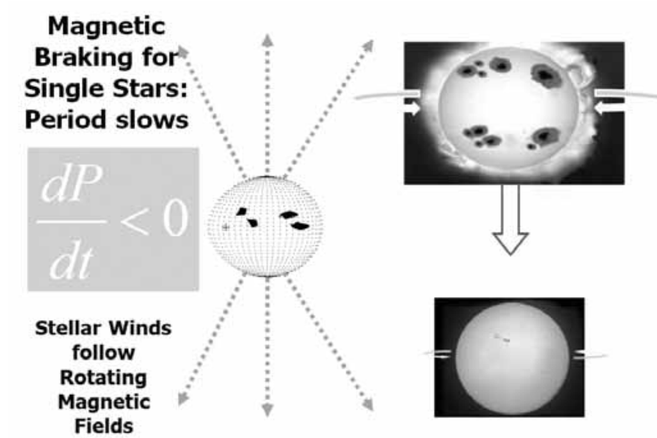

Figure 2. Depiction of single solar-type stars undergoing magnetic braking leading to angular momentum loss (AML). Plasmas leave along North and South Magnetic field lines causing young, magnetically active stars (spotted star in the upper righthand corner) to spin down and become slow rotating stars like our Sun with its ~27-day rotational period.

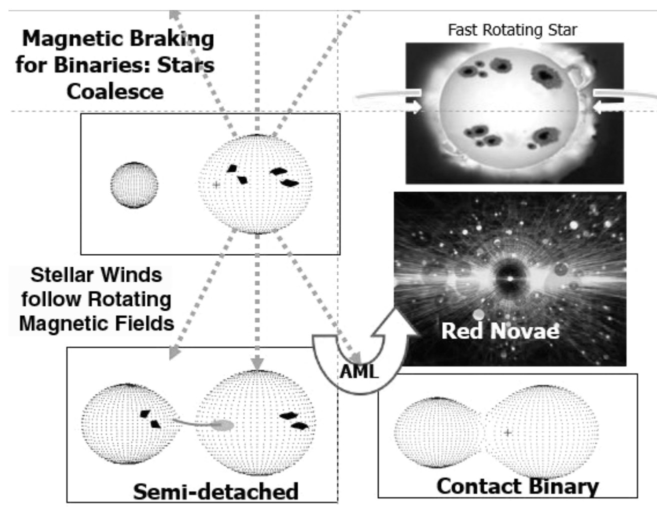

Figure 3. Depiction of a binary star made up of two solar-type stars undergoing magnetic braking which results in angular momentum loss (AML). Plasmas leave along North and South Magnetic field lines cause the magnetically active binary (detached spotted binary in the upper left-hand corner) to lose angular momentum and steadily fill their Roche-lobe and move to a semi-detached and then a contact binary configuration. The binary becomes unstable and a red novae event erupts finally resulting in a fast-rotating single star.

analyzed showed continuous period decreases. These include V1695 Aquilae, NSVS 1083189, NSVS 10541123, V530 Andromedae, NSVS 5066754, FF Vulpeculae, GSC 3208 1986, V573 Pegasi, MT Camelopardalis, and V1187 Herculis. A brief summary of each is given here for each binary. The prime work done directly for the CRS research grant was done in 2016 and 2017 by my research students, C.R. Gray and Amber Olsen at Emmanuel College. D. Maloney and R. Nyauadi were research students in the previous year. D. Maloney's star did not have enough past data available to do a reasonable period study. The other work summarized here is in addition to the paper 1 and paper 2 papers to bring this research up to date for completeness and publication. Much of the material in this paper was all reported at the 2017 Creation Research Society Meeting at Bob Jones University.

V1695 Aquilae

CCD, BVRI light curves of V1695 AQL were taken during the Fall 2016 season at the Cerro Tololo Inter-American Observatory with the 0.6-m reflector of the SARA South Observatory in remote mode. It is an eclipsing binary with a period of 0.4128406d. The light curves yield a total eclipse (duration: 51 minutes) but have an amplitude of only ~0.3 mags. The spectral type is ~G8 (~5500 K). Four times of minimum light were

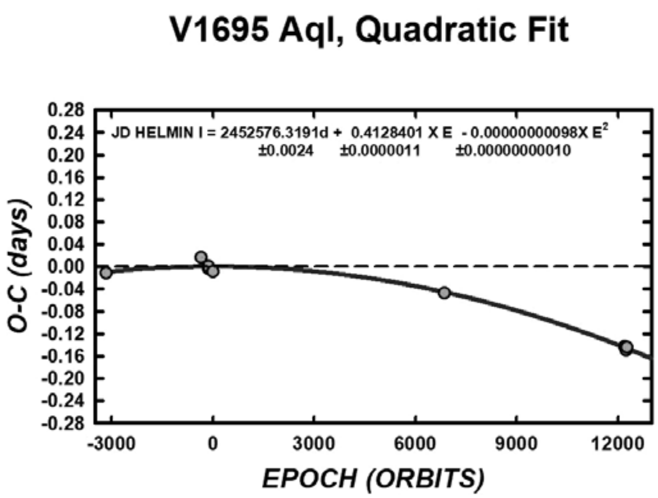

Figure 4. O-C Residuals from the Quadratic Ephemeris of V1695 Aql.

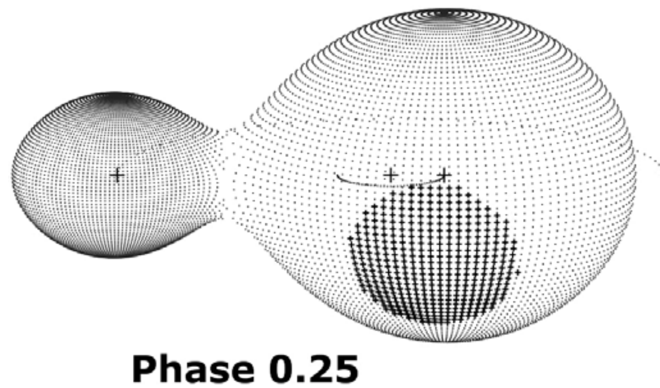

Figure 6. Geometrical Representation at phase 0.25 of V1695 Aql.

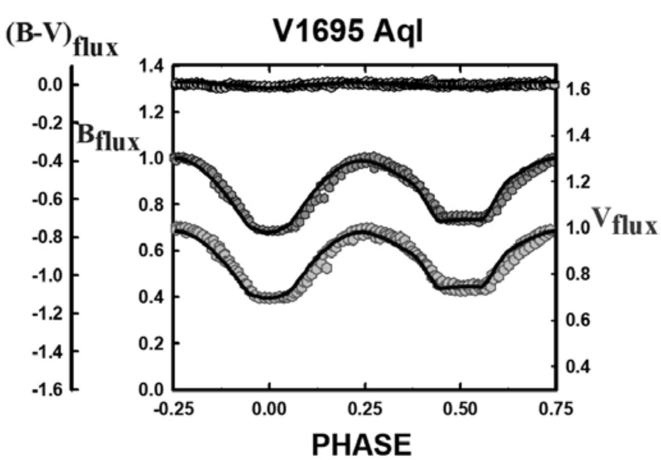

Figure 5. V1695 AQL, B,V Normalized Fluxes overlaid by our solution of V1695 Aql.

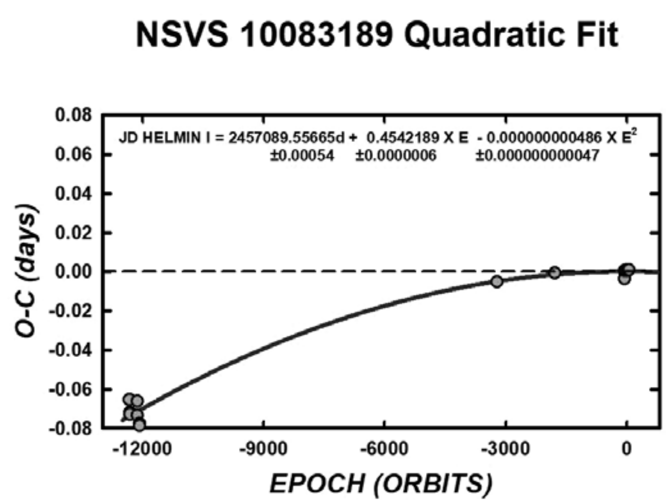

Figure 7. O-C Residuals from the Quadratic Ephemeris of NSVS 1083189.

calculated—all primary eclipses from our present observations. The period study result follows. (In this paper, the quadratic ephemeris is displayed in the residual plots.)

The 14-year period study reveals a period decrease in the orbital period at a high level of confidence. Thus, the binary is coalescing due to angular momentum loss. The solution is that of an Extreme Mass Ratio Binary. The mass ratio is found to be only 0.15. Its Roche-Lobe fill-out is a hefty 43%. The secondary component has a temperature of ~5800 K, which makes it a W-type W UMa Binary. As expected in binaries of this type, it has cool spot regions. The light curve solution for the B,V curves is shown.

NSVS 1083189

Precision BVR$_c$I$_c$ light curves of NSVS 10083189 were taken on 10 nights in 2015 at Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University and on 1 night on the SARA 1-m reflector at Kitt Peak National Observatory (KPNO) in remote mode. It is an ~F8V eclipsing binary with a period of 0.4542238 (2) d. Seven times of minimum light were calculated. In addition, seven observations at minima were determined from archived NSVS Data. A statistically significant quadratic ephemeris was calculated.

Analysis with the Wilson-Devinney program led to a near, but non-contact, configuration (larger component filling its critical lobe and the secondary underfilling). This may indicate that NSVS 10083189 is coming into contact for the first time. Our semi-detached, near contact solution, gave a mass ratio of

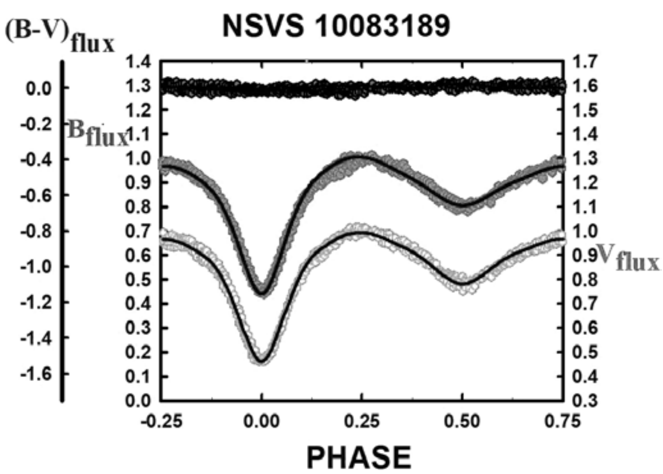

Figure 8. NSVS 1083189, B,V Normalized Fluxes overlaid by our solution.

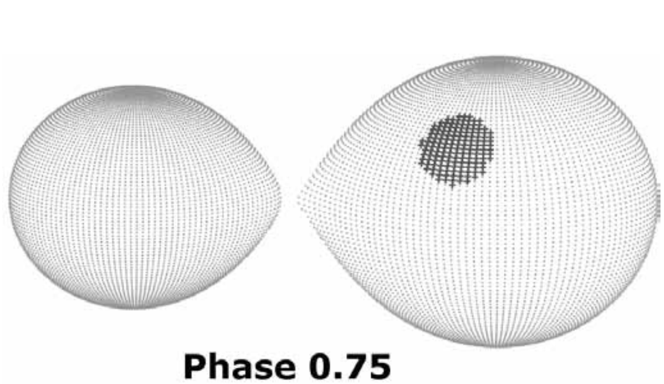

Figure 9. V1695 AQL, Geometrical Representation at phase 0.75

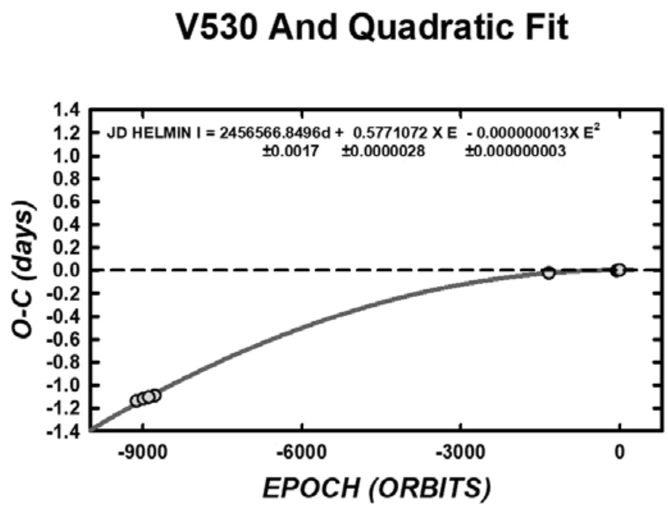

Figure 10. Quadratic O-C residuals from the period study.

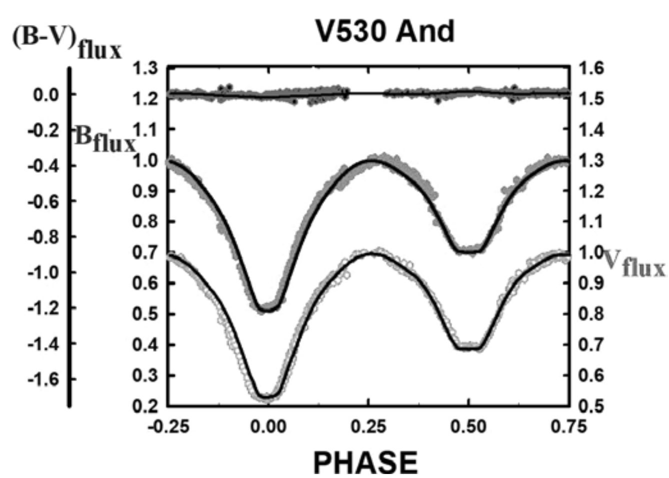

Figure 11. B,V synthetic light curve solutions overlaying the normalized flux curves.

0.58, with temperatures of 6250 and 4573 K. A 15° radius cool spot with a t-factor of 0.85 was determined on the primary star. The fill-out of the secondary star was 99%.

V530 Andromedae

We follow up on our single coverage UBVRcIc light curves and analyses from 2011. Our present UBVRcIc light curves with ample coverage were taken on October 2013, November 2013, and January 2014 with the Dark Sky Observatory 0.81-meter reflector of Appalachian State University. They reveal that the early-type V530 A as a totally eclipsing shallow or critical contact solar-type binary rather than a semi-detached near-contact one. In our extended period study, over a 14.25-year interval, we found a continuously decreasing period. This fits the scenario of magnetic braking for solar-type binaries. The temperatures of the primary and secondary components are estimated at 6750 and 6030 K, respectively. The component temperature difference is large for a contact binary. The fill-out, however, is a mere 5%, so it just passes critical contact. The mass ratio, M_2/M_1, was found to be 0.386. Two star spots, probably magnetic in origin, were determined. We suspect that the binary has recently achieved physical contact for the first time.

NSVS 5066754

BVR_cI_c light curves of NSVS 5066754 were observed on May 2014 at Dark Sky Observatory in North Carolina. It is a

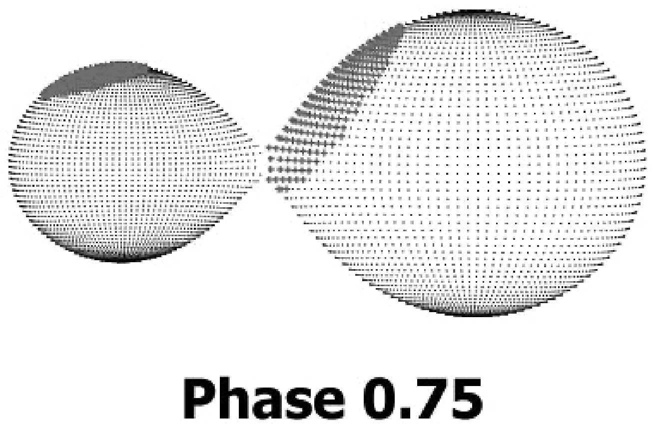

Figure 12. Roche-Lobe surfaces from our BVRI solution, phase 0.75.

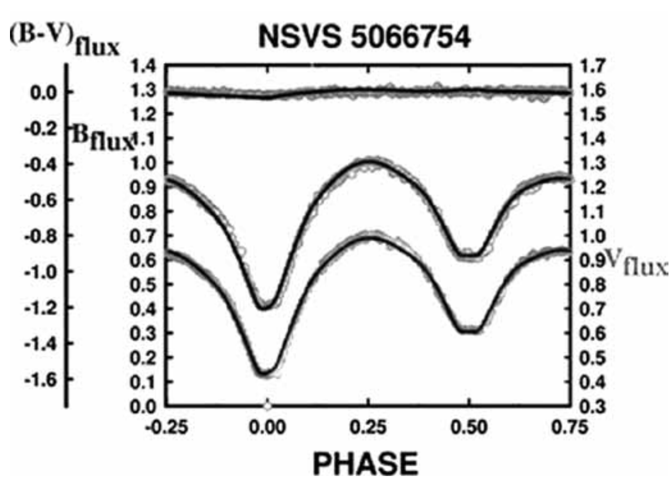

Figure 14. NSVS 5066754, B,V Normalized Fluxes overlaid by our solution of NSVS 5066754.

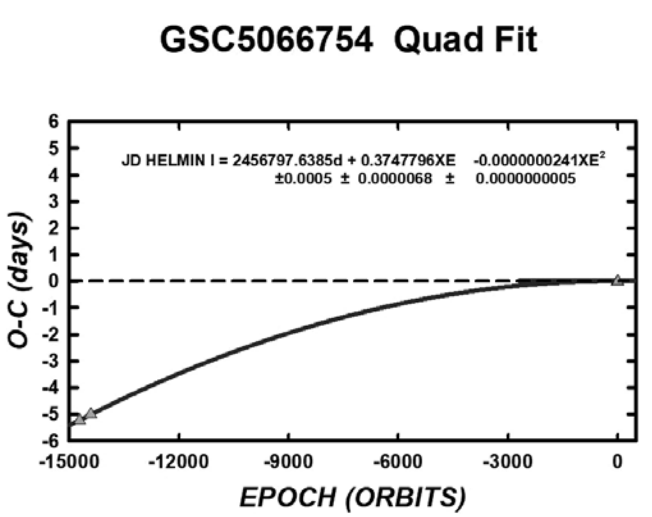

Figure 13. Quadratic O-C residuals from the period study.

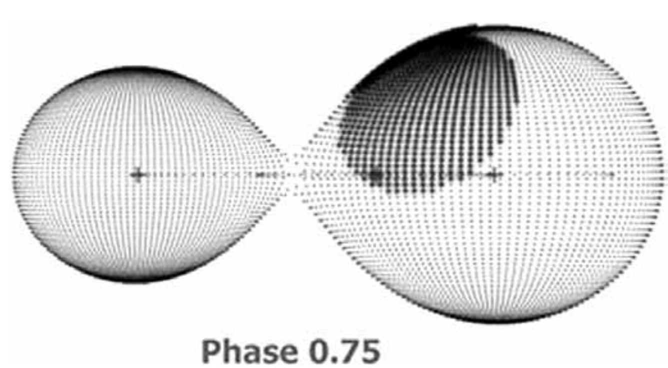

Figure 15. NSVS 5066754, Geometrical Representation at phase 0.75 of NSVS 5066754.

solar-type eclipsing binary (T_1~5750 K) with a period of only 0.3751689(1)d. In fact, it appeared as one of the shortest periods in Shaw's list of near-contact binaries (Shaw 1990, 1994). The Binary Maker fits and our Wilson-Devinney solutions show that the binary could have semi-detached or contact binary configurations.

Five new times of minimum light were calculated, along with two minima determined from archived All Sky Automated Survey observations. From these minima, plus the discovery epoch, a quadratic ephemeris was determined, so a magnetic braking scenario is hypothesized.

The contact solution that has the best sum of square residuals gave a mass ratio of 0.50, and a component temperature difference of ~360 K—somewhat large for a contact binary. Two substantial cool spots were determined in this solution of 48% and 28% radii with a t-factor or 0.94 and 0.78 respectively. The fill-out is very shallow, ~6%.

FF Vulpeculae

High precision BVR_cI_c light curves of FF Vul were observed during the Fall 2015 season with the Dark Sky Observatory 0.81-m reflector of Appalachian State University, and the SARA North 0.91-m reflector at KPNO. It is an eclipsing binary with a period of only 0.444983 (2) d. Our Wilson-Devinney solution shows that the binary is a near-contact, semi-detached binary

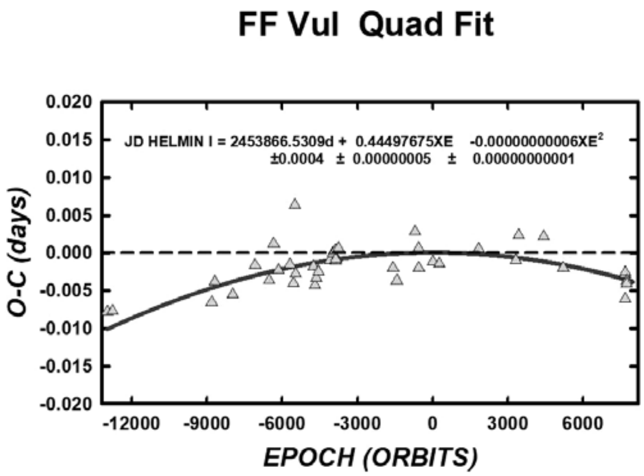

Figure 16. The period study covers over 20 years and shows that a period is decreasing (at about the 6 sigma level).

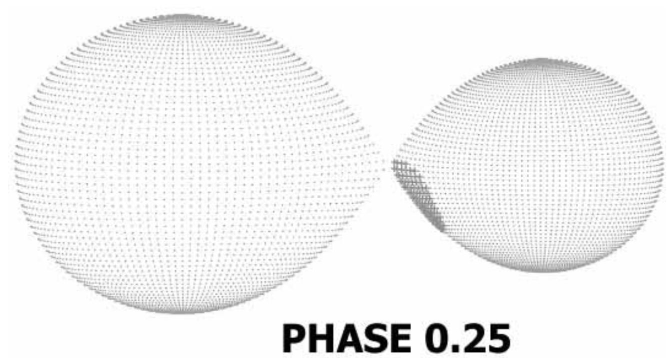

Figure 18. FF VUL, geometrical representation at phase 0.24 of FF Vul.

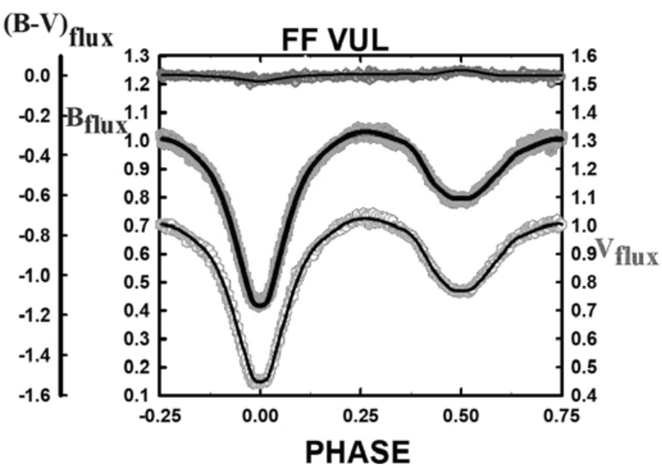

Figure 17. FF VUL, B,V Normalized Fluxes overlaid by our solution of FF Vul.

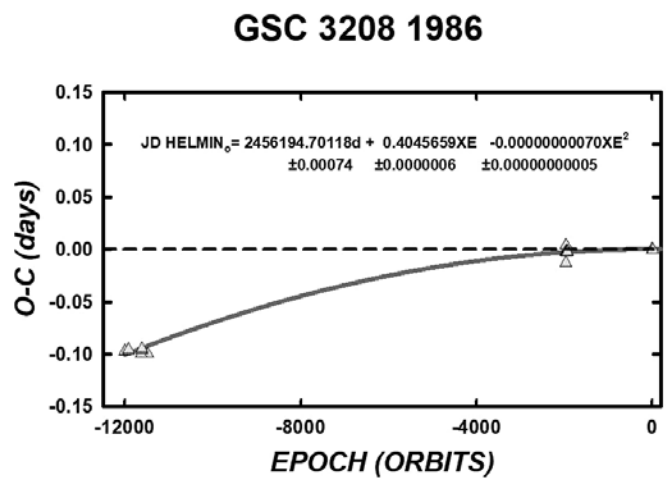

Figure 19. Quadratic O-C residuals from the extended period study, JD $HELMIN_0$= 2456194.70118d + 0.4045659 -0.00000000070.

(i.e., a V1010 Oph type configuration). Five times of minimum light were calculated—3 primary and 2 secondary eclipses. A quadratic ephemeris was determined. The period is decreasing.

A near-equatorial hot spot is probably due to matter transferring onto the secondary component. The component temperature difference is more than 1500 K. The solution shows a total secondary eclipse of 23 minutes duration. As expected in binaries of this type, it has a cool spot region on its hotter component.

GSC 3208 1986

GSC 3208 1986 is a NSVS and TYCHO variable, observed in September 2012, at Lowell Observatory, in Flagstaff, AZ. It is a W UMa variable with a period of 0.405 d. The curve is of high precision, averaging some 5 mmag (milli-magnitudes).

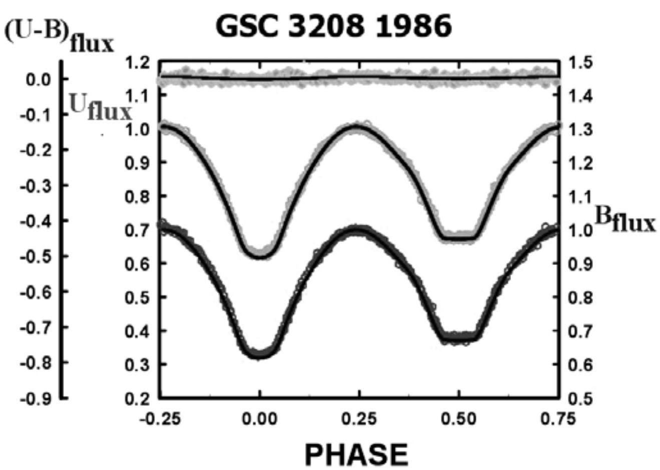

Figure 20. B,V synthetic light curve solutions overlaying the normalized flux curves.

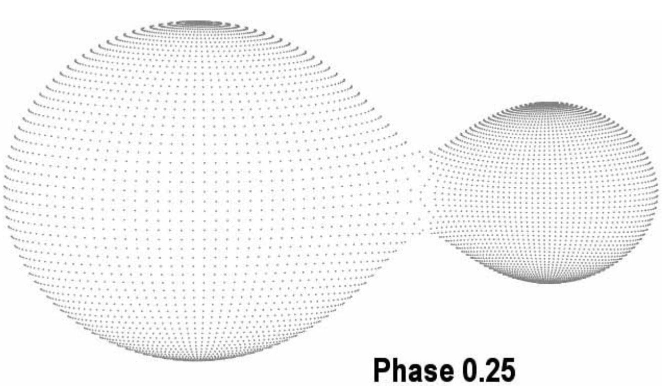

Figure 21. Roche-Lobe surfaces from our $UBVR_cI_c$ solution, phase 0.25.

The amplitude of the light curve is very nearly 0.5 mag. A color index determination by Terrell (2012) gives a F6V type. The linear period determination of 0.4045672 d was done with the available epochs. An early NSVS light curve reveals that the period has been decreasing over its past 12,000 orbits. The binary is evidently undergoing magnetic braking despite its early type. The high inclination of 85° results in a long duration secondary eclipse, lasting some 49.5 minutes. Findings indicate that GSC 3208 1986 is an immaculate (no star spot) extreme mass ratio, q= 0.24, A-type W UMa system.

V573 Pegasi

CCD, VRI light curves of V573 Peg were taken in 2017 on September 26 and 27 and October 2, 4, and 6 at the Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University by the observatory director. V573 Peg was discovered by the SAVS survey which classified it as a V=0.51 amplitude, EW variable. Five times of minimum light were calculated, two primary eclipses and three secondary—from our present observations:

HJD I = 2458023.6420±0.0012,

2458028.6522±0.0021,

HJD II = 2458022.5991±0.0011,

2458023.8510±0.0010 and

2458028.8608±0.0005,

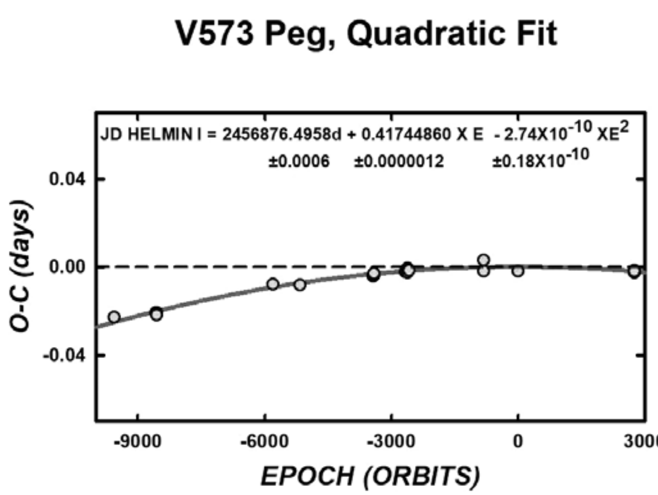

Figure 22. Quadratic O-C residuals from period study, V523 Peg.

The following quadratic ephemeris was determined from all available times of minimum light.

$$JD\ Hel\ MinI = 2456876.4958 \pm 0.0002d + 0.41744860 \pm 0.00000008 \times E - 0.000000000274 \pm 0.000000000012 \times E^2 \quad (4)$$

A 14-year period study (covered by 24 times of minimum light) reveals this orbital period decrease with high confidence, possibly due to magnetic braking. The mass ratio is found to be somewhat extreme, M_2/M_1=0.2629±0.0006 (M_1/M_2=3.8).

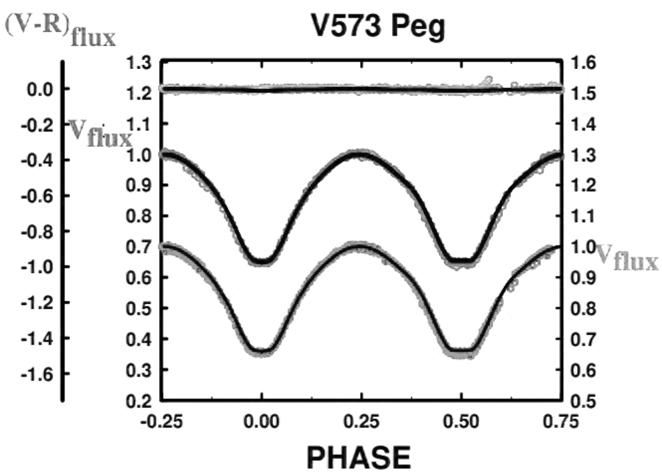

Figure 23. V,R synthetic light curve solutions overlaying the normalized flux curves.

Its Roche-Lobe fill-out is ~25%. The solution had no need of spots. The temperature difference of the component is about ~130 K, with the less massive component as the hotter one, so it is a W-type W UMa Binary. The inclination is 80.4±0.1°. Our secondary eclipse shows a time of constant light with an eclipse duration of 24 minutes.

MT Camelopardalis

We report here on a period study and the analysis of 2017 BVRI light curves of MT Cam (GSC03737-01085). It is a solar-type (T ~ 5500K) eclipsing binary. It was observed for six nights in December 2017 at Dark Sky Observatory with the 0.81-m DSO reflector. Five times of minimum light were calculated from Terrell, Gross, and Cooney, 2016 and 2004 observations (hereafter TGC). In addition, six more times were taken from the literature and 6 were from the present observations. From these 14 years of observations, a quadratic ephemeris was calculated (see Figure 25):

$$JDHelMinI = 24\ 58103.6611\ d + 0.3661389 \times E - 0.000000000041 \times E^2$$
$$\pm 0.00064 \qquad \pm 0.0000003 \qquad \pm 0.000000000021 \quad (5)$$

A BVR_cI_c Bessell filtered simultaneous Wilson-Devinney Program (W-D) solution gives a mass ratio (0.3385±0.0014) very nearly the same as TGC's (0.347±0.003), and a component temperature difference of only ~140 K. As with TGC, no spot was needed in the modeling. Our modeling (beginning with Binary Maker 3.0 fits) was done without prior knowledge of

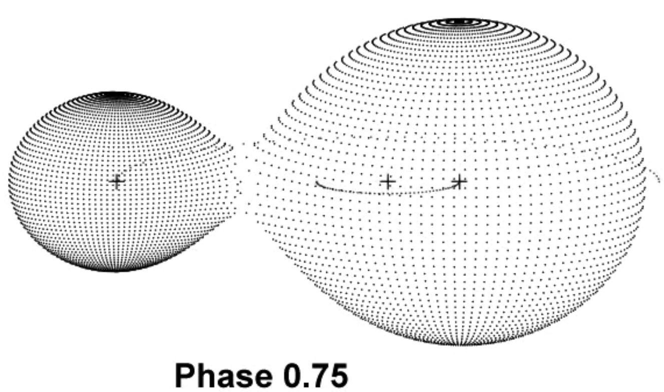

Figure 24. Roche-Lobe surfaces from our VR_cI_c solution, phase 0.75.

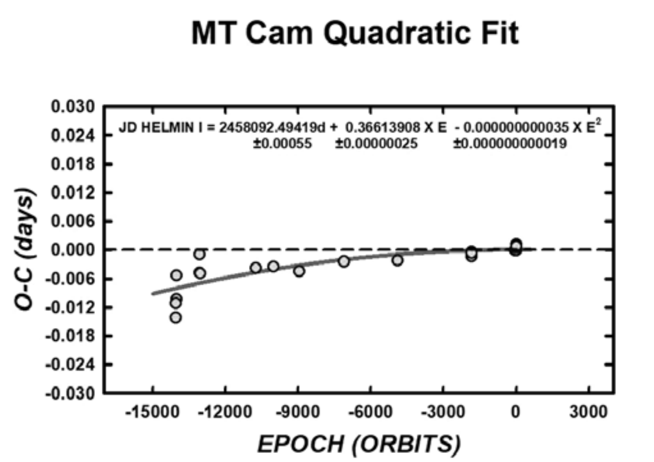

Figure 25. Quadratic O-C residuals from period study, MT Cam.

TGC's. This shows the agreement achieved when independent analyses are done with the Wilson code. The present observations were taken 1.8 years later than the last curves by TGC, so some variation is expected.

The Roche-Lobe fill-out of the binary is ~13% and the inclination is ~83.5 degrees (see Figure 26 and 27). The system is a shallow contact W-type W UMa Binary, albeit, the amplitudes of the primary and secondary eclipse are very nearly identical. An eclipse duration of ~21 minutes was determined for the secondary eclipse and the light curve solution.

V1187 Herculis

CCD, BVRI light curves of V1187 Her were taken in May 2017 at Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University. A spectrum was taken earlier at Dominion Astrophysical Observatory (DAO) with the 1.8m telescope. The spectral type is F8±1V (6250 K) so solar-type activity is expected. V1187 Her was previously identified as a low amplitude ($\Delta V < 0.2$ mag), short period, over-contact eclipsing binary (EW) with a period of 0.310726 d. Strikingly, despite its low amplitude, the early light curves show a total eclipse (eclipse duration: 31.5 minutes). This leads us to believe that the binary is an exceptionally extreme mass ratio binary, perhaps the most extreme known. Four times of minimum light were calculated, from our present observations. An 11-year period study reveals a period decrease in the orbital period with good confidence (see Figure 28). The rate of period change is dp/dt =2.3Í 10^{-07} d/yr, probably due to magnetic braking.

Its Roche-Lobe fill-out is found to be a hefty 79% along with a mass ratio of only 0.0440 ±0.0001, the shortest known among solar-type binaries! It has a cool spot region. The secondary component has a temperature of ~6643±4 K, which makes it a W-type W UMa Binary. The inclination is only 66.85±0.05° despite its total eclipses (see Figures 29 and 30).

NSVS 10541123

NSVS 10541123 is a F2±2 type (T~ 6750K) eclipsing binary. It was observed in April and May of 2015 at Dark Sky Observatory in North Carolina with the 0.81-m reflector of Appalachian State University. Six times of minimum light were determined from our present observations, which include two primary eclipses and four secondary eclipses. In addition, six observations at minima were introduced as low weighted times of minimum light taken from archived NSVS Data.

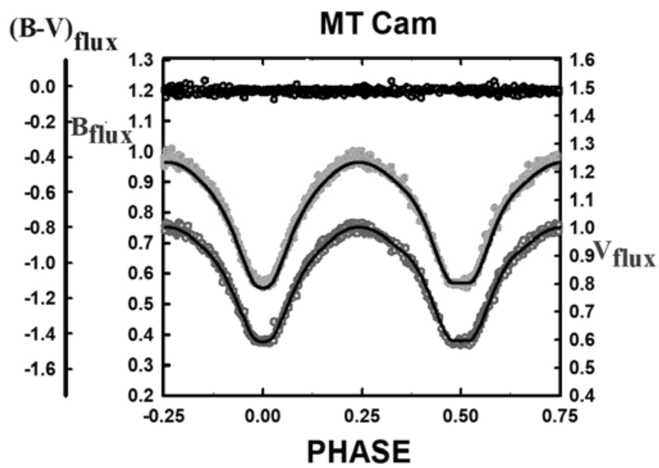

Figure 26. B,V synthetic light curve solutions overlaying the normalized flux curves.

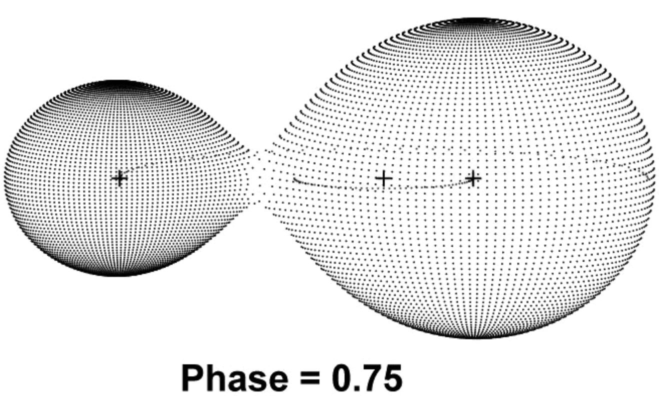

Figure 27. Roche-Lobe surfaces from our BVR_cI_c solution, phase 0.75 of MT Cam.

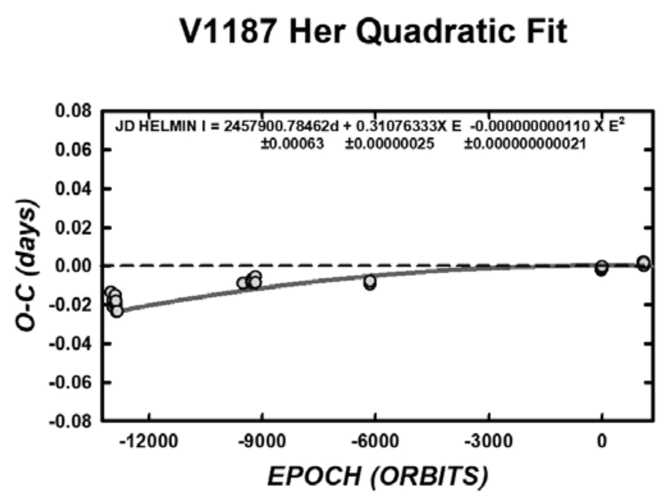

Figure 28. Quadratic O-C residuals from period study, V1187 Her.

Improved linear and a quadratic ephemeris was determined from all available times of minimum light giving a quadratic term -0.0000000043 (12)* (see Figure 31).

The rapid period decrease may indicate that the binary is undergoing magnetic braking and is approaching its contact configuration. A BVR_cI_c simultaneous Wilson-Devinney Program (W-D) solution indicates that the system has a mass ratio (q) of 0.5828±0.0004 (solutions taken from q=0.3 to 1.2 indicates this is the value with the lowest sum of square residual), and a component temperature difference of 2350 K. The large ΔT in the components verify that the binary is not in contact. A Binary Maker fitted hot spot changed somewhat but was not eliminated in the WD Synthetic Light Curve Computations. It remained on the larger component at the equator on the correct (following) side for a stream spot directed from the secondary component (as dictated by the Coriolis effect) (see Figure 32). This could indicate that the components are near filling their respective Roche-Lobes. The fill-out of our model is 96.3% for the primary component and 95.0% for the secondary component (see Figure 33). The inclination is ~79°, not enough for the system to undergo a total eclipse.

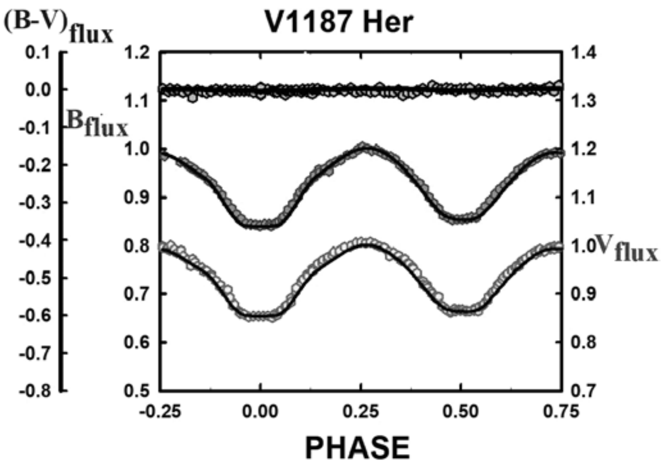

Figure 29. B,V synthetic light curve solutions overlaying the normalized flux curves.

Geochronology Results

The summary or update of the study of *Samec-2*, which now includes the systems of this paper, follows. Tables 1 and 2 summarize the period studies and derived ages. Table 3 shows the gyrochronology results from the 11 systems. An age of each binary is included. The age result is on the order of ~40 million years as the apparent age of the *time dilated universe*. Although this seems large for a creation-based paper, it is much, much smaller than the proposed age of W UMa binaries of some 5–10 billion years. The age is about 1/100th of the theoretical age. The final summary of this paper, plus *Samec-2*, is shown in Table 3. The 5-day initial period binaries (see paper 1 and paper 2), including 82 eclipsing solar-type binaries, have an age of 5.69×10^7 years or 0.4% of the age of the universe proposed by secular astronomers—13.8 Gyr. As reiterated in *Samec-2*, although this does not equal the often-cited age of 6000–10,000 years in creation literature, I remind the reader that this value is the apparent age of a time-dilated universe. The earth and, I believe, the entire solar system remains in the range of ages

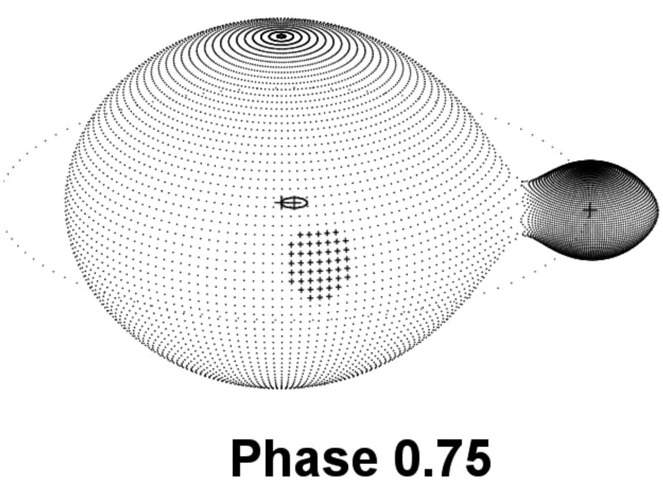

Figure 30. Roche-Lobe surfaces from our BVR_cI_c solution, phase 0.75, of V1187 Her.

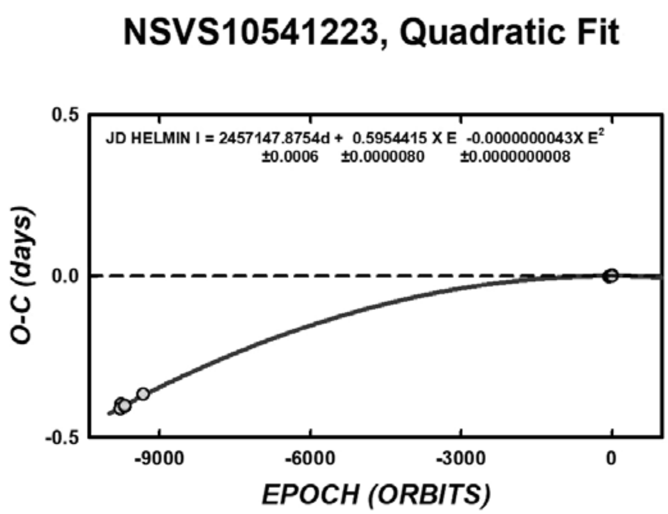

Figure 31. Quadratic O-C residuals from period study, NSVS1054 1223.

last mentioned (6000–10,000 years). And only some ~100 million years (not 13.8 billion!) years of *apparent* history is exhibited at least in the nearby (<2 kiloparsec, or about 6000 LY) cosmos—and probably for the "deep" universe as well.

Red Novae

The critical nature of these studies was recently highlighted by the phenomena of *Red Novae*, a violent event which appears to be the final coalescence of a contact binary into a fast rotating, blue straggler-like single star. This is important since it highlights that these stars are indeed coalescing into single stars. The recovery of archived observations of a contact binary with high fill-out at the site of the red nova V1309 Sco (Tylenda et al., 2011; Tylenda and Kamiński, 2016) has underlined the need for study of the characterization and continued patrol of such binaries in transition. Heavy and continuous sky coverage has yielded the unexpected—actual evidence and observations of mergers of binaries into single stars. It has been found that these events are culminated by a bright and long-lasting peculiar novae—a Red Novae. The color is not the usual blue, high temperature event as expected for a novae and supernovae. It also appears that archival data has revealed that these have happened in the past. Thus, binaries have undergone a complete metamorphosis inside of the age of the universe—covering time intervals much shorter than imagined by secular astronomers. We have shown that the rate of transition is much higher than 100 times faster than expected. These are referred to as *mergebursts*. Mergebursts range of luminosities or energies intermediate between classical novae (explosions from compact binary systems) and supernovae (usually annihilating the star or stars involved). The time interval of the eruption also lasts an intermediate time interval between that of novae and supernovae. They also display a peculiar red spectra (~1000K). V1309 Sco, V838 Mon and M31-RV are examples. Figure 34 (page 4) notes these differences.

The typical light curve of red novae is shown in Figure 35 (page 4) with an irregular rise of about 10 magnitudes (10,000

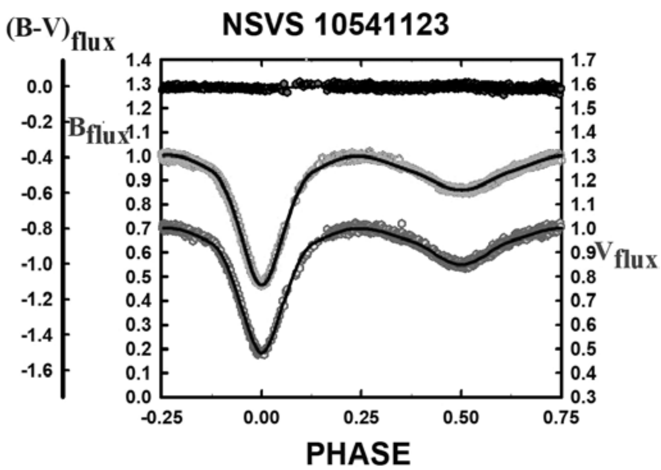

Figure 32. B,V synthetic light curve solutions overlaying the normalized flux curves.

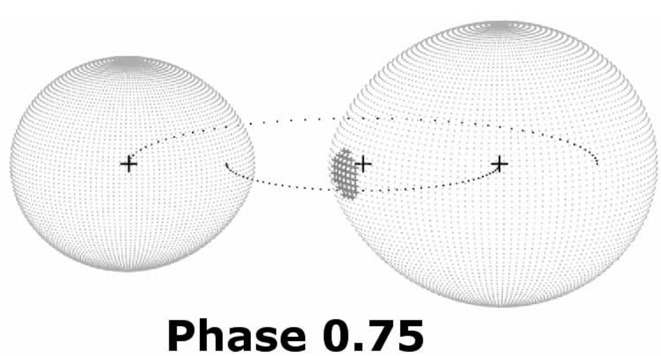

Figure 33. Roche-Lobe surfaces from our BVR$_c$I$_c$ solution, phase 0.75, of NSVS10541123.

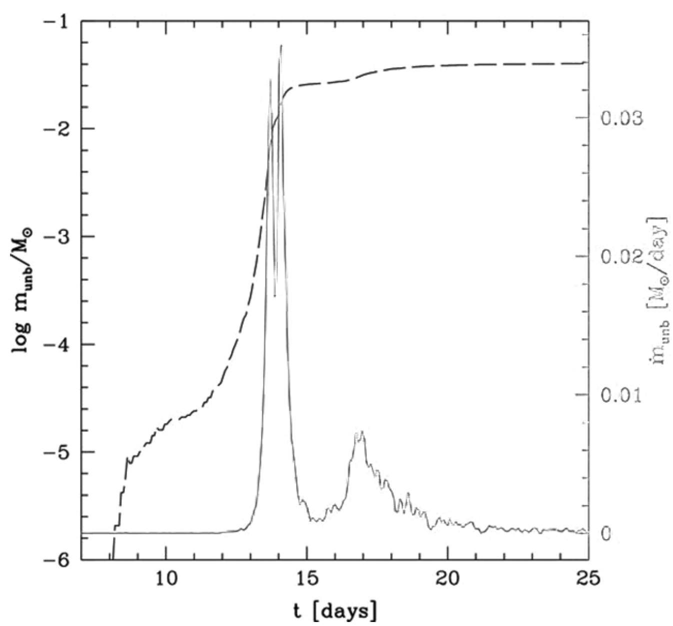

Figure 37. The Mass of the ejecta (black dashed line) and its derivative (blue solid line) as functions of time. Each peak shown in the plot corresponds to one episode of the mass outburst. Shows 3 outbursts (Nandez, Ivanova, and Lombardi, Jr., 2014).

Table I. A summary of the recent solar-type systems analyzed with continuously decreasing periods.

System	Orbital Period	Quadratic Period Change $\frac{dp}{dt}$	Research Student/s	Publication
V1695 Aql	0.41281623 d	$-1.7 \times 10^{-10} \frac{d}{yr}$	Gray, C.R.	JAVSO 45, 140, Samec et al. 2017
NSVS 10083189	0.4542189 d	$-4.9 \times 10^{-10} \frac{d}{yr}$	Olsen, Amber	AAS 2017, JAVSO 2017
V530 And	0.577107 d	$-1.4 \times 10^{-8} \frac{d}{yr}$	Clark, J. D.; Shebs, T.	JAVSO 2016, AAS 2015
NSVS 5066754	0.37478 d	$-2.4 \times 10^{-8} \frac{d}{yr}$	Nyaude, Ropafadzo	AJ 2016, AAS 2016
FF Vul	0.444976 d	$-6.0 \times 10^{-11} \frac{d}{yr}$	Nyaude, Ropafadzo	AJ 2016, AAS 2016
GSC3208 1986	0.404566 d	$-7.0 \times 10^{-10} \frac{d}{yr}$	Kring, J.D.	AJ 2015, AAS 2014
V1187 Her	0.310763 d	$-3.3 \times 10^{-7} \frac{d}{yr}$	Heather Chamberlain	RNAAS 2,1 2018, PASP 2019
V573 Peg	0.417449 d	$-4.8 \times 10^{-7} \frac{d}{yr}$	-	AAS 2018, JAVSO 2018
GQ Cnc	0.422208 d	$-5.0 \times 10^{-8} \frac{d}{yr}$	Olsen, Amber	JAVSO 2017
MT Cam	0.3661389 d	$-9.18\times 10^{-8} \frac{d}{yr}$	-	AAS 2018
NSVS 1054 1123	0.5954966 d	$-5.23\times 10^{-6} \frac{d}{yr}$	-	AAS 2018

AAS: Abstracts, Meeting of the American Astronomical Society
AJ: Astronomical Journal
JAVSO: Journal of the American Association of Variable Star Observers

times increase in brightness) and an irregular decrease occurring over the course of ~100 days. A simulation of such an explosion is shown in Figure 36 (page 4). The top left panel is when the primary has overflown its Roche-lobe and more material is being passed to the companion. The top right panel shows that the Roche-lobe of the companion is overflown. The bottom left panel is for the stage when the companion spirals into the primary, while the bottom right panel shows the two orbiting cores engulfed by the envelope of the primary; after about 0.5 days the cores merge. The mass of the ejecta as a function of time is given in Figure 37.

These violent, relatively cool, events mark the transition from binaries to single stars. It is interesting that many fast-rotating A-type stars exist in the heavens—all possible results of such mergers. Contact binaries are believed by many to be the most abundant of all variable stars in the cosmos—indeed, they are very frequent in the heavens! Their abundance of both contact binaries and fast rotating A-type stars (as well as FK coma variables) conveys a message that should be heeded by the creation community. The occurrence of such objects in the evolutionary view is untenable in regards to age. They should not exist in a universe of such a "young age" as 13.80

Table 2. Update for 2015-1018

Name	dP/dE (d/E)	dP/dt (d/yr)	Period (d)	Est. Spec. Type	Age (years)
V1187 Her	-1.42×10^{-10}	-3.34×10^{-07}	0.310763	F7V	$\mathbf{1.40\times10^{07}}$
MT Cam	-4.60×10^{-11}	-9.18×10^{-08}	0.366139	G7V	$\mathbf{5.05\times10^{07}}$
NSVS 5066754	-2.41×10^{-08}	-4.70×10^{-05}	0.374780	G5V	$\mathbf{9.89\times10^{04}}$
GSC32081986	-7.00×10^{-10}	-1.26×10^{-06}	0.404566	F3V	$\mathbf{3.64\times10^{06}}$
V1695 Aql	-1.73×10^{-06}	-3.05×10^{-03}	0.412816	G8V	$\mathbf{2.66\times10^{06}}$
V573 Peg	-2.74×10^{-10}	-4.79×10^{-07}	0.417449	F7V	$\mathbf{6.58\times10^{07}}$
GQ Cnc	-2.90×10^{-11}	-5.02×10^{-08}	0.422208	K0V	$\mathbf{9.12\times10^{07}}$
FF Vul	-6.00×10^{-11}	-9.85×10^{-08}	0.444976	F4V	$\mathbf{4.62\times10^{07}}$
NSVS 10083189	-4.90×10^{-10}	-7.92×10^{-07}	0.452189	F8V	$\mathbf{5.75\times10^{06}}$
V530 And	-1.40×10^{-08}	-1.77×10^{-05}	0.577107	F4V	$\mathbf{1.15\times10^{08}}$
NSVS 10541123	-4.26×10^{-09}	-5.23×10^{-06}	0.595442	F2V	$\mathbf{6.04\times10^{05}}$
				Average	$\mathbf{3.6\times10^{07}}$

Table 3. Average values from Samec-1 and -2 including this paper

	P_0 5d (initial)	P_0, 8d (initial)	P_0, 10d (initial)	P_0, 15d (initial)	P_0 20d (initial)	Average
AGE (Years)	5.69×10^{7}	2.52×10^{8}	6.65×10^{7}	2.14×10^{7}	2.44×10^{7}	8.432×10^{7}
Maximum	7.15×10^{8}	3.36×10^{9}	1.67×10^{8}	1.02×10^{8}	1.45×10^{8}	3.36×10^{9}
Minimum	1.33×10^{1}	2.20×10^{5}	1.24×10^{6}	8.74×10^{5}	1.64×10^{6}	1.64×10^{6}
% age of Universe	0.4	1.8	0.5	0.2	0.2	0.6

billion years—at least to an evolutionary astronomer. We repeat from *Samec*-2 that this paper gives physical confirmation of the youthful age, in a creationist sense, of the universe in a time-dilation scenario. As I noted, as someone called to our attention at a recent meeting, much of this prehistory took place during the Creation Week following the creation of the first stars on Day 4. Therefore, the time-dilation event postulated by Humphreys falls into the category of a Creation Week event. Regardless, the phenomena did take place and are not due to an apparent, ex nihilo, created history. The events we see truly took place and are objects of legitimate scientific inquiry that the Lord has allowed His children to study. Exodus 20:11: *For in six days the LORD made heaven and earth, the sea, and all that in them is, and rested the seventh day*. Revelation 4:11: *Thou art worthy, O Lord, to receive glory and honor and power: for thou hast created all things, and for thy pleasure they are and were created.*

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The Granite Chaos at Huelgoat in Brittany: The product of millions of years erosion, or a sudden catastrophe?

Martin Johnson* and M.J. Austin**

Abstract

This paper reviews the historic and accepted explanations requiring millions of years of erosion for an unusual geological feature, the granite Chaos at Huelgoat in central Brittany, where huge granite boulders are jumbled together along a narrow valley. The geological evidence from the site does not support such a gradualist explanation, and is consistent instead with a sudden catastrophic flood of water such as might be caused by an outburst flood. The present geography of the site shows that a lake of sufficient size could once have been retained in the valleys upstream of the Chaos, by a natural dam across the present location of the Chaos. Archaeological evidence from nearby Palaeolithic, Mesolithic, and Iron Age sites coupled with Roman history points instead to an event in the time range 3,000–4,000 B.P. Supposedly anomalous radiocarbon dates, once adjusted in line with errors such as have been found in radiocarbon dating in the wider region, support this analysis, but call into question the currently accepted dating of the Palaeolithic and Mesolithic eras. This suggests that the events at this location were much more recent and possibly contemporary with Bronze Age cultures in the Mediterranean region.

Introduction

The small town of Huelgoat in Brittany, the westernmost province of France, has given its name to the granite massif in which it sits—today a heavily wooded area. The word Huelgoat means "high forest" in Breton (a Celtic language). The region was home to lead and silver mining for around 2,000 years, and the small lake alongside the town was first created some 300 years ago to provide water for powering machinery used in mining processes.

A principal tourist attraction of the town is the Chaos; a field of enormous granite boulders found in the small valley extending from the present outfall of the lake to approximately 500 m down the valley (Figures 1, 2, and 3). While many of these boulders, which range in size from around one to greater than 100 cubic meters, give the appearance of having been rounded in flowing water, their sheer size has led to their causation being attributed to the result of erosion and onion-skin weathering (e.g. Bellard, 2001; Chauris, 2008).

The geologists researching this area have likely not suggested that the

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boulders were caused by high-level river flows for two reasons. First, the farthest watershed points of this valley system in the Monts d'Arrée are only eight to ten kilometers distant from the Chaos, with maximum stream lengths (e.g. the Fao river; the larger of two small streams feeding the present lake) of around 10–12 km.

Second, while most of the boulders are at the bottom of the valley, some remain lodged high up on the valley side, including the "Roche Tremblante" (Trembling Rock), which is 7 m long and 3 m high, with an estimated weight of 137 tons. It is located just above the 175-meter contour and presumably originated at an even higher point. This is about 15 meters above the valley bottom, and there are several other large and rounded boulders at or above this level.

It is highly improbable that a river (as opposed to an outburst flood) could have formed at any time with a depth of 20 m or more in this valley system. As will be seen below, the evidence shows that there has never been any river flow of significant force through this valley since the boulders were formed. This conclusion was reached by examining the bases of several boulders and observing the lack of any undercutting of the large boulders in the valley bottom at their bases, as would be caused by smaller rocks abrading their bases during such a flow.

A study of the boulder field in 2019 by the authors shows that the weathering explanations overlook contradictory evidence from the Chaos itself. This evidence is more consistent with the effects of a massive flow of water cutting away the clay layers between the granite beds, which then collapse and break up. Then, the broken rocks in a turbulent water flow jumble up to produce the rounded boulders we can now see.

An explanation from local folklore is that these boulders are really "polished pebbles from the sea," thrown there by an angry giant seeking to punish the

Figure 1. Start of Chaos, beside old ore-crushing mill. Boulder diameters over 10 m (people circled for scale).

Figure 2. Approximately 150 m down the Chaos. Boulder diameters over 5 m (people circled for scale)

Figure 3. Approximately 300 m down the Chaos, boulders 1–2 m diameter.

people of Huelgoat (Finistère Tourisme, 2019). We shall see that this story contains some observations more in line with the actual evidence than the explanations relying on erosion and weathering.

The Huelgoat massif is one of the highest regions in central Brittany. Set far away from any present, major water sources, it is approximately 30 km south of the north coast at Morlaix and 50 km east of the west coast at Brest (see Figure 7).

We will consider the possibility that there was once a much larger lake than the present one, retained by a natural dam. We suggest the failure of such a dam could have released sufficient water to cause the formation of the "giant pebbles" of the Chaos. We will explore the possible time period for when this could have happened and consider geological and archaeological evidence for a late Pleistocene event. We will also consider evidence placing that era much more recently than secular dates of ten- to twelve-thousand years ago. This not only has implications for the dating of the end of the Ice Age, but also the Palaeolithic and Mesolithic periods. The evidence will show that the best explanation for the Chaos at Huelgoat is a glacial lake outburst flood, near the end of the Ice Age.

Huelgoat geology

The Huelgoat massif forms an ellipse about 10 km by 15 km, approximately 100 km^2. It is composed of several different types of granite with different chemical, mineralogical, and granular compositions. The Huelgoat granite found near the town itself (and in the Chaos) is a medium- and large-grained rock, light gray to dark gray-blue, with potassium-feldspar megacrystals and euhedral cordierite. Several probable fault lines have been identified in the area, including one running NW–SE just to the north of Huelgoat, and another running SW–NE just 2 km south of Huelgoat, along the southern edge of the massif (Castaing et al., 1984, pp. 2–14; Castaing et al., 1988b, pp. 3–18; Castaing & Debeglia, 1990). Figure 4 gives a perspective view of the Huelgoat Massif with the Monts d'Arrée, the highest ridge, running southwest to northeast along the northern side, showing Huelgoat and its valley system in the upper right quadrant, and the much larger valley system containing the Reservoir St. Michel at the center (retained by a hydro-electric dam).

The first "geological" attempt at explaining all these rounded granite boulders near Huelgoat, both those in the Chaos and others scattered on nearby hillsides, was by Alexander von Humboldt, who visited the area in 1813. He thought that they were basically bubbles of molten granite that had somehow risen up through lower layers of molten rock, which had eventually become exposed as a result of long erosion (Humboldt, 1823). This idea was dismissed long ago, and it is generally accepted that a granite Chaos is formed as a result of erosion, the fracturing of granite layers into blocks, and then an "onion skin" weathering process affecting thin outer layers of the rock, which rounds off the shape of the blocks (Chauris, 2008), as illustrated by Vincent Bellard below (Figures 5 & 6). Chauris (2008) has shown that there were once many more, very large exposed boulders in the Huelgoat area, but several have been cut up and used as building stone. This does not seem to have affected the Chaos as much as boulders in more easily accessible locations.

The final stage is the erosion of the ground around the blocks, which fall under gravity into the valleys where a Chaos may be found. It is perhaps noteworthy that expert geologist Christian Castaing, who has studied this area very thoroughly, seems to avoid this explanation (e.g., Castaing et al., 1988b, p. 17).

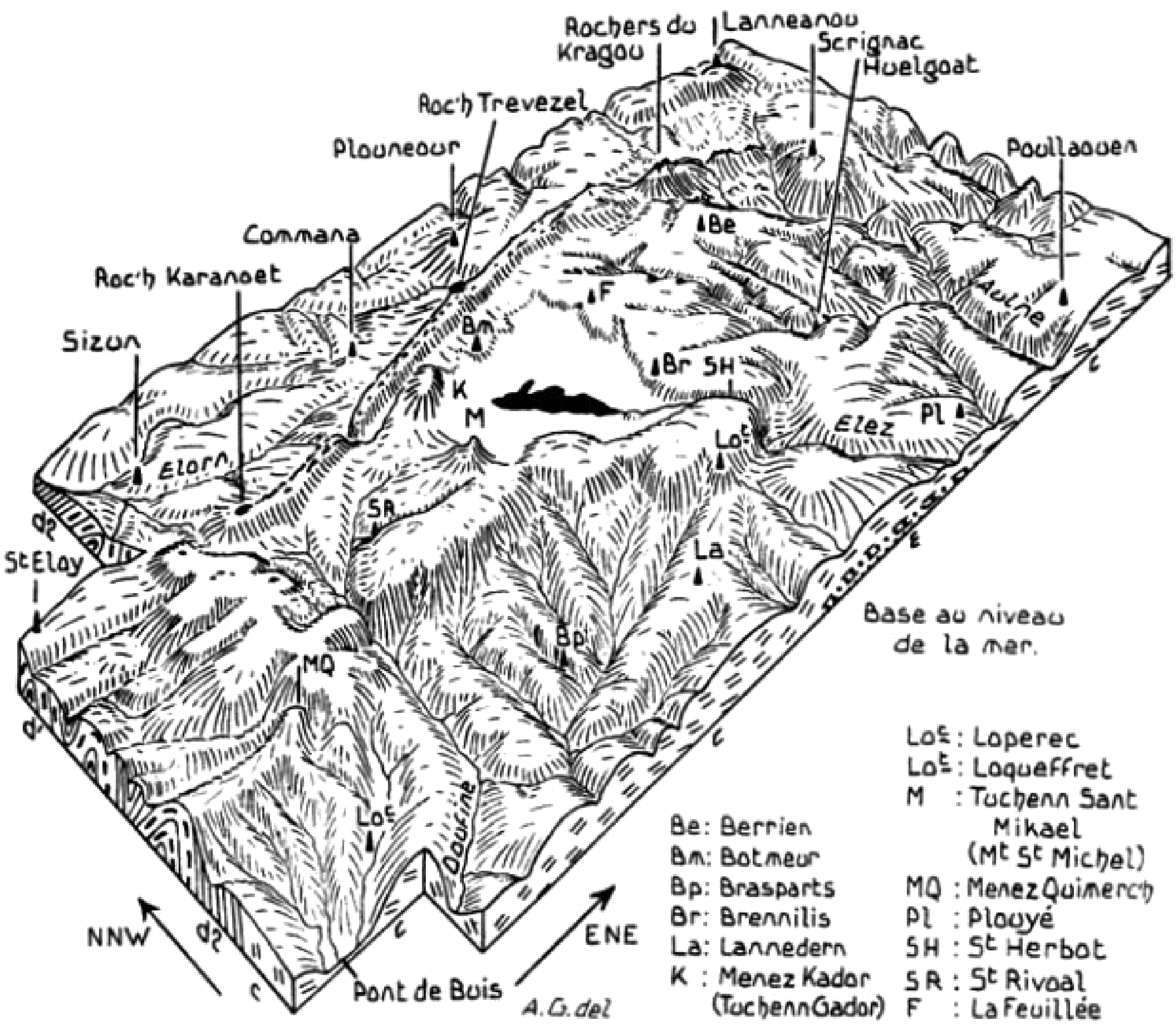

Figure 4. Perspective view of the Monts d'Arrée and Huelgoat Massif (Guilcher, 1949).

The evidence in the Huelgoat Chaos

The authors visited the Huelgoat Chaos in August 2019, and made the following observations:

1. The average boulder size decreases downstream along the length of the valley, from diameters in the order of greater than 10 m close to the present lake (see Figure 1), down to about 1–2 m diameter at 400 m downstream (Figure 3).
2. Many of the boulders at the start of the Chaos are angular in shape, becoming more rounded further down the valley.
3. This valley and others in the area are "V" shaped, indicating no major glaciation has taken place.
4. The boulders are Huelgoat granite, the same as exposed bedrock.

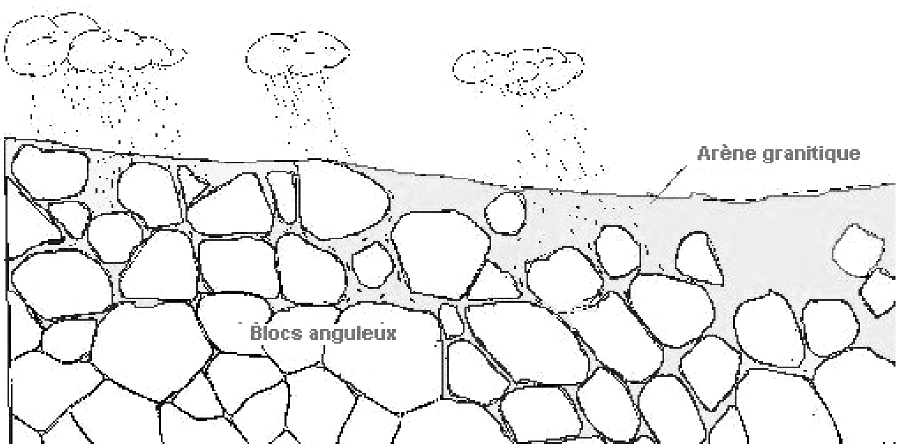

Figure 5. Stage 1 of Chaos formation: water and frost action fissures granite layers into blocks

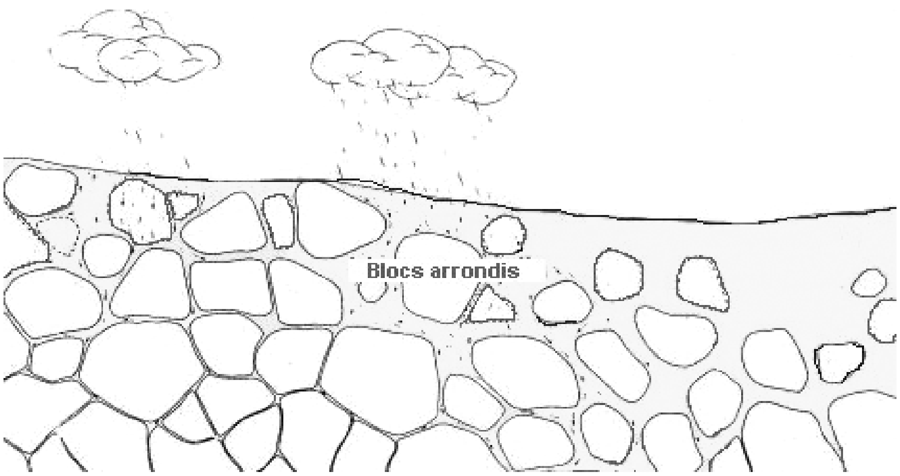

Figure 6. Stage 2 of Chaos formation, "Onion-skin" weathering rounds off edges of blocks in layers through water and frost action in outer layers of blocks.

5. The boulders show a lack of any significant weathering, despite the high rainfall and temperate climate of the region.
6. There has been no noticeable erosion of the lower boulders by the existing river (i.e., a lack of undercutting which would be expected if there had been a strong waterflow tumbling smaller stones against the base of the large boulders over any significant period of time).

Taken together, this evidence points to the creation of the Chaos having been the result of a single event involving a massive flow of water over a relatively short space of time, and no more than a few thousand years ago. There would have been less sorting of the boulders by size along the valley if the flow had been of a long duration; large boulders would have been broken up and moved further downstream. The progressive rounding of the boulders down the valley also shows that there was too short a time to have rounded off the ones at the start.

The lack of evidence for glaciation, especially in this valley, rules out the possibility that this was a glacial moraine, as has been suggested for a much smaller Chaos near St Herbot, some 8 km away (Le Bel, 1920). Saint Herbot can be identified in Figure 4, by the initials "SH" near the outflow valley from the Reservoir St Michel (center), raising the possibility that this chaos may also have been caused by an outburst flood.

Huelgoat archaeology

On the top of a ridge 1 km north of Huelgoat is the Camp d'Artus; a large Iron Age Hill Fort which was excavated by Sir Mortimer Wheeler in 1938. He considered that it was constructed prior to the Roman invasions of the 1st Century BC and abandoned not long afterwards. Close by on the same ridge were silver and lead mines that had been worked at that time. It is thought to have been the main center for the Osismes, a Gallic (Celtic) tribe, which then occupied the region. The ongoing mining for silver and lead in the area, together with the quarrying of granite for buildings, means that few traces of the early mine workers and their activities remain (Duval, 1959). The locations of their mines, below this ridge, and at the edge of the massif just to the east of the town, however, means that the event which created the Chaos must have happened prior to the Celtic occupation of the area. That event could have exposed the seams of silver and lead ore which the Celtic metal workers discovered and mined.

The Osismes are believed to have arrived in Finistère around the middle of the first millennium BC (though the first written records showing their existence are those of the Roman invasion of 51 BC). The next main population movements into the region are the migration of more Celtic peoples (Ancient British) from the British Isles during the 4th and 6th centuries AD (Éveillard, 2015). This indicates a continuity of Celtic (now Breton) culture spanning some 2,500 years in this area.

Two km northwest of Huelgoat, the remains of a stone-age site have been excavated in and near the rock shelter of Kerbizien (Marchand et al., 2014). This site is near the 231 m summit located 750 m northwest of the village of Kerbizien (Figure 8). Thousands of stone tools and fragments have been found at this site. Many of these artifacts have been identified as Azilian (a late-Palaeolithic culture usually found much further south in Europe), as well as others from the Mesolithic era. On conventional chronology, this indicates occupation during a period about 12,000–5,000 BP. The lack of bones found at this site has been explained by the acid nature of the soil. Above the Azilian material, small quantities of wind-blown loess were identified in positions indicating they were deposited by northerly winds. This suggested to the archaeologists that a suddenly warming climate happened at the end of the Ice Age during the Bølling-Allerød period (ca 14,700–12,700 BP). There was no evidence found of Neolithic Bronze or Iron-Age occupation. The archaeologists were puzzled by two aspects, first, why this site was abandoned, leaving large quantities of usable tools, and second, how they managed for a water supply, being so far from and high above any obvious present-day water sources.

The archaeologists reported finding many charcoal fragments (mainly hazel) among the Azilian material, which were carbon dated to between 3,980 and 5,220 BP. They concluded that these dates were incorrect (among late-Palaeolithic artifacts), and that these must have been intruded by burrowing animals and water circulation. The fact that this process should also have mixed Mesolithic and Azilian artifacts (but did not) was not considered. This fails to address the question of what might have happened to charcoal remnants from the cooking fires of the Azilian occupants over centuries or even millennia. If the ground was capable of preserving the charcoal fragments that were found, then it should have preserved more ancient examples too. Figure 7 shows the distribution of known Azilian and Mesolithic sites in Brittany, with Kerbizien included.

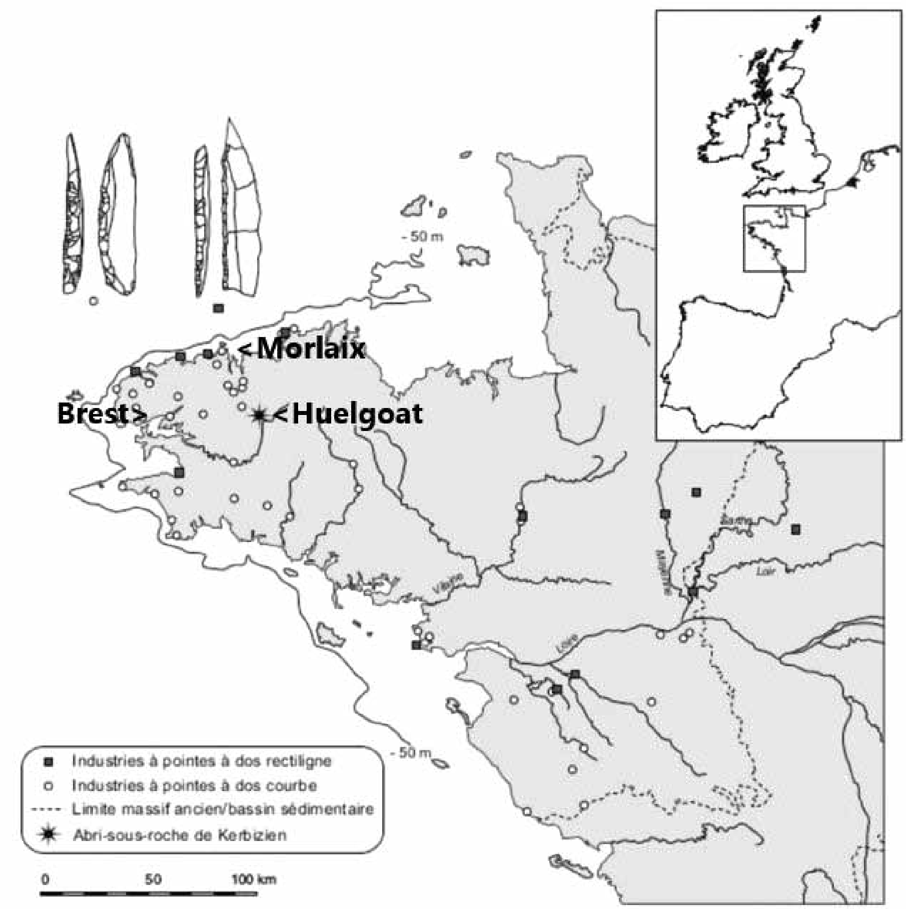

Figure 7. Map showing Azilian and Mesolithic sites in Brittany, including Kerbizien. Typical "curve-back" Azilian implements shown compared with "straight back" Mesolithic implements (Marchand et al., 2014).

A possible late-Ice Age lake

A study of the terrain shows that if the valley where the Chaos is now was blocked in the past, a lake would form and could easily rise above the 200 m contour. The present lakebed is about 160 m At the 200 m contour, such a lake would have a surface area of approximately 5 km^2, an average depth of 20 m, and

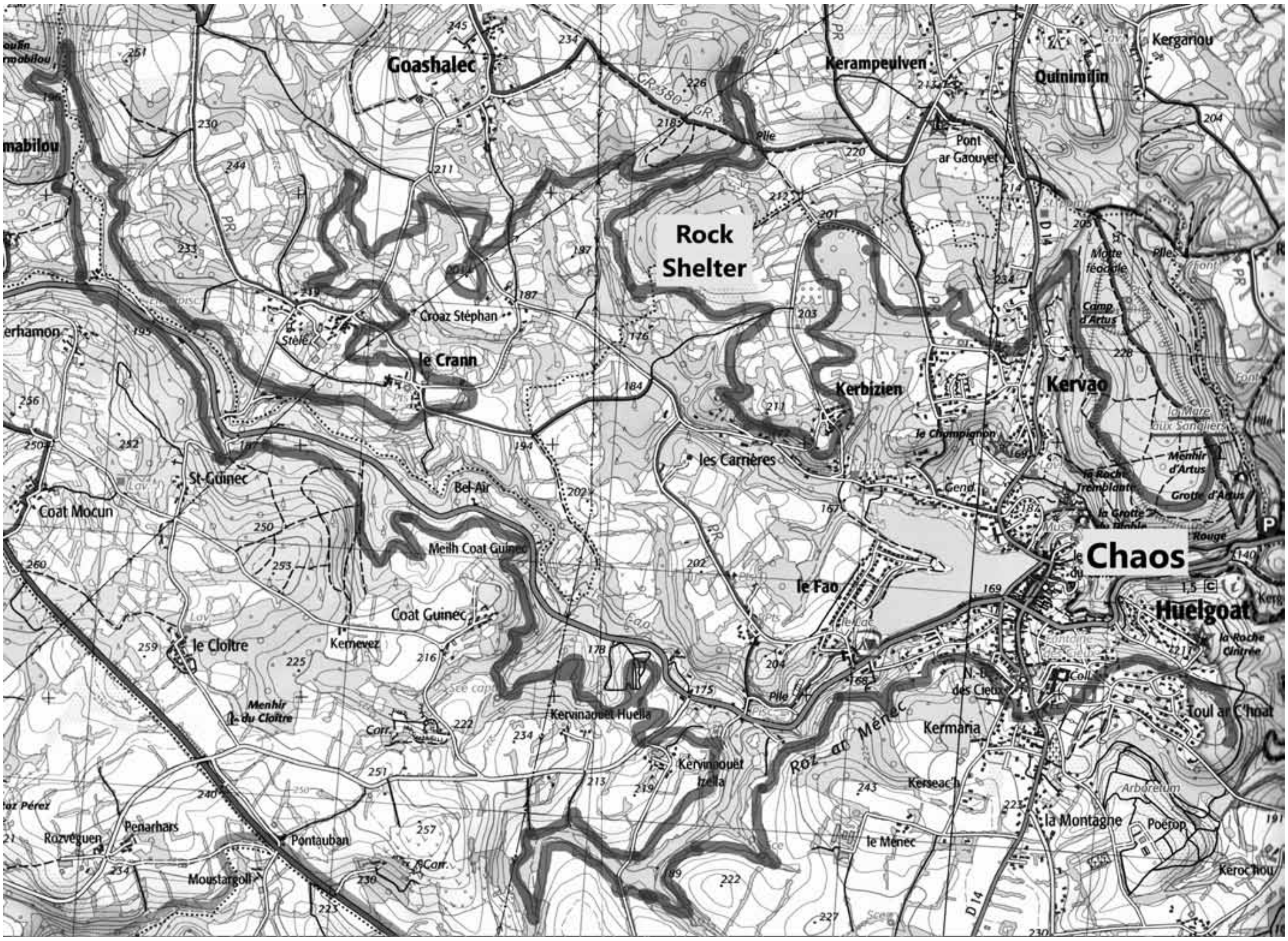

Figure 8. Map of Huelgoat showing 200 m contour (blue) with locations of the Chaos and the Kerbizien Rock Shelter (Extract from: Top 25 Randonnée et Plein Air 0617 OT Huelgoat Monts d'Arrée 1:25,000).

contain about 100,000,000 m^3 of water (Figure 8).

The present rainfall at Huelgoat is 1,400 mm per year. On the one hand, this amount of rainfall means that the hillsides of the valleys above Huelgoat must have been eroded during recent centuries (making the potential lake area smaller in the past). Equally, that erosion will tend to have filled the bottom of the valleys with sediment (making the valleys deeper in the past). Overall, therefore, the potential volume of such a lake would not have been very different from now. Warming conditions at the end of the Ice Age would help provide the water to fill it.

We attempted to identify possible historic lake shore levels by looking for wave-cut platforms. This is difficult for several reasons. The extensive forestation of the area blocks views of the relevant hillsides. The more level areas of land have been farmed for centuries (resulting in artificial levelling) and are intersected by built-up field boundaries typical of bocage countryside (making levels hard to see). There has been quarrying for building stone in several locations in these small valleys, removing stretches of hillside, and building, which has resulted in areas being artificially levelled. In addition, the high rainfall of the area would likely have eroded such platforms creating run-off inclines.

Reviewing the map (Figure 8) it can be seen that the steep and narrow valleys along the southwest side of the possible lake offer no obvious possible platforms. In addition, nothing suitable can be seen along the roadside going northwest up the Fao valley. Taking note of the fact

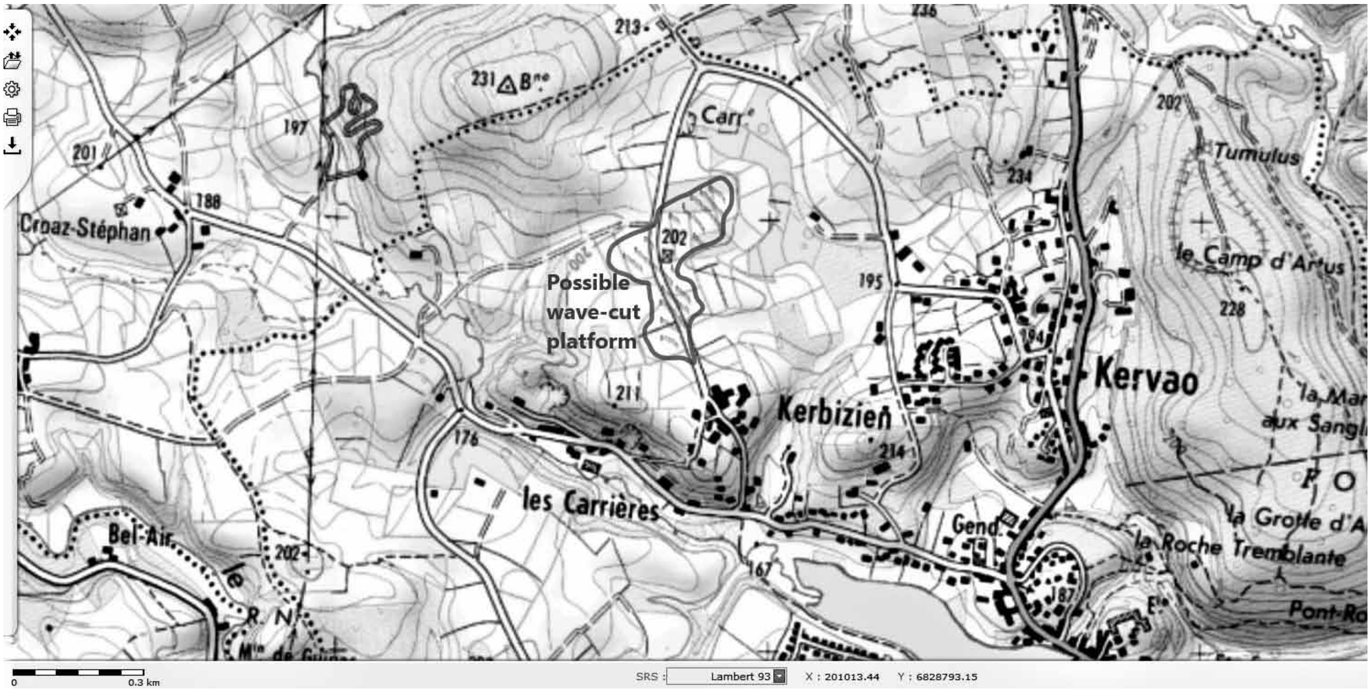

Figure 9. Map enlargement showing Kerbizien village and the location of a possible wave-cut platform (Extract from: SIGES Bretagne http://sigesbre.brgm.fr/?page=carto 1:8,000).

that the prevailing winds over Brittany come from the southwest (because Brittany sticks out into the Atlantic Ocean), the obvious place to study is the low ridge, with the village of Kerbizien at its southern end. This ridge would have been at the heart of the northeast side of the possible lake in its widest part. A small road runs north from Kerbizien for 900 m to a junction, where there is a spot height of 201 m. Five hundred m north of Kerbizien is another spot height of 202 m. The village and road are sheltered for some 200 m by ground rising about 7–8 m higher on the western side, to the 211 m spot height. Then the ridge remains level to within 1 m for about 300 m, to around the 202 m spot height (Figure 9). This forms a platform ranging from 100–300 m wide with small undulations, and would be consistent with wave action "planing off" the top of the ridge if the water was just above that level. There are two more stretches along the line of the road where there appear to be natural ledges at this general height level—the last being just before the road junction. Figure 9 shows the area around Kerbizien, including where a possible wave-cut platform may be. The 231 m spot height in the top left corner is just above the rock shelter where the Azilian and Mesolithic artifacts were found.

This was surveyed using Google Earth Pro (GEP) to make elevation sections at distances averaging 50 m northwards along the line of the road and stretching from the main Fao valley to the west across to the hillside above Kervao. The baseline was drawn from the centre of Kerbizien across the center of Kervao. A discrepancy was found between the map elevations and GEP at the spot heights, of between 1–2 m (GEP higher), which is typical (e.g., El-Ashmawy, 2016), though the GEP relative elevations were otherwise consistent.

The lake could have been retained either by a dam formed from land slippage, possibly as a result of movement of the faults to the north and east of Huelgoat, or by ice from the Ice Age. This dam could have failed either as a result of sudden warming at the end of the Ice Age leading to the overlapping of the dam, or from another landslip triggered by increasing pore pressures within the rock mass due to the rising water level, or as a result of an earthquake.

The failure of such a dam would result in the lake emptying within a few hours, days, or weeks at most. The water would undercut the layers of granite in the valley sides, breaking the jointed and exposed slabs into blocks, which when unsupported, would then fall downwards, and grind against each other in the flow producing the rounding now evident. The longer the granite blocks spent in the water flow, the smaller and rounder they would become, thus explaining the reducing size coupled with increased rounding of the boulders further down the Chaos. The evidence from the boulders in the Chaos suggests a very rapid emptying of the lake.

A comparison of outburst flood damage

A useful comparison can be made with the breaching of the Möhne Dam by the Royal Air Force on the night of May 16 and 17, 1943. The Möhnesee reservoir above the dam contained 132.2 million m^3 of water that night. One hundred sixteen million m^3 of water emptied within 12 hours at an initial flow rate estimated at 8.8 million m^3 per second. The power stations immediately below the dam completely disappeared, all bridges were destroyed for 50 km downstream, as were all houses and buildings on low-lying land near the river for 65 km. The complete disappearance of two power stations built of stone and reinforced concrete was a shocking sight. (Kirschmer, 1949) Of course, the area below the Möhne Dam was much wider and more open than the valley at Huelgoat, meaning that a similar volume of water would take longer to drain at Huelgoat. The force it would have exerted would have been easily capable of first carving out the present valley along a possible fault or shear line, and then undercutting the granite layers on the sides of the valley. This process would be more than adequate to create the granite boulders now in evidence.

Discussion

The presence of a late-Ice Age lake above Huelgoat offers a solution for some of the mysteries about the Azilian and later Mesolithic occupation of the Kerbizien shelter. It would have provided the occupants with a ready source of water and food. Many of the stone artifacts were small arrow or spear heads, useful for hunting both fish and birds. Elsewhere it is common to find Mesolithic people living next to water. The disappearance of the lake would also explain why the occupants left and the site was never reoccupied.

The apparent anomaly of the radiocarbon dates for the charcoal found among the Azilian artifacts needs to be considered. It is only anomalous if the conventional dates for the late-Ice Age, late Palaeolithic and Mesolithic eras can be accepted without challenge. On the contrary, there is good precedent for arguing that those radiocarbon dates overstate the age of the items tested by a considerable margin, and that instead we should consider dates around 4,000 BP, and possibly more recent still.

A study of samples of mortar used in buildings in Pompeii and Herculaneum constructed between 100 BC and 79 AD gave radiocarbon dates ranging from 2,400–5,800BP. This is an error range from around +10% up to +290%. (Lindroos et al., 2007). Further evidence of the unreliability of radiocarbon dating has been given by Baumgardner (2005).

In light of this, we should neither accept the easy dismissal of these radiocarbon dates by Marchand et al., nor even the validity of the dates they have rejected. The radiocarbon dating of the charcoal samples found is instead direct evidence of much more recent dates for the Azilian and Mesolithic occupants of the Kerbizien site, thus challenging the present dating assumptions for these eras. It is reasonable to suggest that in fact these radiocarbon dates are actually evidence for dates of 3,000–4,000 BP as suggested above. When coupled with the presence of wind-blown loess, we are also suggesting a similar date range for the end of the Ice Age (Oard, 2007).

We have seen that the geological evidence found in the Chaos at Huelgoat is best explained by a massive flow of water acting on granite, such as could happen in a glacial lake outburst flood, rather than a gradual process of erosion and weathering. In this, we are doing no more than echoing the implications of the folklore concerning the Chaos, that the boulders resemble polished pebbles from the sea and were delivered in a single event "by a giant hand." It is the more recent attempts at gradualist geological explanations that have ignored the obvious evidence and produced explanations inconsistent with the facts.

The archaeological evidence indicates that such a flood event must predate the Celtic occupation of the area, setting it before ca. 500 BC, while also setting it after the Mesolithic occupation of the Kerbizien site. That also rests comfortably with the (Celtic) folklore, which makes no mention of a lake suddenly and catastrophically disappearing, but is rather an attempt to explain an existing fact.

This leaves a very wide time window (ca. 10,000–2,500BP) using conventional dating. If the radiocarbon evidence is accepted as belonging to the earlier Azilian occupants of Kerbizien, and adjusted as indicated, we should however consider a date around the beginning of the 2nd Millennium BC and towards the 1st Millennium BC. This means that the dating of the Palaeolithic and Mesolithic eras, together with the end of the Ice Age in Northern Europe all need reducing by several thousand years. It also implies that the late Palaeolithic and the Mesolithic eras at this location were compressed into one millennium or less and were probably contemporary with Bronze Age civilizations in the Mediterranean region. This should be no more surprising than the discovery of peoples in Australia and the Americas still using stone-age technology within recent centuries.

Conclusions

The geological evidence at Huelgoat strongly supports the hypothesis that the Chaos was created as a result of a glacial lake outburst flood, around the end of the Ice Age.

The archaeological evidence demonstrates occupation of the Kerbizien Rock Shelter by people or peoples whose stone tool style was originally that of the late Palaeolithic era (Azilian), changing at some point to Mesolithic styles before the site was abandoned, also at some time around the end of the Ice Age.

The radiocarbon evidence from the Azilian layers of the excavations sharply contradicts the conventional dating for the late Palaeolithic (ca. 12,000 BP), and we argue that those secular radiocarbon dates should be adjusted downwards based on comparable finds elsewhere.

The discovery of wind-blown loess deposits among the Azilian and Mesolithic deposits also points to a late-Ice Age occupation.

The otherwise unlikely location of this settlement (far above any present natural water supply) also supports the existence of a glacial lake.

The lack of weathering and erosion on the boulders of the Chaos supports a relatively recent date for the causative event (i.e., only a few thousand years ago). The causative event must, however, predate the first Celtic settlements at Huelgoat, presently estimated at 500 BC.

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Tremendous Erosion of the Cascade Anticlinorium near Mount St. Helens

Part 1: Structure and Calculations

Edward A. Isaacs*

Abstract

The Cascade Anticlinorium is a prominent feature from southern British Columbia to northern California that formed from regional folding during the Cascade Orogeny. Extensive research has been conducted across the anticlinorium and its parasitic folds, but little focus has been given to the erosion surface that truncates the anticlinorium. Outcropping along parasitic folds on the western flank of the Cascade Anticlinorium, Mount St. Helens is an excellent location to assess erosion. An examination of regional stratigraphy and structure of the anticlinorium, as well as the parasitic folds that comprise the deformed basement underlying Mount St. Helens, reveals that at least 7,850 m of strata were eroded along the truncated Lakeview Peak Anticline, while exhumed intrusives in the adjacent Pole Patch Syncline suggest a greater value. Because this erosion surface can be traced across the entire Cascade Anticlinorium, significant erosion occurred across the entire anticlinorium, much of which happened after regional folding. Such massive denudation is only explicable by the Genesis Flood.

Introduction

A profound irony in the geosciences is the unintended demonstration of phenomena best explained by the Genesis Flood. Though first nurtured in a biblical heritage, geology has become the flagship for deep time and its accompanying uniformity of rates punctuated by a preponderance of cataclysms (Reed, 2010; Reed and Williams, 2012). Despite this elevated position, geology has repeatedly bewildered pure naturalistic explanation. Geomorphology, the systematic study of landforms and their origin, is one such discipline not only documenting the numerous mysteries of secular naturalism (Akridge and Froede, 2000; Oard, 2011) but also detailing the impact of the Genesis Flood on Earth and its reverberations throughout history (Oard, 2008a; 2016; Clarey, 2017b). Recent geomorphological studies have shown a growing interest in anticlines as show-

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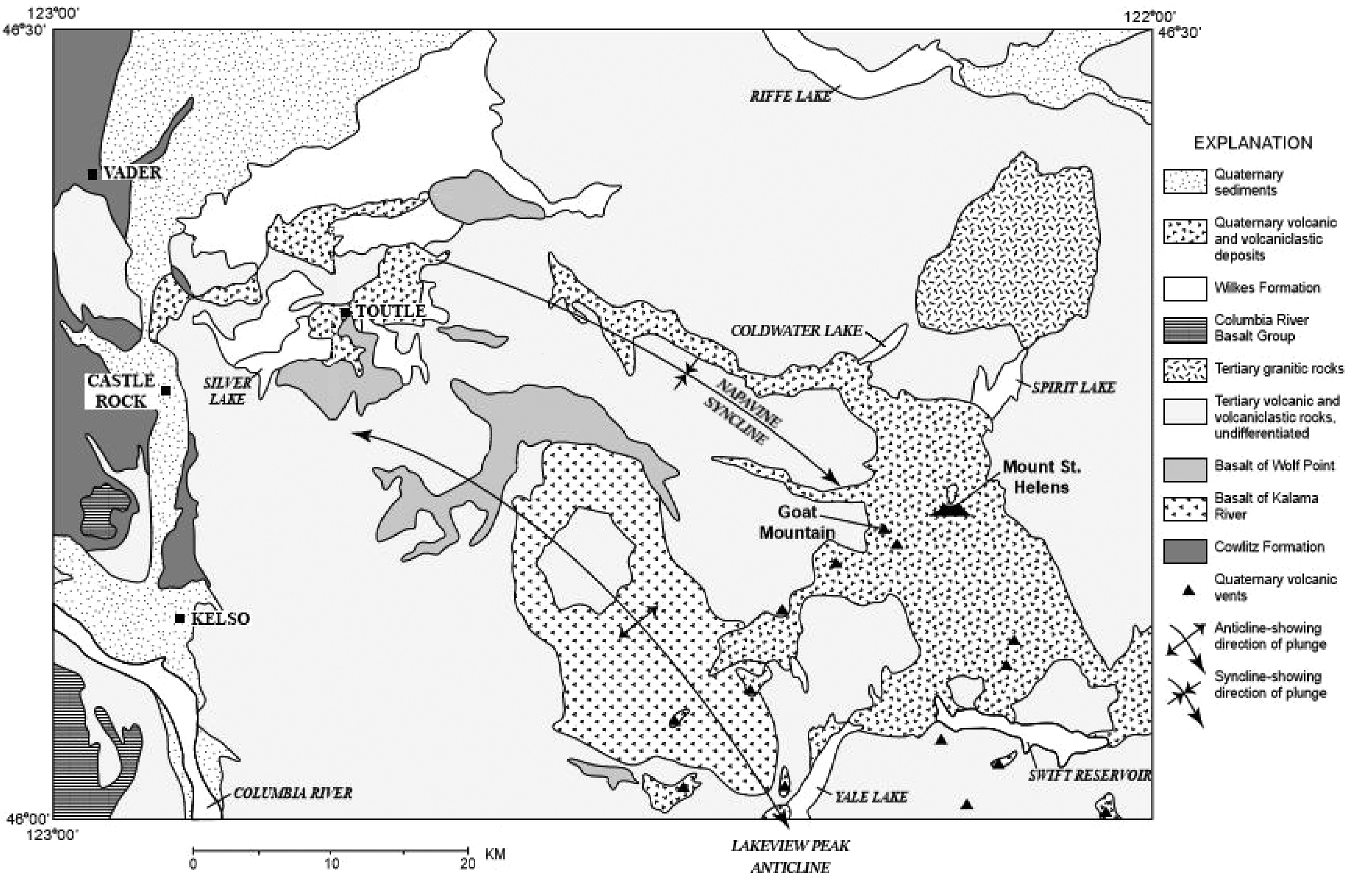

Figure 1. A geologic map of the region contiguous to Mount St. Helens detailing the stratigraphy and structural features of the region. First striking towards the southeast, the Lakeview Peak Anticline strikes easterly before trending south beyond the edge of the diagram, while the Pole Patch Syncline strikes north-south a few km east of the mapped area (c.f. Figure 7). Both Coldwater Lake and Spirit Lake are on the western flank of the Pole Patch Syncline (Evarts and Ashley, 1993b), although the structure of the Pole Patch Syncline in the northwestern region of the diagram is complicated by the lesser Napavine Syncline, which surfaces along the Lakeview Peak Anticline northwest of Goat Mountain. Modified from Figure 1 of Evarts (2001).

cases of prodigious erosion (Oard, 2012; 2013c; Matthews and Oard, 2015; Oard and Matthews, 2015). Ranging from the southern tip of British Columbia to the northern regions of California, the Cascade Anticlinorium is a north-south anticlinal composite fold composed of numerous anticlinal and synclinal parasitic folds. One of several major anticlinoria in the northwestern United States, the Cascade Anticlinorium is a member of a complex fold belt just beginning to be understood (Cheney and Hayman, 2007; Cheney, 2014). One of its features commonly overlooked by secular researchers is the erosion surface truncating the anticlinorium (Cheney, 2016b), which provides the deeply dissected platform hosting several Pleistocene volcanic cones such as Mount St. Helens (Figure 1). The geology surrounding Mount St. Helens shows evidence for diluvial-scale erosion of the Cascade Anticlinorium.

Structure and stratigraphy of the Cascade Anticlinorium

Along the western coast of North America, the Cascade Arc is a belt of continental foreshortening (folding) and increased volcanism that spans British Columbia to California (Cheney, 1997). Dominating the northern region of the arc are north-south anticlinoria, defined as “composite anticlinal structure[s] of regional extent composed of lesser folds” known as parasitic folds (Jackson,

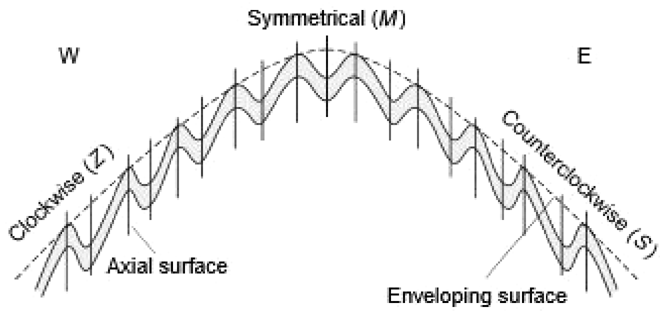

Figure 2. The general structure of a symmetrical anticlinorium, a "composite anticlinal structure of regional extent composed of lesser folds" termed parasitic folds (Jackson, 1997, p. 28); the inverse of an anticlinorium is termed a synclinorium. Figure after van der Pluijm and Marshak (2004). For further information, consult Chapter 10 (Folds and Folding) of van der Pluijm and Marshak (2004).

1997, p. 28, brackets mine; see Figure 2). These anticlinoria are intermittently interrupted by younger, more subdued east-west synclinoria, which are "composite synclinal structure[s] of regional extent composed of lesser [parasitic] folds." (Jackson, 1997, p. 645, brackets mine). This pattern of east-west synclinoria superposed upon the more extensive north-south anticlinoria cumulatively produces the 'egg-crate' topography of the northwest United States (Cheney and Sherrod, 1999). Besides the various anticlinoria such as Hog Ranch-Eagle Creek Anticlinorium and Eocene metamorphic core complexes in Eastern Washington and Idaho, two major north-south anticlinoria are found in Washington State, namely the Coast Range Anticlinorium along the coastline and the Cascade Anticlinorium up to two hundred kilometers inland. The most spectacular of these anticlinoria, the Cascade Anticlinorium exceeds 3.6 km from the structural base of the Pasco Basin in Eastern Washington to the present crest of the Cascade Anticlinorium (Cheney, 2016b).

Although this north-south tending anticlinorium spans the British Columbia border to northern California, the Cascade Anticlinorium is interrupted in northern Oregon by the westerly-striking Dalles-Umatilla Synclinorium, which causes the southerly plunge of the Cascade Anticlinorium in southern Washington and the northerly plunge of the Cascade Anticlinorium in northern Oregon (Cheney, 2016b, pp. 208–209). Within Washington, the Cascade Anticlinorium reaches its highest elevation in the northern portion of the state where it is dominated by igneous and metamorphic bedrock, while further south stratigraphically younger deposits dominate the more subdued topography (Cheney and Hayman, 2007). An impressive erosion surface truncates the Cascade Anticlinorium and its smaller parasitic folds, forming the platform which hosts the region's Pleistocene composite cones.

In total, the fold belt exhibits four major unconformity-bounded sequences (Table 1), termed *synthems*, that define the structural features of the region (Cheney, 2016a). Dated to the Early to Late Eocene, the lowermost sequence is the Challis Synthem, predominately arkosic in lithology (e.g., Wenatchee and Roslyn formations) with interbeds of basaltic to rhyolitic flows (e.g. Teanaway and Taneum formations) and volcaniclastics. Above the Challis Synthem is the primarily volcaniclastic Kittitas

Table 1. The Cascade Anticlinorium is comprised of four unconformity-bounded sequences, termed synthems, composed of a variety of lithologies dated from Early Eocene to recent.

Synthem	Age	Primary lithologies
High Cascade	Pliocene to Present	Alluvial, laharic, volcaniclastic, glaciogenic, and mass wasting deposits
Walpapi	Early Miocene to Pliocene	Flood basalts with interbeds of volcaniclastics, siliciclastics, and lithics
Kittitas	Late Eocene to Early Miocene	Andesitic and felsic volcaniclastics
Challis	Early to Late Eocene	Primarily arkosic with interbeds of basaltic to rhyolitic flows and volcaniclastics

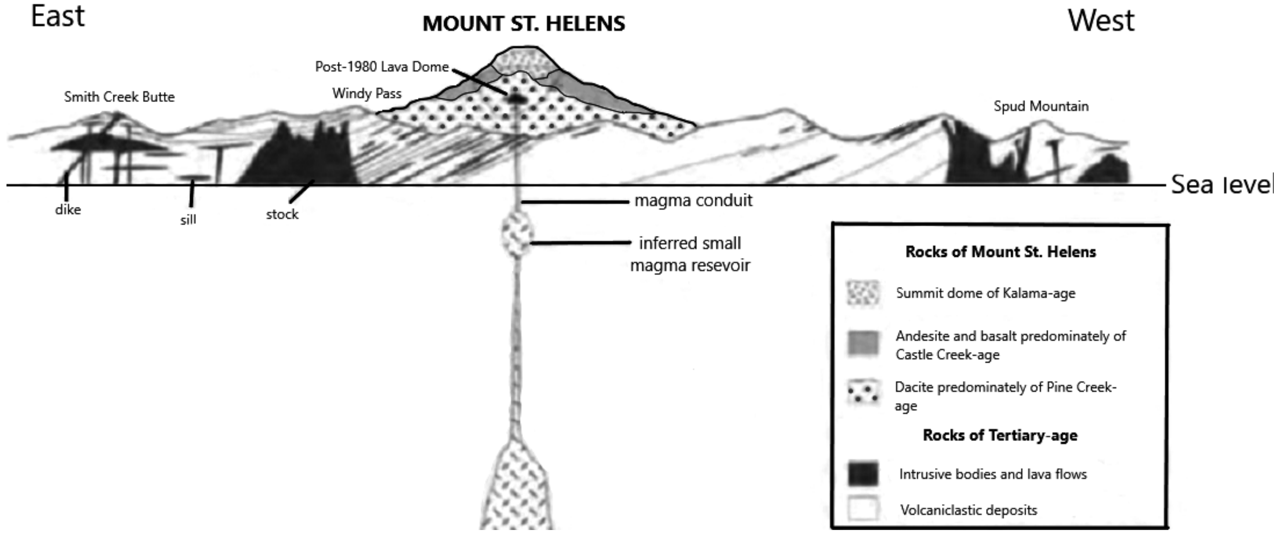

Figure 3. A cross section of Mount St. Helens and the underlying crust clearly depicting the eastward dipping formations of the Lakeview Peak Anticline and adjacent Pole Patch Syncline to the east. Interestingly, the intrusive suite along Spud Mountain has not been greatly deformed by tectonics despite a naturalistic age of 31 Ma, allegedly preceding regional folding by more than 10 Ma. Observe that the dips decrease gradationally towards the west (right) as one nears the Napavine Syncline just beyond the western edge of the diagram. This Napavine Syncline surfaces along the Lakeview Peak Anticline a few km southward, as shown in Figure 1. Modified from Pringle (2002).

Synthem representing the Late Eocene to Early Miocene, which is overlain by the younger Walpapi Synthem of Early Miocene to Pliocene age.

The Walpapi Synthem is exemplified by the Columbia River Basalts, particularly evident in the Columbia River Gorge along the Dalles-Umatilla Synclinorium. Found predominately in structural lows, the Columbia River Basalts have been the subject of much contention over whether they predate or postdate the Cascade Orogeny. Tolan and Beeson (1984) proposed that the Columbia River Basalts were intracanyon flows formed in precursory structural lows through the Cascade Range, but recent research suggests that the Columbia River Basalts were merely *preserved* within structural lows, such as the Dalles-Umatilla Synclinorium (Newcomb, 1967), and thus predate regional folding during the Cascade Orogeny (see Cheney, 2014; 2016a; 2016b and references therein).

Sparsely overlying the Walpapi Synthem, the High Cascades Synthem dated Pliocene to recent is the youngest unconformity-bounded sequence. Dominated by alluvial, laharic, volcaniclastic, glaciogenic, and mass wasting deposits, localized deposits of the High Cascades Synthem dot the erosion surface truncating the Cascade Anticlinorium.

Geology of the Mount St. Helens Region

Towering 1,400 m above the deeply dissected topography in southwest Washington, Mount St. Helens is the westernmost Pleistocene composite cone along the Cascade Anticlinorium (Figure 1). With an extensive history of volcanism and geomorphological evolution, Mount St. Helens is "a living laboratory to document, visualize, and understand a changing landscape" (Austin, 2009). However, this stratovolcano is merely a minor volcanic feature following a long trend of volcanism that both preceded and later succeeded the Cascade Orogeny.

On the western flank of the Cascade Anticlinorium, several truncated parasitic folds comprise a significantly deformed basement that is unconformably overlain by the deposits of Mount St. Helens (Figures 1 and 3). The deeply dissected topography offers spectacular exposures of the internal structure (Figure 4), as Evarts et al. (1987) explain:

Figure 4. The deforestation along the northern regions of Mount St. Helens during the 18 May 1980 eruption left the eastwardly dipping formations (denoted by arrows) of the west limb of the Pole Patch Syncline strikingly visible around Spirit Lake.

> The Tertiary rocks beneath Mount St. Helens strike roughly north-south and dip east at an average of…, forming the northeastern limb of a broad regional anticline that plunges gently south. The axis of the corresponding syncline lies several kilometers east of the mapped area. Such broad open folds are the dominant structures in the Cascade province of southern Washington.

This regional anticline is the Lakeview Peak Anticline (Phillips, 1987a), a doubly plunging antiform that strikes eastward before trending southerly to the west of Mount St. Helens until it is displaced along the younger Chelatchie Prairie fault zone north of Vancouver, Washington (Phillips, 1987b; Evarts and Ashley, 1991; Evarts, 2005). The adjacent syncline east of Mount St. Helens is the,

> broad Pole Patch syncline, a gentle fold in the crustal rocks whose axis is located about 15 mi (25 km) east of the Coldwater Ridge Visitor Center [several km northwest of Mount St. Helens]. (Pringle, 2002, p. 51, brackets mine.)

Complicating the structure of these parasitic folds is the Napavine Syncline to the northwest (Figure 1). This syncline traces along the eastern limb of the Willamette-Puget-Fraser Synclinorium west of the Cascade Anticlinorium before striking eastwardly to the north of the Lakeview Peak Anticline until surfacing along the eastern limb of the Lakeview Peak Anticline northwest of Goat Mountain (Evarts and Ashley, 1990). With amplitudes ranging from an estimated 1–5 km (Swanson et al., 1989), these folds are a sample of the extensive continental foreshortening during the Cascade Orogeny.

Geologic mapping of the region surrounding Mount St. Helens has identified a complex agglomeration of Oligocene to Early Miocene volcanogenic strata correlating to the Kittitas Synthem, although neither the lower nor upper contacts of the Kittitas Synthem have been identified in the region contiguous to Mount St. Helens (Evarts et al., 1987). While this assemblage includes the "remains of basaltic cones and shields, andesitic composite cones, dacite domes, and possibly a small caldera, all intruded by a myriad of subvolcanic to epizonal intrusions" (Evarts et al., 1987), lithified pyroclastics of varying qualities dominate the lithology (Figures 5a and 5b). These volcanogenic beds are assumed to have resulted from subaerial emplacement (Evarts and Ashley, 1993a), although work in recent decades questions that interpretation (Froede, 2000; Oard, 2002; Woodmorappe and Oard, 2002; Froede, 2003). The Kittitas Synthem is locally unconformably overlain by the High Cascades Synthem, which in this locale primarily resulted either directly or indirectly from the Mount St. Helens eruptive cycles.

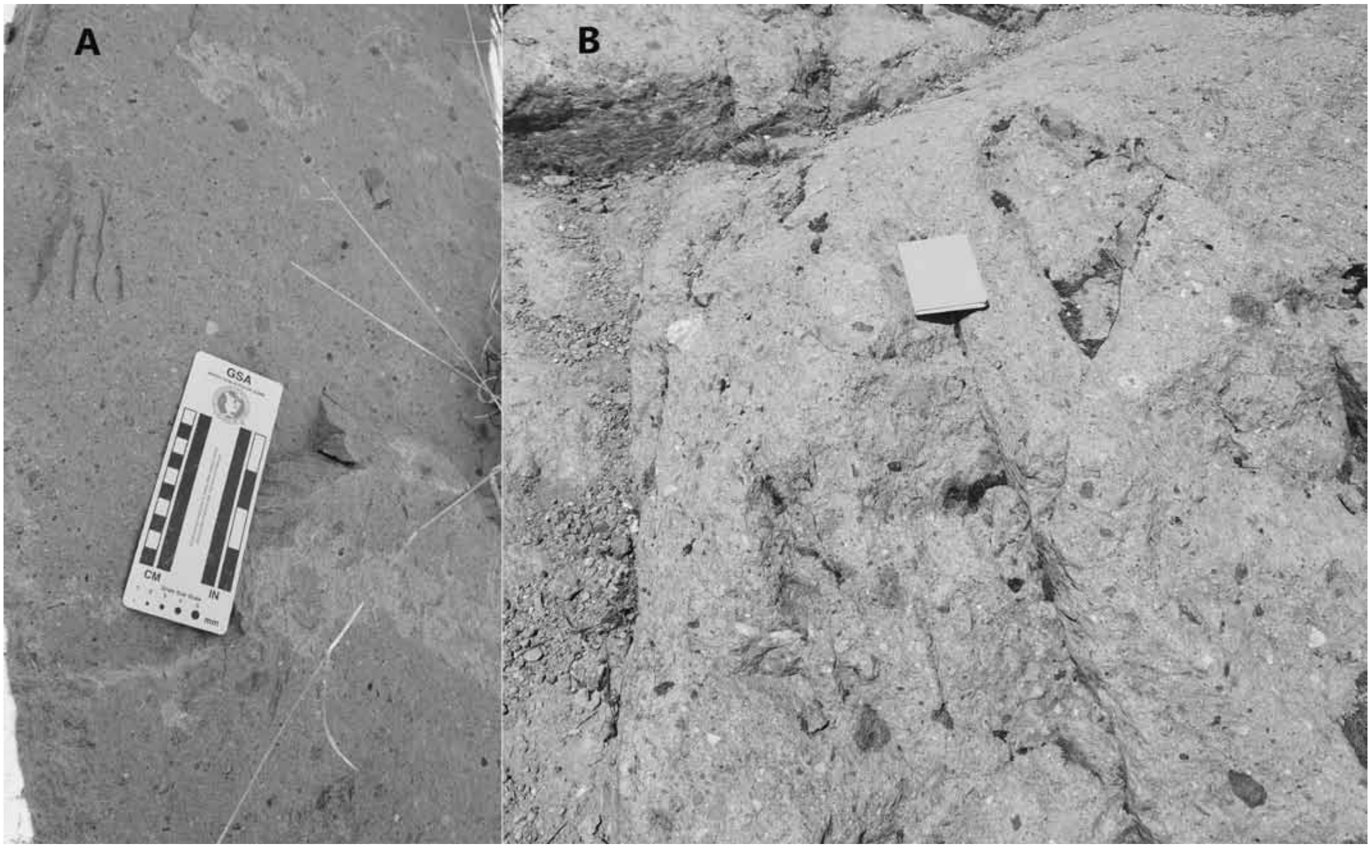

Figure 5. Lithified volcaniclastics are a dominating feature of the Kittitas Synthem throughout the regions contiguous to Mount St. Helens.
A—Roadcuts often expose welded tuff in cross section or contain boulders such as the depicted block.
B—A volcanic breccia (dated approximately 30 Ma) exposed along the Harmony Trail on the northern shores of Spirit Lake.

Intrusives: chronological indicators

Intrusive complexes across the region have been used to decipher the chronology of regional folding. Potassium-Argon dating by Evarts et al. (1987) defined four discrete periods of magmatism dating from the Oligocene to Quaternary. Their first, and most extensive, period commenced with plutonic intrusions, such as the granitic Spirit Lake Pluton, accompanied by extensive extrusion of lava and pyroclastics from the Oligocene to Early Miocene. Evarts et al. postulate local magmatism briefly stalled while regional folding during the Cascade Orogeny (20–15 Ma) formed the Cascade Anticlinorium and its parasitic folds (e.g. Lakeview Peak Anticline and Pole Patch Syncline) until magmatism renewed in the Middle Miocene.

Another episode of magmatism resumed in Late Miocene, although more recent radiometric dating suggests an Early Miocene age (Evarts, 1993a). Intrusives from the "Late Miocene" and subsequent magmatism have remained relatively undeformed and exhumed while their corresponding extrusives were eroded (Hammond, 1980; Evarts et al., 1987), suggesting that these intrusions preceded regional truncation. Evarts et al. (1987) suggest that a final episode of volcanism continued locally through the Quaternary, resulting in numerous intrusions that correspond to their extrusive rocks of the High Cascades Synthem.

The flaws of radiometric dating, however, force us to view this chronology with caution. Drastic revision is not uncommon as new dates are obtained, and they often contradict previous work or alternative radiometric dating schemes. No method is presently available for radiometrically-based relative dating for the Late Cenozoic. Despite the lively debate among diluvialists regarding the use of relative dates (e.g., Humphreys, 2000; Baumgardner, 2012; Froede and Akridge, 2012; Oard, 2013a; Clarey, 2016), examples tend to focus predominately on the pre-Cenozoic or Early Cenozoic strata, and thus lack an

Table 2. Summary of the major stages of intrusives at Mount St. Helens. Because of the questionable dating of these intrusives to specific epochs of the Geologic Timescale, they are here arranged by their relation to the Cascade Orogeny and subsequent erosion. Type localities are also noted, although not all intrusives will always correlate to their faulty radiometrically-assigned date.

Stage	Generally Corresponding Epoch	Type locality
Pre-uplift	Oligocene to Mid-Miocene	Spirit Lake Pluton
Post-uplift/pre-erosion surface	"Late Miocene" to Early(?) Pliocene	Smith Creek Butte Intrusive Complex Kidd Creek Suite
Post-erosion surface	Late(?) Pliocene to Holocene	Goat Rocks Dome

adequate scale of resolution for practicality in the Late Cenozoic.

These challenges to the Evarts et al. (1987) narrative are exacerbated by conflicting chronologies based on intrusives. Although the intrusions of "Late Miocene" (8–12 Ma) postdate regional folding, later radiometric dates (Evarts and Ashley, 1993b) suggested that the intrusions were up to 12 Ma *older* than regional folding (20–15 Ma) despite no evidence of deformation from folding (Evarts et al., 1987). Similarly, the Spud Mountain intrusive suite west of Mount St. Helens, notwithstanding a postulated age of 31 Ma, has not been greatly deformed or tilted by the regional folding that allegedly postdates it by 10 Ma (Evarts and Ashley, 1993b). On a broader scale, the secular construct based on radiometric dating is complicated by the mutually exclusive narratives proposing that the Cascade Orogeny terminated anywhere between 15 Ma to 3 Ma (Appendix). Indeed,

> Stratigraphic details and geologic relationships should be viewed as more factual compared to age-dates, and yet, age-dates seem to always trump any other data sets, *regardless of conflicts*. (Clarey, 2017a, emphasis mine.)

Such is common when dating the Cascade Orogeny, forcing us to rely not on radiometric dating and chronostratigraphy but on empirical stratigraphy to broadly differentiate these various eruptive periods of the Kittitas and High Cascades synthems at Mount St. Helens. These episodes, summarized in Table 2 as pre-uplift, post-uplift/pre-erosion surface, and post-erosion surface, generally correlate to the eruptive cycles of Oligocene to Early Miocene, "Late Miocene" to Early(?) Pliocene, and Late(?) Pliocene to Quaternary, respectively, although there are exceptions which will require further research.

Calculating the magnitude of erosion

The broad open folds of the Cascade Anticlinorium, like any foreshortened region, are analogous to a massive sinusoid whose crests represent antiforms and troughs exemplify synforms. While a fold system can be more complex than a sinusoid, particularly where folding was superposed upon a previously deformed region, the geometry between the axis of the trough and the adjacent crest remain analogous to that of a sinusoid. This allows us to produce a conceptual model to quantify the erosion along the Lakeview Peak Anticline. Extensive mapping of the area contiguous to Mount St. Helens and elsewhere has revealed the fold belt to be shallow and nearly symmetrical without overturned or heavily faulted folds to complicate the structure, making a simple sinusoid a particularly cogent analogy for our calculations.

Like a sinusoid, a fold has a mathematically predictable morphology. Both the crest and trough have their own axial plane that intersects the axis, while the inflection point (midpoint) bisects the sinusoid horizontally. The slope at any point (or pair of infinitely close points) along the sinusoid is measured using a tangent line. As the tangent line measures the slope at a point using a linear function, the tangent line will intersect the antiformal axis either above (higher y-value) or below (lower y-value) the axis depending upon the slope of the tangent line and the position of the point it measures. We may observe from Figure 6 that the intersection of the tangent line and the axial plane produces an angle complimentary to the angle produced by the tangent line intersecting the horizontal plane of the reference point, while the horizontal plane intersects the axial plane at a right angle. This produces a right triangle, simplifying our study to a simple trigonometric calculation.

First, the 20°–25° dip of the strata mapped by Evarts et al. (1987) provides the slope of our tangent line, which constitutes the hypotenuse of our right triangle. Second, the horizontal distance between the arbitrary reference point (from which we can measure relative distance) along the sinusoid to the anti-

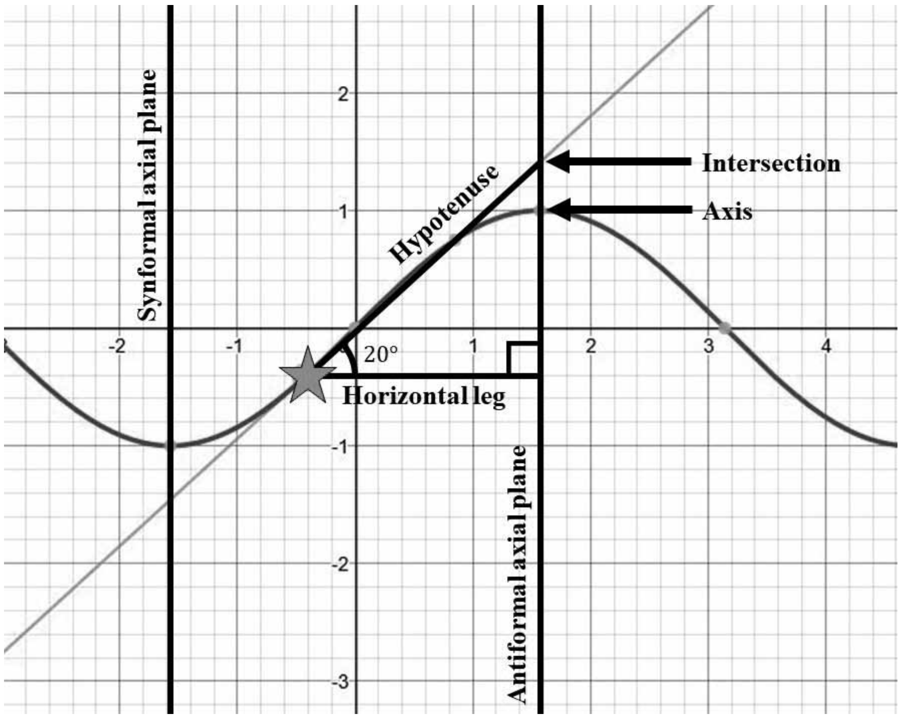

Figure 6. A fold belt is analogous to a sinusoid, which we may use to calculate the height of the Lakeview Peak Anticline before it was truncated. The star denotes an arbitrary reference point, while the slanted line coincident with the line termed 'Hypotenuse' is the tangent line, which in this case is 20° above the horizon. The tangent line intersects the antiformal axial plane (vertical line) at the point denoted as 'Intersection.' The resulting triangle allows us to calculate the vertical distance between the reference point (star) and the 'Intersection,' which we may multiply by a certain value to obtain the vertical distance between the reference point and the axial crest.

formal plane constitutes the horizontal leg. Knowing the slope of the tangent line (and thus the other two angles) and the length of the horizontal leg, we can easily calculate the vertical leg of our right triangle. Because the point at which the tangent line intersects the antiformal axial plane will vary depending on its slope, one must multiply the length of the vertical leg by a certain percentage to yield the vertical distance between the reference point and antiformal axis, as can be seen in Figure 6. Using an arbitrary point for reference, we may easily find this value by examining the structural geology.

Our reference point (Figure 7) lies just west of Smith Creek Butte along the eastern flank of the Lakeview Peak Anticline, as seen in Figure 3. This reference point is approximately 16 km west of the Pole Patch Syncline axis and 28 km east of the Lakeview Peak Anticline axis, placing our reference point approximately 36.7% (16.2/44.2) of the distance from the axis of the Pole Patch Syncline to the Lakeview Peak Anticline. This indicates that the vertical distance from the present topography to the peak of the pre-eroded anticline will be 77% of the length of the vertical leg of our right triangle (see above and Figure 6).

Knowing the minimum slope of our tangent line and the length (28 km) of the horizontal leg b, we may calculate the length of the hypotenuse:

$$\cos 20° = \frac{28.0 \text{ km}}{h}$$

Solving for h yields 29.8 as the length of the hypotenuse or extrapolated strata. To solve for the vertical leg a, or the vertical distance between the present topography to the anticlinal crest, we input this information into the Pythagorean theorem:

$$\sqrt{a^2} = \sqrt{29.8\ldots^2 - 28.0^2}$$

This leads to a = 10.2 km, which we multiply by the 77% (see above) to yield 7.85 km (7,850 m). This value is the anticipated height of the anticlinal crest above the present erosion surface, and thus a likely estimate of the thickness of strata eroded. However, this is a minimal value based on using the lower estimate for the slope. If we used the 25° slope value, the pre-erosion thickness would be 10.1 km.

How extensive is the erosion?

This extensive truncation has greatly altered the topography such that any anticlinal crest is scarcely visible above the adjacent syncline, dictating that the anticline was eroded below the midpoint (inflection point) of this fold system. This has caused the regional fold belt to be nearly invisible on topographic maps because erosion has nearly leveled the structural relief, although geologic maps allow the three-dimensional extrapolation of the pre-eroded structure.

Not only has erosion nearly obliterated any topographical trace of the anticlines, but the synclines have similarly been truncated. After investigating the Kidd Creek Intrusive Suite northeast of Mount St. Helens in the Pole Patch

Syncline, Swanson (1992) noted that this complex postdates regional folding but was solidified at depths between 1 to 5 km before being exhumed by the erosion surface. Because the topographic relief is 1 km, Swanson (1992) proposed that 1 to 4 km has been removed from the Pole Patch Syncline, which would by extension suggest that the Lakeview Peak Anticline was eroded by 1 to 4 km in addition to our calculated 7.85 km (bringing our calculation to 8.85–11.85 km). This local truncation is merely a small segment of the vast erosion surface truncating the entire Cascade Anticlinorium, suggesting that much of the Cascade Anticlinorium was eroded by a similar, if not greater, value.

A preliminary calculation suggests a minimum of 34,000 cubic kilometers of eroded material has been removed from the truncated Cascade Anticlinorium in Washington State alone—greater than the cubic volume of North America's Great Lakes combined (23,000 cubic kilometers). Further research across the Cascade Anticlinorium is required for more specific results.

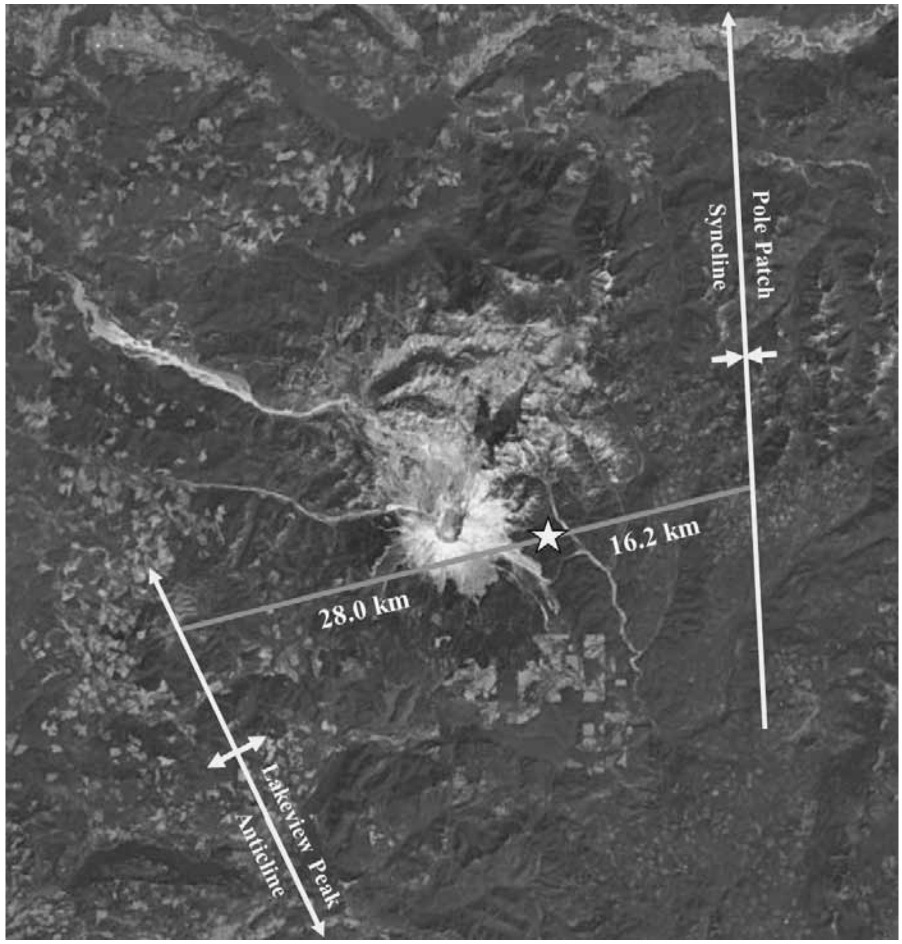

Figure 7. A simplified diagram depicting Mount St. Helens and structural features of the Lakeview Peak Anticline and Pole Patch Syncline; arrows denote direction of plunge (compare with Figure 1 for a more comprehensive examination). The line connecting both Lakeview Peak Anticline and Pole Patch Syncline is a 44.2 km transect representing the distance between axes. The star denotes our reference point west of Smith Creek Butte (shown in cross section in Figure 3), while distances between that point and the axes are also shown.

An enigmatic challenge to secular geology

The formation of this vast erosion surface has long been ignored by secular geologists, no doubt from its challenging implications. Naturalistic geology invokes only gradual processes and the occasional cataclysm; it must rely solely on wind, glacial, fluvial, and mass wasting processes to transform Earth's surface. Options are further restricted when we consider that wind lacks the necessary power, while there is no evidence of glaciers forming such an extensive erosion surface. Similarly, mass wasting would form no such erosion surface and would deposit the sediments in the adjacent valleys, which generally lack extensive basin fill. Such fill would be easily discernable on geologic maps, but many basins in the region are relatively shallow, the obvious exception being the Willamette Valley west of the Cascade Anticlinorium. The Willamette Valley can have tens of meters of surficial deposits but is too far south to contain the vast eroded products of Washington's Cascade Anticlinorium. Furthermore, such sediments pale in comparison to that eroded from the Cascade Anticlinorium (see Plate 15.2 in Cheney, 2016b).

Forced to rely solely on fluvial processes, secular geologists have proposed three primary erosional models (Oard, 2018):

1. Superimposed stream hypothesis
2. Stream piracy hypothesis
3. Stream antecedence hypothesis

Frequently applied to transverse drainages, these models are riddled with assumptions (Oard, 2008b), the first two assuming that the erosion surface formed at the present elevation without significant subsequent uplift, while the third suggests that diastrophism uplifted the erosion surface to the present elevation. Nonetheless, secular geologists must assume that the stream(s) would plane the region rather than transect or circumnavigate the structural barrier, as actually observed today.

The superimposed (or superposed) stream hypothesis postulates that certain structural barriers (e.g., antiforms) were buried by sediment and gradually exhumed by stream erosion, although this model has been discarded by naturalistic geologists chiefly because it assumes that such vast sediment now removed had once buried the underlying topography. Indeed, it posits sediment that is not presently observable anywhere! This problem is magnified by the erosion surface truncating the Lakeview Peak Anticline being a small segment of the erosion surface across the *entire* Cascade Anticlinorium. This forces the conclusion that the entire Cascade Anticlinorium was once buried, but if that happened, the eroded sediment has not been found in any nearby valleys.

Similarly, stream piracy postulates that at least two streams coalesced when one stream eroded more quickly than the other(s) and thereby consolidated the collective discharges into one stream. Although more appropriate for water gaps, one could argue that stream piracy potentially explains the erosion surface, but stream piracy would not create an extensive erosion surface like that extending across the *entire* Cascade Anticlinorium. Instead, it would erode laterally, rounding the folds into ridges separating vast peneplains, as supposed by naturalistic thought, rather than generating a planar erosion surface leveling the folds.

Stream antecedence, the most popularly invoked of the three, is particularly common in the literature on the Columbia River Gorge (Tolan and Beeson, 1984; Tolan et al., 2002), although it has not been proposed for the truncated Cascade Anticlinorium. This model postulates that the stream eroded the substrate at the same rate as the basement rock was being uplifted, opining that erosion and uplift continued in equilibrium. This continued equipoise is highly unlikely to produce transverse drainages (Oard, 2018), so how much more difficult would it be for any stream(s) to erode along vast stretches of the uplifting Cascade Anticlinorium and its parasitic folds, especially maintaining such a perfect equilibrium? Furthermore, the undeformed intrusives near Mount St. Helens were formed at depth subsequent to regional folding, and only later became exhumed by erosion. This indicates that the Cascade Anticlinorium had already been uplifted before extensive truncation commenced.

Not only do these models individually fail to explain the field data, but there is no conceivable combination of them that would explain it. Remember that both anticlinal crests and synclinal troughs have been leveled below the original floor of the synclinal valleys. These naturalistic interpretations furthermore fail to explain how the resulting sediment was transported from the region into the surrounding valleys, which lack the required basin fill. Therefore, two important questions that any model must explain are:

1. How was such an extensive area eroded?
2. Where is the resulting sediment?

Tremendous erosion during the early to late Flood

The Genesis Flood offers mechanisms that can explain the erosion of this region. Deciding which phase of the Flood corresponds to the erosion of the Cascade Anticlinorium requires a combination of various disciplines (Whitmore and Garner, 2008; Oard, 2016), particularly through the application of geomorphology, paleontology (Cowart and Froede, 1994; Whitmore, 2006; Ross, 2012), stratigraphy (Reed, 2005; Clarey and Werner, 2019), and the requisite geologic energy (Reed et al., 1996). While paleontology cannot be applied directly to this locality, the remaining three criteria suggest a dynamic high-energy water event of regional extent produced the ubiquitous erosion surface. Although substantial post-Flood catastrophism negates some of the problems encountered by the gradual processes of naturalistic geology, post-Flood catastrophes appear insufficient to produce the erosion surface due to the scale, as such local events would produce features very similar to the uniformitarian interpretations discussed previously.

Because some undeformed intrusive complexes postdate the onset of regional folding during the Cascade Orogeny but preceded the erosion surface, the formation of the erosion surface would require a prodigious cataclysm. As mentioned above, mass wasting would merely relocate the sediment to a nearby basin, but adequate rock eroded from the region cannot be found in the adjacent synclinoria. Furthermore, the scale of the Cascade Anticlinorium alone is beyond the potential reach of regional catastrophes such as post-Flood lakes or Ice Age floods, which were largely confined to already existent basins rather than traversing major structural barriers. Instead, what is required is a cataclysm that not only encompasses the immediate region but also the adjacent basins. Such a scale could only be achieved during the Genesis Flood.

The truncation of the Cascade Anticlinorium could have occurred during one or a combination of three distinct phases of the Genesis Flood (Figure 8):

1. The initial energy peak of Reed et al. (1996) at the Flood's onset
2. The Zenithic Phase of Walker (1994) at the Flood's climax
3. The recessive Sheet Flow Stage of Oard (2001a; 2001b) during the Late Flood

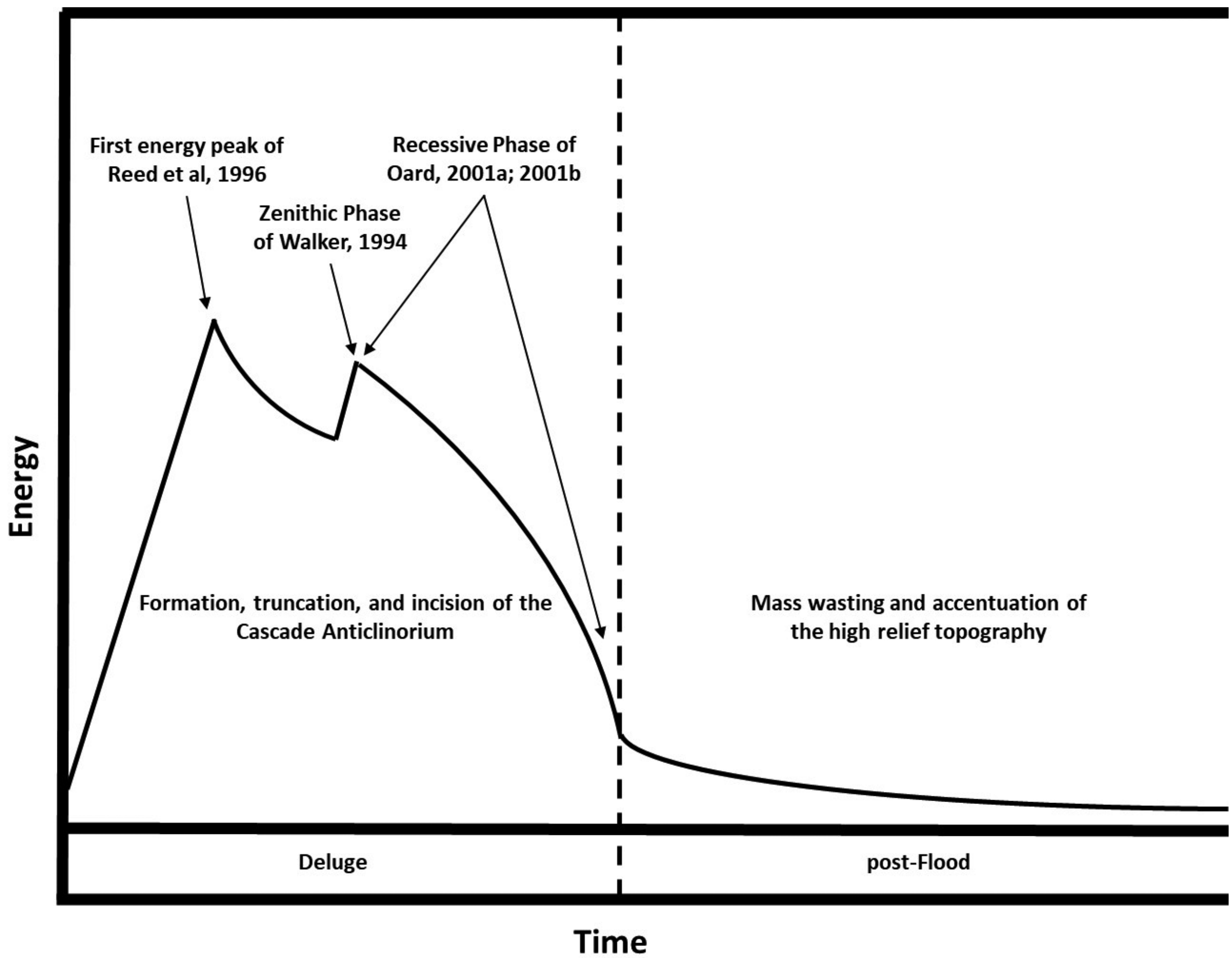

Figure 8. There are three potential phases during which the Cascade Anticlinorium could have been truncated, being: 1) the energy peak of Reed et al. (1996) at the Flood's onset; 2) the Zenithic Phase of Walker (1994) at the Deluge's climax; and 3) the Sheet Flow Stage during the Recessive Phase of Oard (2001a; 2001b) in Late Flood. As Earth gained a quasi-equilibrium state in the post-Flood era, processes such as mass wasting, glaciation, and others would accentuate and sculpt the high-relief topography. Designed after the energy curve in Reed et al. (1996; their Figure 1); not to scale. Similarities between models does not imply complete agreement between the chronologies of Walker (1994), Reed et al. (1996), and Oard (2001a; 2001b).

Determining which stage the truncation occurred must be accomplished through the application of various disciplines, as discussed above. Vertebrate ichnofossils in the Chuckanut Formation and Puget Group of the Challis Synthem (Mustoe, 2002; Mustoe et al., 2012; Mustoe and Hopkins, 2013) indicate an Early Flood or prior origin of the Challis Synthem (Cowart and Froede, 1994; Oard, 2013b), but few fossils in younger synthems make direct dating of the later deposits and subsequent Cascade Orogeny difficult. Stratigraphic analysis of the Cascade Anticlinorium could produce a relative chronology of regional tectonism which in certain locales may be dated directly. For example, determining the age of the Columbia River Basalts (which predate the Cascade Anticlinorium, as discussed above) would help determine the timing of the Cascade Orogeny.

Despite this uncertainty, a general chronology may be inferred. Regardless of the stage, the Cascade Orogeny would overlap with other tectonic regimes across the region, such as rifting in Eastern Washington and uplift of the nascent Rocky Mountains, as attested by the Columbia River Basalts (Woodmorappe and Oard, 2002). Although irregularities would develop, the receding floodwaters would generally trend westward across the Cascade Anticlinorium towards the Pacific Ocean, which would be strengthened by floodwaters receding westward from the nascent Rocky Mountains to the east. Some of the eroded lithics would be deposited in the Willamette-Puget-Fraser Synclinorium west of the Cascade Anticlinorium, but the lack of extensive basin fill suggests that much of the sediment was transported into the Pacific Ocean Basin. Following truncation, further erosion of the Cascade Anticlinorium would continue on a diminished scale during the Late Flood channelized erosion phase and into the post-Flood period, sculpting and accentuating the deeply dissected topography (Walker, 1994; Whitmore, 2013).

Additional research is necessary to properly ascertain the complexities of the regional diastrophism and denudation of the Cascade Anticlinorium during the Genesis Flood and subsequent volcanism and accentuation during the post-Flood era. Such study should ascertain: (1) when during the Genesis Flood was the Cascade Orogeny and subsequent truncation; (2) what volume of material was eroded from the Cascade Anticlinorium; and (3) where the resulting sediment was deposited, as further work in this series will endeavor to answer.

Implications for the Western Coast of the United States

Such tremendous erosion across the Cascade Anticlinorium has major implications on our understanding of receding floodwaters throughout the western United States. Before extensive erosion, the Cascade Anticlinorium would pose a great barrier along much of the Western Coast during the Genesis Flood, temporarily impeding the recession of floodwaters flowing westward from tectonic adjustments along the Rocky Mountains. Both the uplift of the Cascade Anticlinorium to the west and the Rocky Mountains to the north and east would funnel the receding floodwaters southward through Eastern Washington and Oregon toward the present provinces of basin and range (Nevada), Colorado Plateau (Arizona), and others. Further research may use these currents, resultant deposits, and erosive features to decipher a relative geologic chronology for the Western United States.

Conclusions

Once again, empirical geology continues to contradict uniformitarian geohistory. The development of such a widespread erosion surface, in addition to both the calculated depth of erosion along the fold belts and the estimated volume of sediment it represents, collectively suggest hydraulic energy and scale that can only be satisfied by the Genesis Flood. Mount St. Helens straddles the massive erosion surface that truncates a belt of parasitic folds, including the Lakeview Peak Anticline and Pole Patch Syncline. Using various mathematical models, this study has estimated that a minimum of 7,850 m of strata was eroded from the Lakeview Peak Anticline, while now exposed intrusive suites in the adjacent Pole Patch Syncline indicate even greater erosion. The consistency of this extensive truncation suggests vast erosion across much of the Cascade Anticlinorium. Some undeformed intrusive complexes postdating the Cascade Orogeny were exhumed during the formation of the erosion surface, demonstrating that much of the erosion across the anticlinorium postdates the Cascade Orogeny. This severely challenges the naturalistic paradigm.

That this erosion surface probably developed in the Late Flood is suggested by the timing of the Cascade Orogeny relative to other regional geologic events. A post-Flood erosion event is rejected because of the scale and nature of the erosional surface, while post-Flood local catastrophic models also fail to explain the transport of the resulting debris beyond the immediate basins. While baffling to both secular and post-Flood models, the Cascade Anticlinorium is a testimony to the Genesis Flood.

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Appendix

Naturalistic geologists have proposed various conflicting chronologies of the Cascade Orogeny that continue to be debated. Bretz (1917) suggested that the Cascade Orogeny commenced merely 3 Ma, while later research by Tolan and Beeson (1984) on the Columbia River Basalts suggested a minimum date of 15 Ma, similar to that of Evarts et al. (1987), Swanson et al. (1989), and Evarts and Swanson (1994) who suggested the Cascade Orogeny occurred between 20–15 Ma. Recent work by Cheney (2014; 2016a; 2016b) suggests a return to a younger date of approximately 4 Ma, which was corroborated by Mustoe and Leopold (2014) using paleobotany.

To resolve these conflicting dates, Mitchell and Montgomery (2006) proposed that the Cascade Range of Northern Washington was uplifted before 15 Ma while the Cascade Range of Southern Washington was uplifted after the emplacement of the Columbia River Basalts (17 to 4 Ma). However, they did not address the anomalous features that reside wholly within the Southern Washington Cascade Range, which cumulatively necessitate uplift either between 20–15 Ma or approximately 4 Ma. Such a multi-million-year disparity is unusual, considering that naturalistic geologists opine to be capable of dating geologic events with a resolution of one hundred-thousand years! Debate over these various naturalistic chronologies of the Cascade Orogeny will persist until a reevaluation using sound stratigraphical and geomorphological principles is proposed.

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Strategies for More Clearly Delineating, Characterizing, and Inferring the Natural History of Baramins II:

Evaluating Diversity, with Application to the Order Galliformes (Class: Aves)

Jon Ahlquist* and Jean K. Lightner**

Abstract

One foundational goal of baraminology, or the study of created kinds, is to identify which creatures known today are related in that they belong to the same created kind (baramin). From this foundation, baraminology provides a robust framework for better understanding biology and the natural history of life. Once a baramin is delineated with reasonable certainty, it is important to evaluate the unity and diversity within the group. This allows well-reasoned inferences on which traits can undergo change, and which are largely fixed. In part I of this series, we examined the avian order Galliformes, or chicken-like birds. Here we evaluate each of the five galliform families and note some of the morphological and behavioral diversity in this group. This will lay a foundation for further study regarding the natural history of this baramin, and may help to uncover mechanisms involved in generating this diversity (e.g., created heterozygosity, genetic changes, migration, hybridization, etc.).

Introduction

Baraminology can be defined as the study of created kinds, or baramins. This biblically based systematic study of life begins by identifying species that are truly related because they descended from the same created kind (Genesis 1:11–12, 21–22, 24–25). As discussed in the first paper in this series (Ahlquist and Lightner, 2019), this is no small task. Multiple lines of evidence including morphologic, behavioral, and molecular characteristics should all point to the same conclusion before a baramin is considered well-established.

While clearly delimiting baramins is foundational, it is by no means the end of the subject. Characterizing baramins

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not only highlights the unity within the baramin, but points to important diversity as well. The diversity can be further assessed in an attempt to identify what portion was created, and what portion has arisen during the natural history of the baramin (e.g., through genetic changes). This is important to a proper understanding of biology and the design endowed by the Creator that allows His creatures to reproduce and fill the earth.

The result of this approach is a more robust foundation for biologic inferences and hypotheses regarding the design of life and its natural history. Currently, most biologists assume all life is related by universal common ancestry. This leads to some bizarre proposals for natural history. For example, evolutionists are often forced to infer massive gene gains, followed by massive gene losses to account for the large molecular gaps between higher level taxa (Wolf and Koonin, 2013; Rosenfeld et al., 2016). Baraminology, with its recognition of a loving Designer and limited common descent, will provide a stronger, more plausible foundation for understanding biology.

In this paper we examine the five landfowl families in more detail, noting the distribution and characteristics that make each of them unique.

Figure 1. Family Megapodiidae. Micronesian Megapode *(Megapodius laperouse)*, running. Note large feet characteristic of the family. Photo by Michael Lusk. Courtesy of Wikipedia Creative Commons.

Megapodiidae

The family of Megapodes or mound builders, comprise 22 species mainly Australo-Papuan in distribution (Figure 1). The following information has been taken from the account by Elliott (1994), Jones et al. (1995), and a shorter, but difficult to find, article by Sekercioglu (1998).

"Megapode" is a reasonable substantive name for the group. The genus *Megapodius* derives from the Greek μέγας ("large") and πούς, ποδός ("foot"), and alludes to the fact that the birds have outsized feet for their size. (Figure 1) "Mound-builders" is more appropriate with respect to their biology, but not all species build mounds. The German *Thermometerhuhn* comes closest, but "thermometer fowl" doesn't reflect happily in vernacular English.

Although centered in Australia and New Guinea, megapodes have colonized distant islands including Niuafo'ou, Kingdom of Tonga, Central Polynesia; Palau and Marianas Islands in Micronesia; Nicobar Islands in the Bay of Bengal; Solomon Islands; and Vanuatu (formerly New Hebrides). In addition to Australia and New Guinea megapodes inhabit islands in Indonesia and the Philippines. The limiting factors include the presence of mammalian predators such as cats (Felidae) and civet cats (Viverridae), hence megapodes are not found on Borneo, Sumatra, Bali, or Malaysia.

Megapodes are unique among birds in that they do not directly incubate their eggs. They place their eggs in mounds of decaying vegetation—think of an avian compost pile—which is raked from the surroundings (Figure 2). Some place their eggs in warm sand or in burrows close to geothermal vents. The details of this nesting system are so remarkable that they point unambiguously to design and defy attempts to imagine, much less demonstrate, how random events could have produced them. Here we examine a few points of their remarkable breeding biology.

Mounds

The commonest "nest" is a large mound of leaf litter, twigs, and soil raked by the birds from the surrounding area. The process is carried out by the male, in

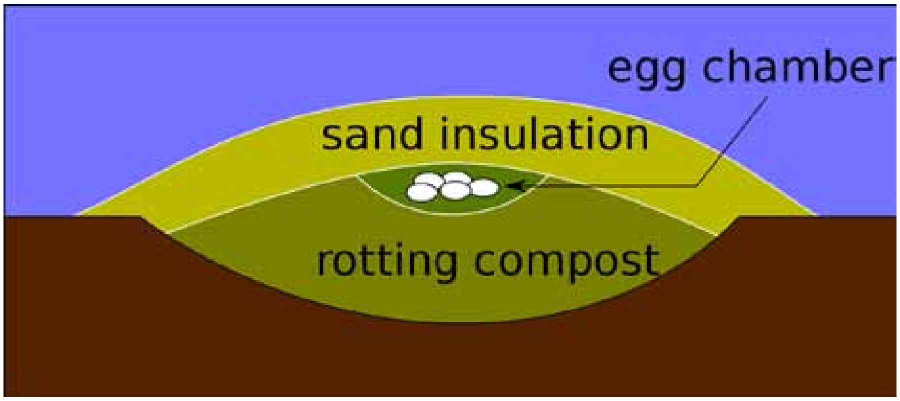

Figure 2. Cross section of a Malleefowl *(Leipoa ocellata)* mound. Artist Peter Halasz. Courtesy Wikipedia Creative Commons Share Alike 2.5 Generic License.

some species with assistance from the female, and can involve months of laborious activity. The material naturally contains a community of fungi, bacteria, and tiny microorganisms that flourish within the mound. Their metabolic activities generate heat which serves to incubate the megapodes' eggs. The birds themselves aid this by adding or removing fresh material, thus regulating the temperature and moisture levels, and keeping the soil aerated by their digging. The birds have a unique temperature-sensing mechanism probably in their tongue or palate—not conclusively demonstrated—and can adjust the incubation temperature by their activities. Ideally, the temperature is maintained around 32–35 °C. The female periodically excavates a hole into the mound into which she lays an egg, thus the breeding cycle is prolonged.

Mounds may be constructed annually, as in the Malleefowl (*Leipoa ocellata*), attain a height of approximately 1.5 meters, a diameter of around 5 meters, and contain several tons of debris. Other species, such as the Orange-footed Megapode (*Megpodius reinwardt*), build upon the same mound year after year. Such mounds can reach 5 meters in height and 12 meters across. A few have been known to be used for 40–50 years by successive generations of birds.

Of 22 species of megapodes, 19 construct mounds. Of these, five also utilize other heat sources in some parts of their range. Only three species—Maleo (*Macrocephalon maleo*), Moluccan Megapode (*Eulipoa wallacei*), and Polynesian Megapode (*Megapodius pritchardii*)—use geothermal or solar-heated sites.

Geothermal heat sources

Considering the amount of volcanic activity in the region, some megapodes, most notably the Maleo (*Megacephalon maleo*), endemic to Sulawesi, dig burrows in proximity to geothermally heated water. The birds excavate burrows around tree roots and boulders, seeking a site with the proper temperature. After laying, the egg is covered with loose dirt or sand and left entirely on its own for incubation. Favorable areas such as those on New Britain may attract thousands of birds during the breeding season.

The Maleo possesses an unusual elongated casque on its head, a rearward projection of the parietal bone. Often thought to play a role in sensing the temperature of the burrow, this appears not to be the case as individuals have been observed to take a bill full of sand while digging the nest burrow (Jones et al., 1995, p. 138), the same as other megapodes. A more likely function is that of thermoregulation, as the exposed area is richly vascularized, similar to that of the Helmeted Guineafowl, *Numida meleagris* (Crowe and Withers, 1979). Another postulated function is that of a shock absorber when the bird cracks open hard nuts (Starck, 1988).

Solar heated sources

Sand warmed by the sun is sought by a number of island-dwelling megapodes, mainly of the genus *Megapodius* that are good colonizers. The birds converge on several favored areas, sometimes by the thousands, excavate burrows to an appropriate depth, deposit their eggs, and then disappear into the inland forests while the young develop and hatch.

The egg

Because predation pressures exist on adults tending the mound, on the eggs (largely by human harvesting), and on newly emerging chicks, female megapodes lay a large number of eggs, staggered over a protracted nesting period. It is difficult to determine the number of eggs laid in a season by an individual, but an average clutch size of 12 to 24 is not unusual, and an exceptional number of 56 has been reported from a captive female. The intervals between eggs range from two to nine days in Australian Brush Turkeys (*Alectura lathami*) up to 13 days in Orange-footed Megapodes (*Megapodius reinwardt*). The interval reflects the need for the female to acquire enough nutrients for egg formation. In a season a single female Malleefowl (*Leipoa ocellata*) may produce eggs equivalent to 150–250% of her body weight, and a Maleo may lay eggs equivalent to 120–180% of female body weight.

The egg is large compared to the mass of the female, ranging from 75g in the Polynesian Megapode (*Megapodius pritchardii*) to 231g in the Maleo. A more meaningful way of expressing this value is that it represents between 10% to 22% of the female's body mass. In this respect only the flightless kiwis of New Zealand lay larger eggs.

The amount of yolk is high, occupying from 48 to 69% of egg contents, reflecting the requirements of the developing chick. Correspondingly, the water content is low.

The egg shell is remarkably thin. The pore size changes (enlarges) as incubation proceeds, the calcium being utilized by the developing embryo. These features are designed for incubation in the mound where oxygen tensions are low but carbon dioxide and moisture are high.

Incubation times are long—49–65 days being the normal range—and are related both to slower developmental rates as well as the precocity of the young at hatching.

Contrary to what one might expect, there is a definite breeding season, its length being terminated by the dry season in arid Australia or the onset of monsoonal rains in the tropical forests or sandy beaches.

The chick

Young megapodes hatch in a hyper-precocial condition with fully developed feathers. Although an egg tooth is present during development (as in other birds), it is not used in hatching. Because of the limited water loss in the egg, an air space does not form late in incubation as in other birds. Thus, there is no overlap between chorioallantoic and pulmonary respiration in megapodes. The chick hatches by resolutely kicking free of the shell, which is already thinned during development, a process that takes only minutes. This means that blood flow through the chorioallantois stops immediately after it is torn by the feet. Its lungs lose fluid immediately and aerate rapidly.

More challenging is digging its way out of the mound, a process that can take from a couple hours to a couple days, depending on the depth of the egg and the compaction of the compost.

Once out of the mound, the young immediately finds food on its own, is capable of thermoregulation between ambient temperatures of 3°C to 46°C, and can fly on the day of hatching. They receive no parental care. Little is known about the life of the young after it exits the mound, as they quickly disappear into the forest. Mortality is high, exceeding 90% in the first year of life, but this is balanced by the large number of eggs laid by each female and the staggered hatching times.

An intriguing question is how megapode chicks recognize their own species considering that they hatch out independently from other nest mates and do not see their parents. Göth and Evans (2004) investigated this using newly-hatched megapode chicks and robotic models made from megapode chicks dying from natural causes. In a test enclosure the robotic chicks were programmed to perform various behaviors and the responses of naive chicks were measured. Not surprisingly, the positive responses were toward pecking for food, something that the young chicks would instinctively look for.

Most interesting were the chicks' responses to various light regimes. Here the legs and feet of the robots reflected light strongly in the UV and elicited a strong response from the live birds. This would be a definite clue as to species identity. Furthermore, reflection of blue UV light would be invisible to an avian predator overhead, and would not be perceived by a mammalian predator on the ground. Presumably, only snakes and goannas (*Varanus* lizards) would potentially be able to see in the UV range.

The advantages of this nesting system are that it reduces the energy investment in parental care and enables the female to lay large clutches over an extended period of time. This habit could only occur in an area where predation by land animals is low enough to permit its maintenance. Evidently, in the Australo-Papuan area existing predators such as monitor lizards, snakes, and raptorial birds are not mitigating factors. Megapodes, surprisingly, are good colonizers. Even young birds have been reported flying over water miles from any land.

Cracidae

Curassows, guans, and chachalacas comprise 55 species found in Central and South America (Figure 3). Information is taken from the monograph by Delacour and Amadon (1973) and del Hoyo (1994).

We may think of cracids as being arboreally adapted pheasants. They are characterized by long tails and legs with all four toes being on the same level, unlike other landfowl. This adaptation, especially of the hallux, or hind toe, enables them easily to grasp tree limbs, even small twigs. The plumage is somber-colored, being black or barred brown in guans and curassows and uniform pale tan in chachalacas. Bright colors are restricted to the legs and feet and more especially to the facial region which is characterized by knobs, horns, dewlaps, or wattles that serve as sexual markers as well as species-specific characters.

The sexes are usually similar in plumage, and the birds are monogamous. Unlike other landfowl, they construct a nest in trees and lay small clutches of eggs, two or even one in the larger curassows and three or four in the smaller guans and chachalacas. Both sexes participate in care of the young. The young are adroit at clambering around in the trees after hatching and can fly within a few days. Also, unlike

Figure 3. Family Cracidae. Yellow-knobbed Curassow *(Crax daubentoni)*, female, captive bird. Photo by Jim Capaldi. Courtesy of Wikipedia Creative Commons.

Figure 4. Family Numididae. Helmeted Guineafowl *(Numida meleagris)*. Except for the genus *Agelastes*, the finely dotted plumage is a hallmark of the guineafowl. Photo by Lip Tee Yap. Courtesy of Wikipedia Creative Commons Attribution-Share Alike 2.0 Generic License.

other landfowl, the young are fed by both parents for a considerable time until independence is reached.

Unfortunately, cracids are good to eat and easily shot. The result has been that many species are in decline and endangered through the twin pressures of habitat loss and over-exploitation. Their low rate of reproduction simply cannot maintain viable populations under such conditions.

Odontophoridae

The New World quail contain 34 species of North, Central, and South America (Figure 4) and are apparently not closely related to their Old World ecological counterparts. Data are from Johnsgard (1988), Madge and McGowan (2002), and Carroll (1994).

The New World quail form a compact group of small to mid-sized landfowl including the familiar Bobwhite (*Colinus virginianus*) of the eastern U.S., desert species of the American southwest (*Callipepla*), to the wood-quail (*Odontophorus*) inhabiting Neotropical forests south to southern Brazil. Superficially, they resemble Old World quail but are distinguished by a toothed, or serrated, bill and the lack of tarsal spurs. The bill is of a distinctive high-arched shape, and many members possess head crests or plumes. Numerous anatomical features serve to separate them from Old World forms (Holman, 1961). Cladists consider most of these characters to be symplesiomorphic (primitive) and not indicative of true relationships.

Numididae

Guineafowl are a small group of 6 species found in south Saharan Africa (Figure 5); information is taken from Martinez (1994).

The guineafowl, along with the turacos and colies, are the only families endemic to Africa. They exhibit many characters in common with other landfowl, but can be recognized by their excessively rotund shape accented by a thin neck and relatively small head. This gives them a distinctive profile. This shape is further enhanced by the fluff of upper tail coverts. The head and neck are usually devoid of feathers, brightly colored, and with a variety of bony or fleshy protuberances or other excrescences, sometimes ornamented with a tuft of feathers on top of the head. In addition to bearing species-specific characters the bare skin is believed to function in thermoregulation. The plumage, except in *Agelastes*, is finely and exquisitely dotted with white. The best-known species is the Helmeted Guineafowl (*Numida meleagris*), which is widely domesticated.

Guineafowl are highly terrestrial birds, retiring to trees only at night. They range from open country, to grasslands, and dense tropical forests. Typical of landfowl, they lay large clutches of 6–12

Figure 5. Family Phasianidae, Subfamily Meleagridinae. Ocellated Turkey *(Meleagris ocellata)*. Photo by Dennis Jarvis. Courtesy of Wikipedia Creative Commons Attribution-Share Alike 2.0 Generic License.

Figure 6. Family Phasianidae, subfamily Tetraoninae. Rock Ptarmigan *(Lagopus muta)*, spring plumage (molting), showing fully feathered feet and toes. Photo by Friedrich Böhringer. Courtesy Wikipedia Creative Commons Share Alike 2.5 Generic License.

eggs, incubated by the female alone with the male standing guard nearby.

Phasianidae: Pheasants and Allies

This large assemblage, mainly Old World in distribution, divides into several natural groups. Here we list them for convenience as subfamilies. Most taxonomies recognize turkeys and grouse as separate groups. Beyond that, the remaining large group is either recognized as a single family or split into two subfamilies, Perdicinae and Phasianinae, which works satisfactorily, even by eye.

Meleagridinae

There are 2 species of turkeys, one in the United States and another in Mexico (Figure 6).

Turkeys hardly need an introduction (see Porter, 1994). The Wild Turkey (*Meleagris gallopavo*) is considerably sleeker than its overweight commercially produced cousin and sports an incredible plumage of coppery iridescence. A second species, the Ocellated Turkey (*Agriocharis ocellata*) of Yucatan and adjacent areas, is somewhat smaller and more strikingly arrayed in plumage of iridescent greens.

Turkeys are polygynous with a male attending a harem of females with whom he mates. Egg laying, incubation, and tending of the young is the role of the female herself.

The Wild Turkey (*Meleagris gallopavo*) is a fairly hardy omnivore, breeding into southern Canada and occupying a variety of habitats. In the eastern United States, they are primarily feeders on mast of oaks (*Quercus*), beech (*Fagus*), and chestnut (*Castanea*) during winter. The clearing of forest, chestnut blight, and over-exploitation reduced their numbers drastically. One of the great wildlife management victories of the twentieth century was the re-introduction of wild individuals (not game-farm raised birds) to areas from which they had been extirpated. This was aided by the regrowth of eastern hardwood forests and assiduous protection from landowners.

Tetraoninae

The grouse are mainly Holarctic with 17 species or more depending on the authority followed (Figure 7). Johnsgard (1983) and de Juana (1994) provide good introductory accounts. Hennigan (2000) gives valuable data on the Ruffed Grouse (*Bonasa umbellus*) from the point of view of creation biology. The data on physiology come from the monograph by Potapov and Sale (2013). Roald Potapov began studying grouse as a teen in 1947 near St. Petersburg (Potapov, 2011) and over 60 years later produced his monograph in English. This work is of paramount value as it summarizes his own research and much Russian literature unknown to us in the West. Russian biology focuses on what we might term "physiological ecology" and those species

Figure 7. Family Phasianidae, subfamily Tetraoninae. Sharp-tailed Grouse *(Tympanuchus phasianellus)*. Photo by Alan Schmierer. Courtesy of Wikipedia Creative Commons CC0 1.0 Universal Public Domain Dedication.

Figure 8. Family Phasianidae. Erckel's Francolin *(Pternistis erckelii)*. Photo by Dick Daniels (http://carolinabirds.org/). Courtesy of Wikipedia Creative Commons Attribution-Share Alike 3.0 Unported License.

of economic value such as grouse merit a great deal of attention.

We may consider grouse to be a group of boreal pheasants. Their design and adaptations rival those of the megapodes, although we are less likely to appreciate the details. The principal adaptations are to the cold and fall into four main areas.

Feet and feathers

Pectinate toes are a feature of grouse—except for the three species of prairie chicken (*Tympanuchus*)—that are unique among landfowl. The pectinations are comb-like, deciduous horny projections along the sides of the toes. They more than double the surface area of the feet and are important in enabling the bird to walk on soft snow (think snowshoes) and to dig rapidly in snow.

At the base of the tarsometatarsus are condyles for the attachment of the toes. In grouse they are so arranged that the toes can be spread more widely than in other phasianids, again an adaptation both for digging in and walking on soft snow.

The design of feathers provides further assistance in the harsh winter weather. The nostrils are covered with feathers, not a horny operculum as seen in other landfowl. The feather covering serves two purposes: protection while digging in snow and a means of retaining moisture from exhaled air. The latter is important in keeping humidity in the snow burrow low and preventing ice formation on its walls, thus depriving the bird of oxygen while incarcerated.

All grouse have feathered legs and feet to some extent. Depending on the climate, the feathering may cover only the tarsus, or in the case of the ptarmigan (*Lagopus*) may extend all the way to the tips of the toes. The feathers of the tarsus point backward. This aids in moving through snow and, more importantly, forms an effective cushion of warmth to the legs and feet while the bird is in its snow burrow.

Finally, the down feathers have a special structure that provides for more efficient insulation against the winter cold.

Beak and feeding

Grouse are designed for feeding on low-quality foods, namely buds, twigs, and conifer needles, not "good eats" even to a dedicated vegetarian. The beak and associated parts of the skull enable the birds to nip off twigs and twist off conifer needles. The maxillary and mandibular tomia (the horny cutting edges of the bill) are sharp and employed as follows. The bird begins at the end of a twig and successively nips off pieces that are slightly less than the width of the beak. The twig is held in place somewhat diagonally by ridges on the palate as it is cut. The bird simply works down the twig until its diameter precludes being easily cut, then moves to the next one. Conifer needles are seized by the bunch and are resolutely cut and torn away by a jerk of the head.

The usual foods are the commonest and consist of buds and twigs of birch (*Betula*), willow (*Salix*), alder (*Alnus*), and poplar (*Populus*). The needles of pines (*Pinus*), spruce (*Picea*), fir (*Abies*), hemlock (*Pseudotsuga*), larch (*Larix*), and cedar (*Juniperus*) are consumed. All are super-abundant. In the worst of weather conditions, the birds can fill their crops in a half-hour's time, then dive into the safety and comparative warmth of a snowbank, and proceed with digestion.

The crop itself is supplied with muscular connections to the sternum that assist in its being able to distend considerably.

Digestion

Two important questions arise concerning the diet of grouse. The first is the low quality of the food consumed. The second is the potentially hazardous nature of the secondary chemical compounds in conifer needles and other plant products eaten by the birds.

Unlike ruminate mammals or termites, grouse do not have a symbiotic micro-organismal flora to break down cellulose into its constituent sugars. The indigestible plant material is selectively passed to the large intestine where the water contents are resorbed. What is defecated is a dry and odorless pellet. The advantage of this fecal matter is twofold. It does not attract mammalian predators to the bird's igloo in the snowbank, and it does not contain excessive moisture to disturb the humidity inside. The warmth of the excreted pellets also provides heating to the burrow.

The material useful for the nutrition of the grouse is moved into large caeca, which are extensions from the small intestine and which act as a fermentation vessel to extract nutrients. The caeca of grouse average from 60–140% of the length of both small and large intestines, providing a copious chamber. The pelvis of grouse is broader than in pheasants to accommodate the mass of the digestive system.

The entrance to the caeca in the domestic fowl is shown by McLelland (1991, Figures 152, 153, p. 63) in scanning electron micrographs. One can see the caecal sphincters exercise considerable control over the products of digestion that are admitted. In grouse the muscular sphincters are enhanced by a filter system formed by thick three-cornered protuberances (Potapov and Sale 2013, Figures 14 and 15, p. 22).

Nutritional values for over two dozen food items are summarized by Potapov and Sale (2013, Table 4, p. 29). The large volume of the caeca plus the long time for bacterial fermentation ensures maximal absorption of nutrients as demonstrated by examination of caecal contents. Grouse have thus maximized a digestive system already designed in landfowl.

The burrow

Making the burrow is greatly facilitated by the adaptations of the feet described previously. A grouse being pursued by an aerial predator like a Goshawk (*Accipiter gentilis*), can plunge into the snow and excavate a burrow within seconds. For the more leisurely task of digesting food, rapid burrowing is also an advantage to escape detection by predators in general.

The burrow is more than a hole in the snow. The bird digs a tunnel of suitable length and depth to provide for warmth. It is critical that the air temperature of the burrow is between -3°C (27°F) and -1°C (30°F). Much lower and the bird is below its thermo-neural zone and risks hypothermia; above freezing will cause moisture to form, endangering the insulating capabilities of its feathers. The bird is able to sense the temperature and poke its head through the snow to let in cooler air, or dig in deeper if necessary. The temperature receptors are located in the palate and tongue, as they are in megapodes (above). Domestic fowl are quite sensitive to temperature differences (Freeman, 1983; Kare and Mason, 1986), and it is possible that this ability is even more finely tuned in grouse.

A burrow is used only once, but may be occupied for 22 hours or even longer. During this period the night temperatures outside can drop to -40°C (-40°F). The temperature inside the burrow is maintained by the heat of the bird, the heat from the excreted droppings, and heat of exhaled air from the nostrils.

If the bird leaves voluntarily, it pokes its head through the snow to check for possible predators, then breaks through, and walks away, leaving a few feet distant the caecal droppings, which are odoriferous.

Phasianinae

The Old World partridges include 108 species. Their distribution is entirely Old World and represent quail, partridges, francolins, and spurfowl. Pheasants, of which 51 species are recognized, include tragopans, pheasants, and peafowl, all Old World. (Figures 8–10)

The remaining landfowl run the gamut from tiny quail to the large peafowl (*Pavo*) and argus pheasants (*Argusianus*). We are used to marveling at the array of striking plumages displayed by the males of many pheasants, but one would do well to observe—whether in museum skins or close-up photographs on the Internet—the subtler patterns in tans, browns, grays, and white shown by the less gaudy members of the group. Here, the delicate patterns of individual feathers are so varied as to be different from one species to another. What the Creator has set aside in bright colors, He has more than made up for with intricacies of design.

The Phasianidae live in habitats from desert to rain forests and in alti-

Figure 9. Family Phasianidae. Temminck's Tragopan *(Tragopan temminckii)*, male. During courtship the bright blue skin around the face and neck can be inflated into an impressive structure. Photo by "Fr. Ted." Used courtesy of Wikipedia Creative Commons Attribution-Share Alike 2.0 Generic License.

tudes from sea level to alpine grasslands above the timber line. Likewise, the breeding habits vary from monogamy to extreme polygyny in which the only pair-bond occurs during mating.

The typical pheasants with their extreme development of extravagant male plumages are often cited by evolutionists as examples of extreme "run-away" sexual selection (Andersson, 1984) augmented with the idea of the "handicap principle." This latter postulate put forth initially by Zahavi (1975) and later popularized by Zahavi and Zahavi (1997) suggests that the elaborate (and cumbersome) train of feathers—of which the Peacock (*Pavo cristatus*) is a premier example—represents a severe handicap to the survival of its possessor; hence a bird bearing such a "handicap" must be *ipso facto* the carrier of "superior" genes and thus extremely desirable to a female.

The bright plumages and colorful fleshy facial adornments of many male pheasants similarly fall into this category, although not as such extreme examples. Biblical creationists were quick to point out fallacies in the theory. Burgess (2001) discussed in detail the complexities of color and structural features of the peafowl feathers and such represented an example irreducible complexity, not something that could have arisen by random chance without a designer. Such an analysis could be repeated for at least three dozen pheasants whose plumage is of similar, but less striking complexity.

Burgess asks the reasonable question of why a peahen would be attracted to tail feathers in the first place, thus highlighting the improbability of the evolutionary scenario. Further, one might ask why a female tragopan should be attracted to the brilliant blue air sacs adorning the head and neck of her prospective mate.

Takahashi et al. (2008), over a seven-year study, found that peacocks with the most elaborate tails did not have a higher rate of mating success, thus calling into question its importance in female choice. They were, however, countered by Loyau and coworkers (2008), and so the debate goes on.

There are many puzzles of relationships yet to be resolved, as we will see in the taxonomic section.

Assessing Current Diversity

Mating systems

Generally, monogamy prevails in this taxon until we get into the Phasianinae proper. Evidence is somewhat equivocal for megapodes where there seems to be a pair-bond established and with both sexes participating in mound maintenance. However, given the nature of females being less closely tied to the mound than males, there exists the possibility of polygamy.

Grouse are derivative of pheasants and are polygynous except for ptarmigan where a pair-bond is maintained and the sexes participate in care of young. One pattern is for the male to act as a decoy or lookout for predators; he will be chased, for example, by a Gyrfalcon while the female disappears into cover with her brood.

Since grouse and turkeys are closely related, turkeys also have a harem mating system. Within pheasants it is variable, although the life histories of many species, common in captivity, are not well known in the wild. Probably monogamous are Blood Pheasant

(*Ithaginis*), trogopans (*Tragopan*), and eared-pheasants (*Crossoptilon*, 4 spp., no sexual dimorphism either).

Nesting

We have discussed the megapodes with the use of natural heat sources to incubate their eggs: mounds of decomposing vegetation; location of nest near a naturally occurring heat source in the forest such as a hot spring, thermal vent, or similar; the use of burrows in the sand heated by the sun. In the last-named site, the birds gather, sometimes in large groups (thousands reported in New Britain), in favored areas of sandy beach on islands, lay their eggs in burrows, and disappear back into the forest.

The cracids are nearly unique in being arboreal nesters. With few exceptions all build a nest from a few feet to as much as 40' above the ground. The smaller species, such as chachalacas, tend to nest lower in a mass of tangles, brush, or vines. Clutch size is remarkably small (two-to four eggs) for any landfowl. This may be facilitated by the fact that the young are extremely agile at getting around in trees and are safe from ground predators.

Most of the rest of landfowl, as far as is known, nest on the ground in greatly concealed locations and have moderate to large clutch sizes, 6–8 as a minimum, up to ~20. Blood Pheasant (*Ithaginis*) and tragopans are said to nest in trees, and some montane pheasants in China are imperfectly known.

Figure 10. Family Phasianidae. Palawan Peacock-Pheasant *(Polyplectron napoleonis)*. The iridescent ocelli ("eyes") on the wing and tail feathers are reminiscent of those of peafowl and are an indication of relationship between the two groups. Photo by markaharper1. Used courtesy of Wikipedia Creative Commons Attribution-Share Alike 2.0 Generic License.

Facial ornamentation

As Bernard Stonehouse would have put it, "Landfowl take their facial ornamentation very seriously." Ridgway and Friedman (1946) list a number of terms in describing them: wattles, dewlaps, caruncles, combs, wrinkles, warts, protuberances, lappets, papillae, etc.

These excrescences are usually brightly colored; some may be erectile (via blood supply) or inflatable, attached to the cervical air sac system. Some involve extensions of the rhamphotheca (horny covering of the bill). A few are bony extensions, usually of the frontal bone, as seen in the Maleo (Megapodiidae, *Megacephalon*), the Helmeted Guineafowl (*Numida meleagris*), and in the Horned Guan (*Oreophasis*). Galliformes are unique in indulging themselves in such structures.

Megapodes have them, as do cracids. They are present in grouse, turkeys, and the "crown" pheasants (those of the "erectile clade"). The only groups in which they are reduced or almost absent are the odontophorines and Old World quail, and even here one sees the presence of some bare skin around the eye.

Bill structure

The "chicken bill" is amazingly uniform. It has a generalized, all-purpose design for picking up food items, with virtually no specializations. Landfowl are prokinetic, meaning that the upper beak (maxilla) rotates on a naso-frontal hinge, or a pivot point where the bill meets the skull. This is usually not a suture but a flattening of the bones that gives some flexibility. This permits a grasping or cutting motion between the maxillary and mandibular tomia (sharp edges of the bill). A prokinetic bill is found in other birds, including many passerines (e.g., cardinal, chickadee, titmouse). It allows for proficiency in opening seeds, and also permits the beak to exhibit some ornamentation, as we see in the cracids, for example. The opposing condition is rhynchokinesis in which there is an additional flexible point along the upper mandible. This is most easily seen in a woodcock or other sandpipers which can open the bill at the tip to grasp a prey item in the mud.

One consistent beak difference within landfowl is the arched culmen and presence of a tomial notch in the bills of the New World quail, hence the name *Odontophorus*, "tooth-bearing." It is unknown what the function is for this shape. Otherwise, Galliformes are unusual in the uniformity of the beak; most avian groups are more variable.

In grouse the rhamphotheca (horny covering of the bill) is deciduous, shed in the spring and replaced during the summer. This is an advantage in having a fresh, sharp cutting edge for winter. During the summer the birds can feed on insects and berries. It would be worth investigating if this correlated in any way hormonally with feather molt. Such shedding and replacement of bill sheaths is seen in puffins which lose the bright outer covering of the bill in the non-breeding season.

Foot structure

Again, a basic form designed for running and digging in substrate is prevalent. The "oversized" feet of megapodes are clearly designed for scraping up piles of compost for the nesting mounds or burrowing in sand. A major adaptation in the Cracidae is to have the hallux (hind toe) on the same level as the other three toes. This aids in climbing about in trees.

The modifications of feet seen in grouse seem fairly minor, involving the growth of lateral dermal papillae on the toes and the more lateral positioning of the inner and outer toes to create a better mechanism (wider shovel) for digging snow burrows.

Many species have tarsal spurs (1–3) which presumably are used in fighting. Attempts have been made to use the presence or number of tarsal spurs as a taxonomic character, but have not been successful.

Tails

The tails come in various sizes and shapes and seem to correspond to natural groups. The megapodes *Alectura*, *Aepyodius*, *Talegalla*, *Leipoa*, *Macrocephalon* have moderate to large tails; whereas they are small and stubby in *Eulipoa* and *Megapodius*. This may be correlated with increased vagility in the smaller species (*Megapodius*).

Tails are long in all Cracidae. This is correlated with arboreal habits, both in flying and in balance as they are very agile in moving about treetops.

Short, stubby tails characterize Odontophoridae and Old World quail (Perdicinae). Definite trends are seen in the pheasants (Phasianinae), especially in species that are polygamous/polygynous and tails become an important part of display.

In pheasants we can recognize several types of tail morphology. Monals (*Lophophorus*), of which there are three species, have large, broad square tails of 18 rectrices; bright orange-rust color in *L. impeyanus*. Gallopheasants and firebacks (*Lophura*), which includes nine species, have somewhat diverse tails of 16 feathers; arched somewhat like that of a domestic fowl. Eared-pheasants (*Crossoptilon*), including four species, are non-dimorphic, both sexes mostly gray and white; tail of 20–24 feathers vaulted into a huge soft bustle; other plumage similarly soft-textured; the "ear" consists of several white spike-like feathers. Genera *Catreus* (Cheer Pheasant), *Syrmaticus*, *Phasianus*, *Chrysolophus* are ones we think of as "typical" pheasants with long, graduated tails, barred and otherwise with bright flashy plumage. Reeve's Pheasant (*S. reevesi*) has a tail up to 1.6 meters long. The final group consists of the peacock-pheasants (*Polyplectron*), the peafowl (*Pavo*), Great Argus (*Argusianus*), Crested Argus (*Rheinardia*), and Congo Peacock (*Afropavo*)—in other words those with oversized tails and "eye-spots" (ocelli) of one sort or another.

Wings

Landfowl are heavy-bodied and have short, broad rounded wings with a deep camber. This aids in explosive rapid take-off to escape enemies and short burst of rapid flight. Most will fly just far enough for escape and then run to cover as necessary. Pectoralis minor (supracoracoideus) is fairly large compared to pectoralis major, suggesting a possible lift force on upstroke in flight.

The very large snowcocks of the genus *Tetraogallus* are said to run rapidly uphill and then launch into a long glide across a valley; they are not good at all in powered flight. A few such as *Megapodius* and *Coturnix* are dispersive or migratory and have longer wings and lower wing loading to aid in longer flight distance. Even megapodes that are not fully grown have been seen flying across water out of sight of land. This may explain why megapodes have spread to numerous islands in the southwest Pacific.

Conclusions

The above pages have reviewed the *dramatis personae* of the landfowl. From possibly humble and unspecialized precursors on Noah's Ark the landfowl have filled the created avian world with great diversity and beauty. The beak-foot-body *bauplan* built into these birds by our Creator has proved amazingly resilient in accommodating to a diversity of habitats and life styles. From this foundation, further research can answer other important questions such as: which features are ancestral and which are derived? Or, what is the genetic basis for various adaptations seen in different lineages of landfowl?

The extent to which our flow-chart outlined in Part I of this series can explain the morphological changes and dispersal history of the landfowl will be explored in Part III.

"But ask the animals, and they will teach you, or the birds of the air, and they will tell you. To God belong wisdom and power; counsel and understanding are his." (Job 12:7, 13 NIV)

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Clarifying Confusion about Eagles' Wings

Based upon a verse in Deuteronomy, namely 32:11, many expect that an eagle mother, in the wild, sometimes "carries" her young eaglets "on their wings." Yet that behavior is not observed in the wild (or in captivity), so Bible skeptics allege this discrepancy is a so-called Bible "error"—but is this a straw-man accusation, based upon a translation confusion?

To recognize what is true, careful observations are needed, both when studying God's **Word** and when studying God's **world** (Johnson, 2014). So, when Scripture refers to the world of wildlife, as it often does, due diligence should be given to the Biblical exegesis and to the "science."

QUESTION: Does the text of Deuteronomy 32:11 actually say that an eagle mother "carries" young eaglets "upon her wings"?

ANSWER: No. Many translations and paraphrases confuse the literal meaning of this Biblical Hebrew text.

The first problem in the puzzle: English Bible translations (that are popularly available) do not clearly match the singulars to the plurals, and other literal aspects of the Hebrew text of **Deuteronomy 32:11.** Also, grammatical gender information is sometimes garbled in translation.

The literal Hebrew indicates that it is God Who carries on His wings, not the eagle parent. To a large degree, the confusion is rooted to imprecise translations of the English text of Deuteronomy 32:11, particularly where "her" is sometimes translated for "him," as well as twice "them" for "him." This confusion-clearing clarification—by looking at the actual Hebrew text of Deuteronomy 32:11—was buttressed by the analysis of Hans-Georg Wünch (Wünch, 2016), which specially scrutinized the pertinent Hebrew nouns and verbs. Details on this follow.

Although the King James Version of the English Bible is usually very literal (and precise), in those very rare situations where the King James Version mistranslates the underlying Hebrew text's words, it is likely to be with those KJV Bible verses that describe wildlife. These particular verses are more likely to have imprecise/non-literal translations—and that is likely due to the historical life experiences (and priorities) of the King James translators (in the early AD 1600s, finishing in AD 1611).

In short, the KJV text of Deuteronomy 32:11 is suggesting that eagle parents "carry" eaglets "upon their wings." However, the Biblical Hebrew text (i.e., the Masoretic Text of Deuteronomy 32:11), interpreted within the immediate context of verses 9–13, is anthropomorphically recalling how God historically "took" and "carried" Jacob (i.e., both "Jacob" the man, as well as the Jewish nation that is ethnically descended from Jacob, i.e., "Israel"). This is comparable to how the Lord Jesus Christ compared His willingness to protect Jews to a mother hen's protectiveness, in Matthew 23:37 and also in Luke 13:34.

However, the most important key (to solving the puzzle of this confusing-on-the-surface passage) to properly understanding this verse, is to recognize that **the subject noun of most (if not all) of the contextual sentences is God, not a mother bird**—although you must look back to Deuteronomy 32:9 to see that Deuteronomy 32:11's subject noun is "the LORD" [Hebrew YHWH], i.e., God. (Notice also the action verbs in the Biblical context—most of these verbs refer to God only.)

Also, the relevant bird (translated "eagle" in King James Version) is mentioned in a way that is best translated "like an eagle" (or "like a vulture," depending on how you translate *NESHER*, which is the Hebrew noun for the bird in question). Careful context reading is needed to recognize how much of the verse applies to the simile phrase "like an eagle," because not all of the activities that are part of Deuteronomy 32:9–13 correspond to eagle-behavior comparison.

Therefore, let us look at the overall context, i.e., Deuteronomy 32:9–13. Below I have inserted, using brackets, clarifying nouns (or pronouns), to match the literal meaning of the specific Scripture verbs and pronouns.

Also, keep in mind that "the LORD" [YHWH] is masculine, "Jacob" [Ya'aqōb] is masculine, and "eagle" [*nesher*] is also masculine, so matching each pronoun to its proper noun requires some context-based interpretation. This is further complicated by a mistranslation in the English phrase "her nest" because the

Hebrew literally says "his nest," i.e., the Hebrew word for "nest" [qēn] has a masculine singular suffix.

In other words, Deuteronomy 32:11 is literally saying "his nest." The same English mistranslation appears in the English phrase "her young" (which literally says "his young" in the Hebrew). Likewise, the same English mistranslation appears twice in the English phrase "her wings" (which twice literally says "his wings" in the Hebrew).

Confusingly, the Hebrew-to-English translation plot thickens.

In the English translation of Deuteronomy 32:11, the plural pronoun "them" appears twice where it should say "him," because the Hebrew pronominal suffix is a 3rd person singular, not a 3rd person plural.

This is, in my opinion, the most important clue, in conjunction with the plural noun "young," for solving this puzzle, because the "taking" action—as well as the bearing action—has "him" as its (singular) direct object, yet the noun translated "young" is plural, so the taking and bearing action did not happen to young birds—rather, the taking and bearing action happened to "him," which the overall context (of Deuteronomy 32:9–13) indicates is "Jacob."

In other words, because a plurality of hatched birds would need a plural suffix, it is not the hatched young birds that were "taken" and "carried" in Deuteronomy 32:11. Rather, God is providing these caring actions ("taking" and "bearing") to Jacob/Israel, because "Jacob" is a 3rd person singular masculine person, so "Jacob" can be the direct object "him."

> 9 For the LORD's portion is His [i.e., God's] people; Jacob [whom God later re-named "Israel," so this name refers to both the man Jacob and to his descendants who became the nation "Israel"] is the lot of His [i.e., God's] inheritance.
>
> 10 He [God—notice that God is the subject noun of this Hebrew sentence, which is a sentence that actually continues beyond verse 10] found him [i.e., Jacob, a/k/a Israel] in a desert land, and in the waste howling wilderness; He [i.e., God] led him [i.e., Jacob, a/k/a Israel] about, He [i.e., God] instructed him [Jacob, a/k/a Israel], He [i.e., God] kept him [i.e., Jacob, a/k/a Israel] as the apple of His [i.e., God's] eye.
>
> 11 As an eagle [some say this should be translated "hawk" or "vulture"—it means a large-winged carrion-eating bird], ["he" or "He"] stirs up her [actually the Hebrew says "his," which might mean "His"] nest; ["he" or "He"] flutters over her [actually the Hebrew says "his," which might mean "His"] young [i.e., "young ones," since this noun is plural]; ["he" or "He"] spreads abroad her [actually the Hebrew says "his"] wings; ["he" or "He"] takes them [literally "him"—actually this is a 3rd person singular masculine suffix, functioning as a direct object of the action verb]; ["he" or "He"] bears them [literally "him"—actually this is a 3rd person singular masculine suffix, functioning as a direct object of the action verb] on her [actually the Hebrew says "his"] wings:
>
> 12 So the LORD alone did lead him [i.e., Jacob, a/k/a Israel], and there was no strange god with him [this "him" seems to mean "Jacob," though it more likely refers to God, because it is "the LORD alone" Who accomplished this shepherding care over Jacob].
>
> 13 He [i.e., God] made him [i.e., Jacob, a/k/a Israel] ride on the high places of the earth, that he [i.e., Jacob, a/k/a Israel] might eat the increase of the fields; and He [i.e., God] made him [i.e., Jacob, a/k/a Israel] to suck honey out of the rock, and oil out of the flinty rock.

This is a confusing Hebrew mistranslation problem, so many readers of the Bible (using English translations or paraphrases) have stumbled in trying to discern its literal meaning. Because wildlife observers do not see mother eagles carrying young eaglets "on their wings," it is no surprise that many folks have been puzzled by this verse (Lacey, 2019).

According to the literal Hebrew text, analyzed grammatically—with special attention to singular-vs-plural and masculine-vs-feminine details, **this verse** (i.e., Deuteronomy 32:11) **is talking about God's providential care of His people, *with only some of God's actions being comparable to an eagle/hawk/vulture.***

Moreover, some of the ***other*** caring actions listed (in **Deuteronomy 32:11**) do not match bird behavior, regardless of whether the Hebrew noun *nesher* should be translated as "eagle," or "hawk," or "vulture" (Wigram, 1874, pp. 849–850). So the complicated part (for interpreting Deuteronomy 32:11's text) is accurately distinguishing:

(a) which phrases fit **God only** (even if those phrases are anthropomorphic, like Matthew 23:37 & Luke 13:34),

(b) which phrases apply to **the *nesher* bird only**, and

(c) which phrases apply to **both God and the *nesher* bird.**

In sum, here is my pronoun-interpreting understanding (and exegesis), of what I think the Hebrew text of **Deuteronomy 32:9–13** is saying:

> 9 For the LORD's portion is God's people; Jacob/Israel is the lot of God's inheritance.
>
> 10 God found Jacob/Israel in a desert land, and in the waste howling wilderness; God led Jacob/Israel about; God instructed him Jacob/Israel; God kept him Jacob/Israel as the apple of God's eye.
>
> 11 Like an eagle, God stirs up God's nest; God flutters over God's young ones; God spreads abroad God's wings; God takes/was taking Jacob/Israel; **God bears/was bearing (i.e.,**

> **carrying) Jacob/Israel on God's wings;**
> 12 So the LORD alone led Jacob/Israel, and there was no strange god with Him.
> 13 God made-to-ride Jacob/Israel upon the high places of the earth, so that Jacob/Israel might eat the increase of the fields; and God caused-to-suck Jacob/Israel honey [from] out of the rock, and oil out of the flinty rock.

In sum, many interpreters have misidentified the subject noun of that verse, by stretching the comparative noun (*nesher*, which can/could be translated as "eagle," "hawk," or "vulture," though it likely means "eagles" in Deuteronomy 32:11) in a way that causes the *nesher* bird to supplant God as the subject noun of the sentence.

In other words, instead of the eagle (*nesher* bird) being comparable to some things that God does, many have interpreted the verse as if every action verb applies to the bird when actually that is not the case.

Having processed the precise parts of this puzzle, which parts should not be studied apart from the big-picture message of the passage, I conclude with a comparison to **Psalm 23:1a**, which says "the LORD is my shepherd"—that is the main message of **Deuteronomy 32:9–13**—i.e., it is God Himself Who carries us through all of life's risks and challenges.

James J.S. Johnson

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Letters to the Editor

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Concerning Johnson's "Peleg" Article and a Tribute to Dr. John C. Whitcomb

More Time

Two recent events have prompted this letter: the passing and honoring of Dr. John Whitcomb, and the 2019 Summer *CRSQ* article concerning Peleg by Dr. James Johnson. These men have done outstanding work. In his article, Johnson firmly established, linguistically, that the division of Peleg was a physical division and not the social division of Babel. Johnson (2019) maintained that that division occurred about 100 years after the Flood. However, Whitcomb (1961) maintained that the division—whatever it was—occurred later, probably much later. Whitcomb considered Genesis 11 an abridgment. He advocated for more time.

Most of Johnson's (2019) article sought to establish what was Peleg's division. With the division occurring at 100 years, Johnson was "reluctant" to accept the theory that Peleg's division was continental separation because, had such a massive separation occurred then, that division would have been globally catastrophic.

Johnson (2019) held that Peleg's division occurred before the Glacial Epoch, the "Ice Age." Because of his chronology, his glacial period had to be brief, probably 700 years. Unfortunately, those who support such a brief span may not understand the physical evidence that reveals the Glacial Epoch almost certainly lasted much longer. This letter describes glacial phenomena with the purpose of appraising the Epoch's duration. This letter also briefly considers the Epoch's possible role in continental separation.

Assess the Evidence

To establish the Glacial Epoch's formation, it is helpful to view the Epoch as a long period consisting of stages of activity, of glacial lobes that advanced and then, by melting, retreated. Figure 1 describes the final stage of the Glacial Epoch in Wisconsin. The various lobes are identified by the moraines and striae they produced.

Note: Terminal or end moraines form where a glacier reaches its maximum extent. As the ice melts and more debris is pushed forward it reaches a temporary standstill and dumps debris in a curving hill marking the maximum extent of advance. Some end moraines can be several hundred feet high, depending on how long the glacier remained in equilibrium or stagnant. Recessional moraines are created in a similar manner, but as the glacier is receding it can also reach a stagnant equilibrium and dump debris into a moraine but behind the end moraine. Some debris, "erratics," are very big, e.g., a rock 60 ft by 135 ft by 30 ft high—called, "Big Rock." The glacier moved this rock 580 miles, revealing the glacier's size and power and the time used to move it, e.g., 840 years at the high rate of 10 feet per day: see Google, Wikipedia, etc., for "glacial erratics."

Lake Michigan and Green Bay Lobes

Consider the Lake Michigan and Green Bay Lobes of the last stage of the Glacial Epoch (Figure 1). The physical evidence reveals that the Lake Michigan Lobe advanced from the northeast into the eastern side of the State of Wisconsin and then partially retreated. That retreat was followed by the advance of the Green Bay Lobe from the north.

Note, because local climates vary, advances and retreats could occur at the same time. The directions of movements of each lobe is revealed primarily by the directions of their striae and drumlins. Also note: advances and retreats of lobes took considerable time. How much time is not known.

Evidence reveals the sequence of the movements of these two lobes. For example, a long region in eastern Wisconsin, parallel to Lake Michigan and extending from near Green Bay in the north to near Lake Geneva in the south, is filled with glacial phenomena, e.g., kettles, eskers, kames, produced by the Lake Michigan Lobe. (For an explanation of these terms, see Wikipedia, Google, etc.) The subsequent movement of the Green Bay Lobe into that region from the western side also produced these same glacial phenomena. These two movements produced what is called the "Kettle Moraine" region, notable for its turbulent terrain. Some of its moraines are very massive: a church on top of one moraine, called "Holy Hill," is so high it can be seen throughout southeastern Wisconsin. (For a picture see Google.)

Massive Glaciers

Other very large moraines exist, e.g., Long Island, New York. Most of that glacial mass is now below sea level. The glaciers producing these moraines must have been massive and their forces great. A weakness of the theory of a brief glacial period is its glaciers are too thin to do the work the glaciers actually did, to move huge masses great distances, and to depress the crust as much as it did. (The Great Lakes rebound is about 1 foot per 100 years. Hudson Bay's rebound is about 1 inch per year: the glacier's thickness there had to be great.) Reiterating, the Ice Age glaciers's size do not indicate a brief glacial period. Concerning its size Henry Morris asserted:

> A large amount of evidence has been amassed to show that ocean levels were at least 400 feet lower than at present, possibly much more. (Whitcomb and Morris, 1961, p. 294)

Indeed, based on ten measurements taken over a twenty year span, sea levels at the Glacial Epoch maximum averaged about 450 vertical feet lower than today's level (Nelson, 2017, p. 311). With at least 200 vertical feet of ocean water remaining as ice on Greenland and Antarctica, at the Glacial Epoch maximum the post-Flood sea level dropped about 650 feet. Consequently, with an average thickness of one mile, and including the 9% water to ice expansion, about 18 million square miles of ice existed—which likely took considerable time to form. Some of that immense ice also developed in the Southern Hemisphere. The thickest ice, possibly three miles thick, created not only downward pressures but also great lateral pressures—so the glaciers had to flow. These magnitudes are consistent with the dimensions of our two large glacial masses, and also explain the awesome work the glaciers did.

The Two Lobes

Remarkable evidence of the relationship of the Lake Michigan and Green Bay Lobes are the striae located midway in the Kettle Moraine area. These striae are on a large, flat limestone bedrock, probably 100 feet wide. Striae produced by the two lobes cross. The evidence indicates the Lake Michigan striae were made first. The angle between the two striae is about 120 degrees.

Nelson (2017, p. 310) describes evidence which reveals the sequence of these two lobes, i.e., the phenomena of the buried forest at Two Creeks, Wisconsin. See Figure 2. The color of the darker till below the forest matches the color of the darker bedrock to the east, while the color of the lighter, reddish till which buried the forest matches the lighter bedrock to the north. This evidence indicates the Green Bay Lobe followed the retreating Michigan Lobe.

It's important to consider the time it must have taken to produce these buried forest phenomena. Examine Figure 2 and consider the duration of each stage in its development: **Stage 1:** the main, continental glacier developed in the north and then its Lake Michigan Lobe penetrated there, eroding dark bedrock on the way; **Stage 2:** that lobe melted and retreated, leaving its grey till; **Stage 3:** because its melt waters were blocked,

Figure 1. The Glacial Epoch's final lobes in Wisconsin.

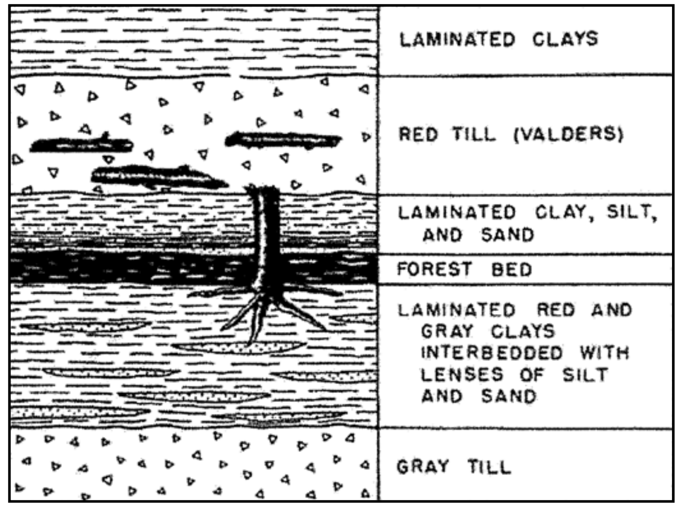

Figure 2. Generalized cross-section of the Two Creeks Buried Forest.

a lake formed which supported aquatic life (e.g., mollusks); **Stage 4:** the lake drained so a forest could grow; **Stage 5:** the forest grew: the average age of the trees was about 60 years while one tree lived 142 years (Schultz, 2004, p. 164); **Stage 6:** with drainage blocked, meltwaters again developed a lake which caused the trees to die; **Stage 7:** the Green Bay Lobe, eroding reddish bedrock, penetrated from the north but did not destroy but rather covered the forest remains while pushing over upright tree stumps; **Stage 8:** that lobe melted leaving a reddish till which buried the forest remains; **Stage 9:** another lake developed over those glacial remains. (See USNPS Scientific Monograph No. 2.) This protracted sequence is one of many lengthy developments during the Glacial Epoch.

Concerning durations, more glacial activity transpired after the Buried Forest phenomena were completed. However, most significant is the post-Flood initiation of the Glacial Epoch and the elapsed time for the main continental glacier to grow—and then to develop lobes. In fact, just as moraines and striae outline the lobes that are pictured in Figure 1, many older terminal and recessional moraines, striae, and other debris exist which reveal that the Glacial Epoch had a prior history, i.e., stages that preceded the Lake Michigan and Green Bay Lobes. (See "Previous Glaciation" in Figure 1.) But because glaciers are very destructive of evidence, how many stages existed is very difficult to determine.

However, beside the duration of the last stage described above, and the more important evidence of older, preceding stages, all those durations do not require that the Glacial Epoch lasted eons of time. An authority on the Glacial Epoch forthrightly stated that geologists do not know what caused the Ice Age nor do they know how many and the durations of the past cold and warm seasons with their glacial advances and retreats. (Schultz, 2004, pp. 139–143)

In fact, the Flood gave birth to the Glacial Epoch. And the duration of the Ice Age may well be much less than today's popular long-age assertions. Nevertheless, the Glacial Epoch was a prolonged event whose remaining glaciers we still see; Greenland and Antarctica are the vestiges.

Peleg's Division

The issue of time is the primary purpose of this letter. But what was the physical division giving Peleg his name? With much more time, which Whitcomb advocated, the door is open to consider the probability of continental separation, and that those movements, though gradual, were perceived. Today our continents are moving, but their movements, though measurable, are not discernible. However, Peleg's probable earth movements, though slow and not catastrophic, had to move enough to be observed—and to be recorded.

At the Epoch's maximum the glacial ice was immense, covering approximately one-third of Earth's land surface. The transfer of sea water to ice and the dynamics of thick, rotating glacial masses on the moveable crust of Earth were significant. These phenomena may have caused Peleg's division. I have described in detail some of these dividing dynamics and also other measures of time (Nelson, 2007).

Dr. Whitcomb's Chronology

When the Creation and the Flood occurred and the continents separated are very significant subjects. For valid analyses, Dr. Whitcomb's chronologic principles should be incorporated. See *The Genesis Flood*, Appendix 2.

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Glatt Comments to Lorentz

Let me begin by saying I compliment Lorentz's (2019) mathematical analyses; his application of [and parenthetically explaining] the Dirac delta function; incorporating the Dirac delta function into Maxwell's four equations; his Appendix B equations derivations; and I thank Lorentz for introducing me to Jefimenko's equations.

Lorentz seems susceptible to what I perceive as most of us being still unable to explain the difference between Einstein's two relativity theories' forest-vs-trees, in this case the trees versus the forest in Lorentz's evaluation of Akridge's 1979 *CRSQ* essay. General Relativity Theory (GTR) governs long range cosmogony mathematics, called Weyl's long-range analysis. Lorentz wrote only about the tree, Special Theory of Relativity (SRT) which resides in the "local frame" (aka Ricci's local field.) By ignoring the GR forest, Lorentz gives only three lines in his conclusion discussing his math, and then only to the local electric flux.

Electric fields terminate on charged particles. Magnetic fields and electric fields go wherever gravity goes, and magnetic fields can follow gravity across the universe's extremely large scale structure (i.e., gravity spans the universe, e.g., eventually bringing Einstein's "big crunch"); Lorentz's conclusion only mentions the electric.

Akridge's 1979 contemporary, Theodore Frankel, presented (page 121 center, in his 1979 book, but without citing his source) his equation (13), tying magnetic fields and electric flux to gravity, and stating immediately following that equation:

> "A pure electromagnetic field curves space-time."

Both Frankel's statement and his formula mean gravity creates both an electric field and a magnetic flux.

A Cambridge student, Tsagas (2005) published an essay deriving and expanding (by including time in his math, e.g., conformal time variable and equations (39) and (40) time derivative) Frankel's math and equation, but didn't know about Frankel's equation or book. Tsagas divides between, and then combines, his analyses of Weyl's long-range analysis and Ricci's local field.

Five years earlier, in 1974, Bob Jones University student St. Peter analyzed General Relativity. I recommend St. Peter to GR beginners—as a Bachelor-of-Science student he wrote a 13-page essay with 87 references, though later St. Peter stated that paper was a bit naive.

Like Guth in his 1981 Inflation Theory, Lorentz does not explain magnetic and electric fields' fates, as their associated particles (quarks which gave rise to protons, electrons, neutrons) expanded from a quantum fluctuation, or Gamow's (1952) neutron cloud ("fluid") out to today's universe. Magnetic fields don't suffer electric fields' demise, i.e., electric fields terminate on electrical charges, e.g., ions.

I don't find where Lorentz gives the math for his statement (page 106, high right) that both an electric field and a magnetic field (and, by GR, could he have said gravity?) travel at light speed? All of his math, I see, leads to his repeated statements, e.g., page 109 (low right), that magnetic and electric field *disturbances* (a visual analogy is a rock creating water waves) move at light's velocity. Disturbing the field (e.g., notes we hear across the distance from strumming a guitar string) is different than what's traveling up and down the magnetic and/or electric flux lines.

Lorentz should explain his own "simultaneous currents filling all of space" (page 109). I speculate that by excluding GRT, Lorentz falls short in his ability to explain the mathematical results that arise from his non-GR analyses.

Chuck Glatt

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Tsagas, C.G. 2005. Electromagnetic fields in curved spacetimes. *Classical and Quantum Gravity* 22:393–407. Note that in equation (13), Tsagas differs from Frankel's page 121 equation by a factor of 1/p. The 1/p factor is a unit-related issue. Tsagas is using the so-called Heaviside-Lorentz units. He states in Note 1 that 8pG = c = 1, and Tsagas explains what that means for his calculations.

Lorentz Reply to Glatt

I appreciate the opportunity to interact with these questions and comments. The letter raises four main issues, namely, my reference to "simultaneous currents filling all of space;" lack of accounting for General Relativity (GR); misunderstandings about electric/magnetic fields; and the relationship between these fields and gravity. I address each point below; note that equation numbers refer to the original article (Lorentz, 2019).

First, the paragraph mentioning "simultaneous currents filling all of space" deals with a specific situation, in which we introduce charge at the origin through a current density of $\mathbf{J}(\mathbf{r},t) = -q\hat{\mathbf{r}}/8\pi\epsilon r^2$. This equation describes radial currents (throughout all space) converging at the origin. As a result, charge builds up only at the origin (nowhere else), providing the correct time-dependence for the charge. But the main point to note is that this is a toy model, designed to show that the unexpected term in Equation 7 comes from violating local charge conservation (Equation 10). The statement about "simultaneous currents, etc." applies only to this specific situation; it does not imply that any such currents actually fill space in the real Universe.

Next, regarding GR, we should bear in mind the limited scope of the article, which was written to interact with Akridge (1979). Since Akridge did not mention GR either, one might say that a "tree" is an appropriate response to another "tree." However, it is possible to generalize Maxwell's equations to curved spacetime (see Sections 22.4–5 of Misner, Thorne, & Wheeler, 1973), and this generalization does not change the basic thesis of the article—namely, that conservation of energy does not mandate in-transit creation of light.

Third, there might possibly be some confusion about electric/magnetic fields—for instance, as far as we know, nothing is "traveling up and down the magnetic and/or electric flux lines." Rather, it is the *changes* (disturbances) in field-values which propagate from one point to another. When I wrote, "the fields propagate with the speed of light" (p. 106), I technically should have said, "the *changes* in the field values propagate," etc. In my defense, the terminology I used is standard, but I do regret any confusion it might have caused. I should also note that only in static situations must the electric field lines terminate on a charge; a changing magnetic field can produce an electric field with closed loops (i.e., it is divergence-free)—and, in fact, this is part of how electromagnetic waves propagate.

Finally, let us consider the statement from Frankel (1979). It says, "A pure electromagnetic field curves spacetime." But let us note that it does *not* say the reverse—curved spacetime (gravity) does *not* necessarily produce electricity and magnetism. After all, a cloud of hydrogen gas also curves spacetime, but it does not follow that gravity produces hydrogen.

Again, I appreciate the interaction with the article, and I hope this brief reply is helpful.

Max Lorentz

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Concerning Tomkins, Daniels, and Johnson's Article on the Septuagint vs Masoretic Text Debate

The *Quarterly* recently published a paper by Tomkins, Daniels, and Johnson on the Septuagint (LXX) vs Masoretic Text (MT) debate (Tomkins et al., 2019). We have spent countless hours on this issue, performing detailed textual analyses and publishing multiple papers on the subject, including responses to challengers and detractors (Cosner and Carter 2015, 2018, 2019a, 2019b, 2019c). However, they overlook not only the contributions of their fellow biblical creationists; they are detached from the entire discipline of text criticism and the history of debate on these issues. They also neglect to show the academic impartiality and restraint that is expected of serious researchers.

We published an article online that details our objections to Tomkins et al., so we will not restate everything here. However, here is a quote from that article:

> For something that supports our position, we do not support the way the article is structured, the way the points are argued, or the way the authors draw their conclusions. They assume the conclusions they need to prove (question begging) and use unfair accusatory language toward their opponents. They use at least one suspect publication as an authoritative source, and extensively cite it as if that proves their points without providing real supporting evidences. They fundamentally misunderstand the historical questions and evidence surrounding this topic. Finally, they fail to cite prior work by biblical creationists, including a paper we co-wrote that demonstrably answers one of their main criticisms of the LXX. The LXX-MT debate is straining the creation movement, but this one article sets us back by years. There is not a single paragraph that does not demonstrate a significant flaw. (Cosner and Carter, 2020)

Their main case rests on the fanciful notion that the LXX was written *after* the completion of the New Testament canon, instead of in the second century BC, which is the unanimous belief among modern textual scholars. They also resort to speculation about how the LXX was corrupted by Origen, even though this was entirely out of his ability, and the long-discredited theory that the Dead Sea Scrolls contain fragments of some of the New Testament books (specifically fragment 7Q5). Much of their discussion is tangential to the debate (like the long excursus about legged whales on the Ark) and many statements are simply factually incorrect. They also appeal to King-James-Only conspiracy theories. While we do not seek to diminish the importance of that translation in history, unsubstantiated conspiracy theories should not be part of any academic discussion.

This subject is already causing unnecessary strain within the creation community and articles like this only make things worse. It is not our intention to disparage the authors, but if we hold our friends to the same standards as we hold our opponents, this paper should never have been published. We request that it be withdrawn.

Robert Carter and Lita Cosner

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Johnson and Daniels Response to Carter and Cosner Letter

Regarding our article on the Septuagint's unreliability [*CRSQ* 56:40–47 (Summer 2019)—herein called "TD&J's LXX Critique"], this is the third Letter to the Editor (herein "Carter and Cosner Objection") that we are responding to.

The Carter and Cosner Objection has miscellaneous protest points. Those points, unless redundant with points already addressed (via replies to the two previous Letter-to-the-Editor criticisms, published in earlier *CRSQ* issues) are sorted and addressed herein according to these categories:

1. Protests that assume proof of reliable provenance of today's LXX, as having textual translation content traceable to BC (i.e., pre-N.T.) origins;
2. Protests that assume that Bible translation text corruptions cannot result from culprits who are theologically motivated, individually or conspiratorially, to change Scripture content;
3. Form-over-substance protests that dislike stylistic aspects of TD&J's LXX Critique;
4. Protests about what is relevant, or not, for showing why today's LXX is an unreliable source of O.T. chronology for biblical creationists;
5. Protests that mischaracterize the purpose or analysis of TD&J's LXX Critique; and
6. Protests that underestimate the competence and focused analysis of the co-authors, informing the TD&J's LXX Critique.

Lastly, comments are added to show ***why*** this controversy is especially important to scientific community members *who care about the Bible's doctrine of creation*, especially as Earth's providential history is reported in Genesis.

FIRST, Carter and Cosner insist that we assume proof of reliable provenance of today's LXX, as having textual translation content traceable to BC (i.e., pre-N.T.) origins—complaining that we offer "the fanciful notion that the LXX was written *after* the completion of the New Testament canon, instead of in the second century BC, which is the unanimous belief among modern textual scholars" [*sic*]. Are Carter and Cosner suggesting that we are not "textual scholars" or that we are not "modern"? Their generalization presumes that a majority opinion, which is promoted as "consensus science," should be the norm for determining what assumptions should be made about the provenance of today's LXX text(s). However, the "consensus science" approach is unstable quicksand, when applied to ***empirical science*** contexts (Guliuzza, 2009; Johnson, 2012)—and it is even more so when applied to ***forensic science*** contexts, such as document authenticity and provenance controversies (Johnson, 2012a, 2012b, 2015).

David Daniels's very topic-relevant book—*Did Jesus Use the Septuagint?* (Daniels, 2017)—was cited in our TD&J's LXX Critique. For example, regarding the so-called Letter of Aristeas (Daniels, 2017), the evidence indicates it is a fanciful and history-contradicting text. Even those who favor that text would go not much further than claiming it has a "grain of truth" within the story. The fact that David Daniels' LXX-critiquing book was written, examining each alleged provenance-relevant witness (used to promote the idea of a pre-N.T. Septuagint) helps *CRSQ* readers to dig deeper into the evidence, to consider the relevant provenance evidence for themselves (Johnson, 2012c, 2018a, 2018b, 2016).

CRSQ articles are necessarily short, so—just as Carter and Cosner chose not to reproduce their many previous papers, but merely refer to them, while inserting one conclusory quote—so, too, Tomkins and Johnson chose to utilize and cite Daniels's Septuagint-critiquing book (Daniels, 2017) that is easily accessible for those who care to delve into the evidentiary basis for that analysis).

SECOND, Carter and Cosner insist that we *assume* that Bible translation text corruptions *cannot result from* nefarious culprits who are theologically motivated, individually or conspiratorially, to change Scripture content. It has sadly become popular as of late to disregard (as if disqualifying) anyone's disagreement as a "discredited conspiracy theory." The USA has just gone through over three years of this hyperbole and yet, after all the bluff and bluster, it turns out many "theories" are historically fact-based—i.e., repeatedly, there really ***was*** a conspiracy, as newly released papers continue to prove. So, Carter and Cosner's rhetoric seems more of an emotional reaction than a meaningful consideration of our forensic science analysis (regarding today's LXX). For example, an earlier reply (defending TD&J's LXX Critique) already noted the unexpected-yet-plausible role of nefarious actors, citing the historic example (in The Dalles, Oregon, during 1984) of the Rajneeshee cult's conspiratorial *Salmonella* food-poisoning (Török, Tauxe, et al., 1997), where a *Salmonella* epidemic was unexplained until an investigator was willing to seriously consider—as a plausible etiology—that like-minded humans actively (and nefariously) perpetrated an organized food-poisoning operation. With careless imprecision, Carter and Cosner err by casting the "King-James-Only conspiracy theory" label—failing to distinguish between "King James Only" advocates, and those who defend the Protestant Reformation's O.T. text (i.e., Hebrew Masoretic Text) and N.T. text (i.e., Greek Textus Receptus). The latter category includes Dr. Henry Morris, founder of ICR. Tomkins, Daniels, and Johnson unapologetically stand with Dr. Henry Morris in defending the Protestant Bible's underlying texts (i.e., the Masoretic Text of the Old Testament and the Textus Receptus Greek New Testament). To simply agree with Martin Luther, John Calvin, John Knox, William Tyndale, and/or Henry Morris—regarding God's providential preservation of the Holy Bible's Old and New Testament texts (as He has)—does not justify Cosner and Carter's histrionic phrase "rabidly anti-Catholic" (Cosner and Carter, 2020).

Meanwhile, Origen was a paragon of corruption—he is surely no role-model as a scholar or as a theologian; tragically his aberrant theology led to self-castration. There is no reason to be shy in documenting how his Greek translations (of O.T. passages) differ from those of contemporaries (Daniels, 2017). The readings in Origen's column are completely different from that of Aquila, Symmachus, and Theodotion, when they match a New Testament citation of the Old Testament in various crucial points (Daniels, 2017). So, the Hebrew, transliterated Hebrew, and the Greek of the three aforementioned writers, are qualitatively different from Origen's column in those telling places (Daniels, 2017). The reader can decide what that means. How Origen is deemed to be "out of his ability" to change (i.e., corrupt) a Biblical text (including one in translation), when he had about a 20-year window to do so, is not explained. Origen has been admired, historically, by the Jesuit Order for his belief in the "doctrine of reserve," wherein lying is permitted by withholding important truths from those deemed unworthy. Origen was inconsistent between his conversations with Julius Africanus, and those between him and his textual friends. Jerome later picked up on that inconsistency, both citing Origen in his letters rebuking Augustine about utilizing Theodotion and removing "asterisks and obelisks," but afterward putting all those added words into his own Latin text, and including translations by Theodotion as well. Origen's *De Principiis* displays his disbelief in the literal truth of scripture, including doctrines that biblical creationists hold dear. In sum, it was well within Origen's bias and ability to pervert Scriptures that he chose to allegorize, rather than believe as written.

THIRD, Carter and Cosner dislike stylistic aspects of TD&J's LXX Critique, as if a form-over-substance protest (i.e., "you don't write articles like we do") supports a withdrawal of the TD&J's LXX Critique. Carter and Cosner claim, "… we do not support the way the article is structured, the way the points are argued, or the way the authors draw their conclusions." Yet the article was perspicuous enough that *CRSQ* readers should have noticed that we flatly rejected Henry Smith's "solution" to the Methuselah chronology error (which is a too-little,-too-late "solution" that Carter and Cosner endorse, ironically), as forensically untenable—because ***the Methuselah math error occurs in all 3 of the main codex sources for today's LXX***, in the Alexandrinus LXX, in the Vaticanus LXX, and in the Sinaiticus LXX (which are obviously written post-N.T.). Admittedly, we respect many of Carter and Cosner's criticisms of Henry Smith's Septuagint advocacy (and we alluded to that on page 41). However, it is vitally important—for clarifying the big-picture study of Septuagint controversies—that we distinguish (due to its corruption of Messianic prophecies, Methuselah's chronology, etc.) our rejection of today's LXX, as a source for creation research, because what is today called the "Septuagint" (which is basically a blend of the Greek O.T. translations within codices Alexandrinus, Vaticanus, and Sinaiticus) is provenance-backdated and/or theologically corrupted, and thus is forensically unreliable.

FOURTH, Carter and Cosner err in recognizing what is forensically relevant, or not, for showing why today's LXX is an unreliable source of O.T. chronology for biblical creationists. In forensic contexts, authenticating witnesses, as well as actors whose actions are at the core of a controversy, are scrutinized (Johnson, 2012, 2016). Neither Carter nor Cosner have publicized any claim of forensic science credentials: no objective education (e.g., J.D. degree); no government-issued certification in a forensic field (e.g., paternity establishment post-doc); no forensics-applied professional license or experience (e.g., litigating lawsuits that focus on documents of disputed authenticity, adjudicating court cases—as a trial judge--lawsuits that focus on documents of disputed authenticity, credentialing as a Board-certified attorney based upon frequent litigation in federal courts); no membership in the American Academy of Forensic Sciences. Yet Carter and Cosner quickly dismiss several serious forensic issues, despite their lack of competence to adequately analyze those issues. This is like an astronomer blasting creation ecology studies reported by experienced ecologists.

FIFTH, Carter and Cosner mischaracterize (perhaps due to misunderstanding) the purpose or analysis of TD&J's LXX Critique, accusing us of "overlooking" others' analyses—and further accusing us of being "detached from the entire discipline of text criticism and the history of debate on these issues." Carter and Cosner are irked that we "fail to cite prior work by biblical creationists, including a paper we co-wrote that demonstrably answers one of their main criticisms of the LXX" (Cosner and Carter, 2020). Yet, much of the literature we reviewed was not listed, else the citation list would be distractingly long.

Moreover, to disagree with someone's analysis doesn't prove that it was "overlooked"—in fact, we reviewed relevant literature by Carter and Cosner, and by Henry B. Smith, Jr., and by Jeremy Sexton, and by S. Douglas Woodward, as well as literature by those who distrust the Septuagint's provenance (as its textual content is popularly presumed to be BC in origin)—and so we disagree with Carter and Cosner, who (in LXX provenance matters, as well as in the Methuselah math problem) concur with Smith, Sexton, and Woodward.

Using the logic of Federal Evidence Rule 403, our analysis rejects the forensically unreliable assumption that today's LXX matches textual content translated *prior* to the N.T.'s formation. Moreover, the Carter and Cosner Objection substantively skips the critical importance of our forensic analysis—as if a non-forensic approach was valid and apt to reach accurate conclusions—which is the same methodological error that, for decades, led uniformitarian scientists to misdiagnose the time-of-death (and thus age) of about 300 Viking skeletons in England, as previously reported in *CRSQ* (Johnson, 2018a, 2018b).

SIXTH, Carter and Cosner under-estimate the competence and focused analysis of the authors of the TD&J's LXX Critique. Neither Cosner nor Carter has the years of Biblical Greek and Biblical Hebrew scholarship that we three co-authors collectively have, much less practical experience in Bible translation (such as that of David Daniels, who studied linguistics in both his B.A. and M.Div. programs, plus training with the Summer Institute of Linguistics). All three of us co-authors earned theology degrees, plus one of us received the American Bible Society Award (Wake Forest University) for excellence in Biblical studies and Biblical languages. While academic credentials alone do not carry the day—they are relevant, when criticisms are cast using histrionic innuendos (e.g., "academic impartiality," what is "expected of serious researchers," suggesting that the "LXX-MT debate is straining the creation movement, but this one article sets us back by years," concluding that "[t]here is not a single paragraph that does not demonstrate a significant flaw"). Even the apostle Paul defended his credentials when they were challenged (compare 2nd Corinthians 10:18 with 2nd Corinthians 11:1–33). Lamentably, the Carter and Cosner Objection is heavy on unsupported assumptions and conclusory condemnations, but light on actual evidentiary specifics that meaningfully challenge our article's substance.

SEVENTH, the request in Carter and Cosner's Objection, for a "withdrawal" of TD&J's LXX Critique, reveals how Cosner and Carter misjudge the importance of this controversy, to scientific community members *who care about the Bible's doctrine of creation*, (especially as Earth's providential history is reported in Genesis). Ironically, they recognize the relevance of the topic, saying in an online criticism (Cosner and Carter, 2020): "We began studying the chronology of the Old Testament by comparing the numbers contained in the different text families several years ago. This was in response to a trend among some creationist researchers toward using the inflated chronology of the Septuagint (LXX), which allows them to add several hundred post-Flood years to Earth's history." Thus, Carter and Cosner admit that creationists are impacted by this controversy, yet they now aver that refuting that "trend" is "tangential," as if the YEE (young-Earth evolutionist) saltation scenario of "legged whales on the Ark" was somehow irrelevant to creation scientists.

But the more serious problem is this: why do Carter and Cosner now urge journalistic quashal—censorial squelching—of the research and analysis of the three creationists who have seriously studied this controversy? In their online criticism (Cosner and Carter, 2020), they exhibit that neither is trained in forensic evidence analysis, so their reaction is to censor those who use such analysis—and who draw conclusions different from those of Carter and Cosner. Worse, rather than just disagreeing, Carter and Cosner seek a "withdrawal" of TD&J's LXX Critique (despite it containing nothing that clashes with CRS's core tenets).

But unlike Carter and Cosner, we do *not* request that their objection be censured ("withdrawn") from *CRSQ*, because (1) we confidently welcome meaningful debate on the topic; plus (2) Carter and Cosner, although we heartily disagree with their criticisms, have not promoted any doctrine contrary to the foundational tenets of CRS.

James Johnson and David Daniels

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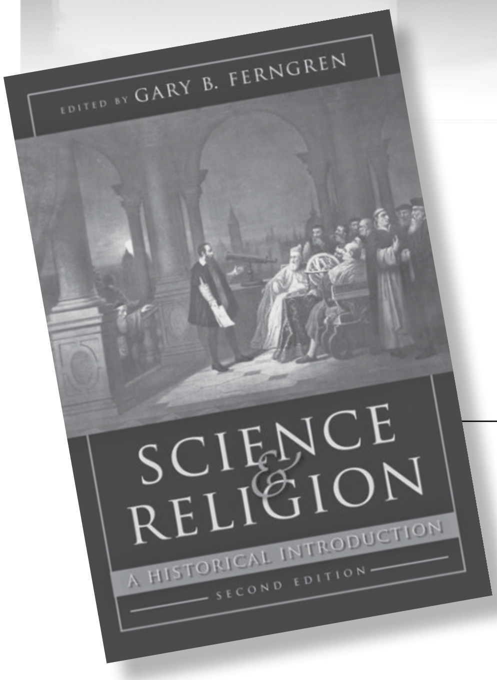
Errata

Two zeros were omitted from the caption of Figure 3 in the paper "Deep Time Philosophy Impacts Radiocarbon Measurements" by Cupps and Thomas, *CRSQ* 55(4):219. The caption of Figure 3 originally read, "LD of approximately 0.8 pMC," but it should read, "LD of approximately 0.008 pMC."



Science & Religion: A Historical Introduction

Gary Ferngren, Editor

Second Edition, Johns Hopkins University Press, Baltimore, 2017, 496 pages, $32.95

Editor Ferngren is professor of history at Oregon State University and also teaches history of medicine at First Moscow State Medical University, ID. He is past vice president of the *International Society of the History of Medicine*.

This second edition survey of the Western religious tradition and its interaction with science offers eleven new essays including Judaism, Islam, Asiatic tradition, and atheism. Other essays include The Bible & Science, Modern Synthesis in Evolution, Anthropology, and Neuroscience and the Human Person.

The book has six sections. Section One, *Conflict or Complexity?* sets the stage as Ferngren explains the historiographic terms Presentism and Essentialism and also the "Whig Interpretation of History."

Section Two, *Premodern Period*, explains the early church's negativity toward Aristotelianism until fourth century Alexandrian philosophers wrote Greek commentaries on Aristotle. This and pressure from Islam led Christian scholastics to integrate Aristotelianism with Christianity. Eventually the Aristotelian idea that logic and experience are the only way of testing truth was inculcated into western thought.

Section Three, *Scientific Revolution*, discusses Copernicus, Galileo, early modern Protestantism, Galileo, Newton, Galileo, and Natural Theology. There is extensive focus on the varying receptions of Copernicus and Galileo, and the fortunes of Copernican supporters.

Section Four, *Transformations in Geology, Biology and Cosmology*, covers the period 1650–1900. There are no surprises here. The biblical deluge "came to be regarded as incorrect and antiquated" (p. 171). In examining fossils in sedimentary layers, natural history "demanded explanations as to how and why these successive populations changed; thus biology was developed as a discipline modeled on the historical discipline of geology" (p. 176).

Contributer James Moore writes an odd account in the "Charles Darwin" entry, portraying Darwin and opponents of Christianity in exalted terms, and those opposed in a negative way.

As debates in evolution proceeded, allies sometimes became opponents on certain issues. This is an excellent example of the complexity thesis first put forward by John Hedley Brooke in his 1991 book *Science and Religion: Some Historical Perspectives*. The concept is carried throughout Ferngren's book.

Section Five is titled *Response of Religious Traditions*. John Stenhouse opens "The Bible & Science" portion by agreeing with Thomas Henry Huxley that science is impeded by "the mistaken zeal of Bibliolators," whereupon Stenhouse continues, "such views continue to flourish among nonspecialists and the general public" (p. 236). He focuses on biblical hermeneutics and its impact on church beliefs.

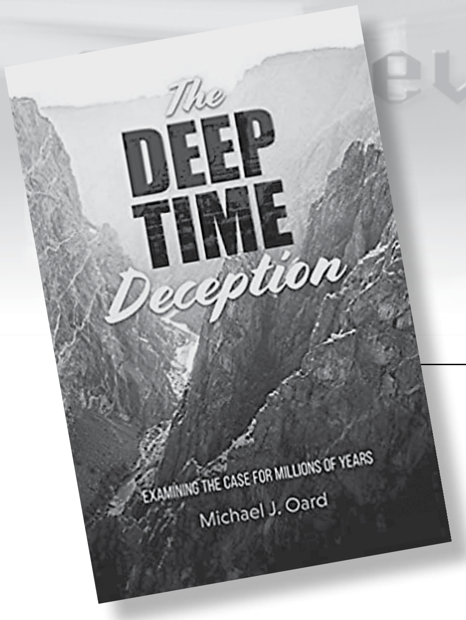
In the *Atheism* section John Henry claims atheists had to wrest science away from theists to prevent its use in promoting theism. "The practice of science itself was secularized as a result of the influence from the wider culture" rather than science being a driver in secularization. Henry acknowledges that it is widely viewed the other way. Given the previous strong connection between theology and science, atheists had no choice but to attempt to sever the link.

Section Six, *Theological Implications of Modern Science*, shifts tense, covering current science and Christianity. Heisenberg shows that even with theoretically perfect instruments, exact physical information on particles cannot be known. "The world at the quantum level is structured in such a way that God can continuously affect events without disturbing the immanent order of the universe" (p. 364).

The book accomplishes ambitious aims, reinforcing Brooke's complexity thesis, providing depth to the history of interaction between science and religion, and refuting poor, lopsided, or intentionally slanted historiographical accounts. The broad summaries on the current state of scientific knowledge and the competing theories and philosophies are very helpful. In light of slanted accounts throughout history, however, the removal of historiography from the first edition is lamentable.

The tone of the book is thorough and nuanced until the *Darwin, Geology, and Evolution* section. Prior to those, the positions of Bible-believing theologians are noted and explained. In following pages, pejorative and subjective terms are applied to Bible-believing theologians and groups. Thus, the book transitions from historical narrative to partisan heckling. Had the editor included a chapter on the difference between empirical observations in the present, and conclusions about the past based on current observations, the writers might have found themselves forced to confront basic questions about the difference between science and ideology.

Anthony Vincent



The Deep Time Deception: Examining the Case for Millions of Years

by Michael J. Oard

Creation Book Publishers, Powder Springs, GA, 2019, 168 pages, $15.99

Known for his extensive work in diluvial geology, Michael Oard sequels his recent treatise on "the great time cruncher" (Oard and Reed, 2017) with a strike at the bulwarks of naturalistic geology itself, uniformitarian time. These extended periods of cosmological time, monikered "deep time," is not only the flagship of the evolutionary naturalistic paradigm but also the foundation of the entire structure. Once deep time is removed, the entire naturalistic paradigm collapses. Standing upon decades of diluvial research, Oard is well poised to provide a broad summary of the latest research.

Beginning with a relatively small chapter, Oard introduces the reader to the deep time debate from a biblical perspective before descending into the chasm of deep time. After reviewing the historical context of the debate and early arguments for deep time, the reader is presented in Chapter 3 with research that challenges those early arguments for deep time. What follows are four chapters on dating the age of Earth, first examining methods that suggest a relatively young Earth (Chapter 4) before examining the assumptions of radiometric dating (Chapter 5) and its shortcomings (Chapters 6, 7). This is followed by a discussion on how Carbon-14 corroborates the biblical narrative rather than challenging it (Chapter 8). Chapter 9 then summarizes the importance of this information on the behavior of humanity, although the reader may be surprised to find this followed by a refutation of compromise on the biblical age of Earth (Chapter 10). An appendix examines the cosmological arguments for deep time and finds them lacking, while Oard applies the "principle of multiple working hypothesizes" (Smith, 2008; Oard, 2010; 2013) in his examination of solutions to the light-travel time problem in Creation Science.

This book provides a useful summary of the debate on deep time and evidence challenging the naturalistic paradigm. However, one may be surprised to find this book focuses predominately on radiometric dating rather than such topics as the alleged multiple ice ages or other supposed deep time evidences. The book occasionally deviates from the flow often seen in Oard's books, such as when Chapter 9 discusses the importance of the deep time debate *before* Oard examines biblical arguments against deep time in Chapter 10. If Chapter 10 were relocated to the status of the second chapter, the reader would be provided with the necessary biblical background, especially for those Christians not familiar with the biblical reasons for Earth being younger than demanded by the naturalistic paradigm. Nonetheless, this book provides an excellent summary of the current state of diluvial research at a level almost anyone can understand.

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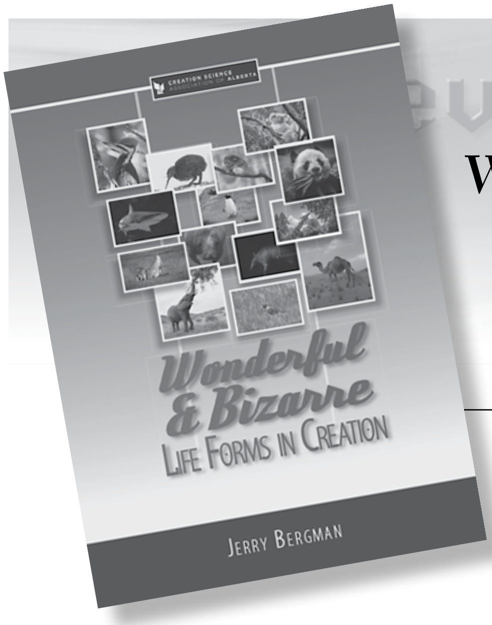

Wonderful & Bizarre Life Forms in Creation

by Jerry Bergman

Creation Science Association of Alberta, Canada, 138 pages, $22.00

Life presents itself to us humans in unfathomable forms and behaviors which lead us to focus on this question: How did these numerous species arise with such unique life habits, diets, and special "talents"? For those who accept an almighty creator, the unique lifestyles of different species discussed in Bergman's book are a sure testimony of God's creative power: Intelligent design is completely obvious. Dogmatic evolutionists explain all life as a purely naturalistic process from molecules to "simple" life, and finally to exquisite life forms and their particular modes of living.

For each of the 23 wonderful and bizarre species presented by Bergman, life styles are presented in a way that raises the question how these individual behaviors could possibly have evolved from a less specified precursor. Evolutionists with strictly naturalistic opinions on origins have not been able to suggest family trees for these creatures. Included are camels, geckos, giraffes, kiwis, pandas, seahorses, tarsiers and woodpeckers.

Naturalists assign species characteristics and behaviors to DNA-based genetics. However, attributing animal behavior to differences in proteins alone is not convincing. The habits of the different species go far beyond their biochemistries and convincingly point to the Creator. None of the species presented has an agreed upon phylogeny preceding their place in the tree of life. The theory of evolution strikes out in these cases with too many precise behaviors to be accidents of nature alone.

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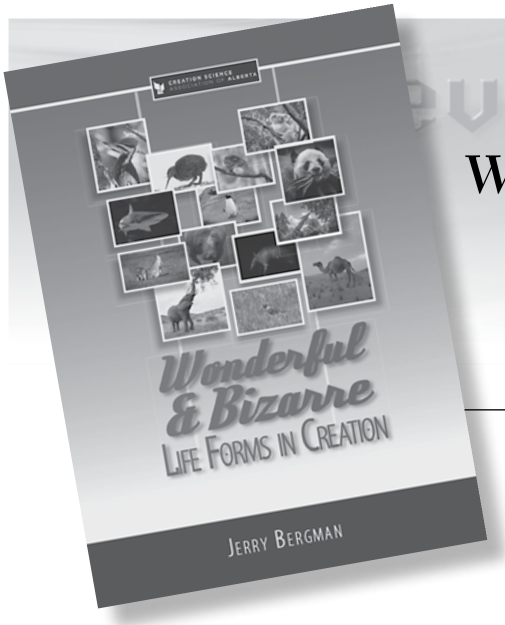

Wonderful & Bizarre Life Forms in Creation

by Jerry Bergman

Creation Science Association of Alberta, Canada, 138 pages, $22.00

As the author of over 50 books, author Bergman is well known as a researcher of significant, yet controversial, issues. In this book, Bergman shares his expertise in a biological bonanza of life-forms deemed not only as “wonderful” and “bizarre,” but as “popular,” “remarkable,” and “spectacular.” The 23-chapter, alphabetically-arranged lineup includes invertebrates (earthworms, octopuses, trilobites), fishes (archer fish, seahorses, sharks), amphibious creatures and reptiles (mudskippers and geckos), and birds (kiwis, pelicans, penguins, woodpeckers). The content continues with a mammalian menagerie featuring the armadillo, camel, elephant, giraffe, koala, manatee, skunk, tarsier, and the collective casts of marsupials, pandas, and rodents. Fossil fans will appreciate the mention of more than a dozen extinct vertebrates.

The book offers color photos, stiff-paper pages and effective use of subtitles. Vocabulary is defined including the names of scientific/philosophical models, taxonomic terms, and anatomical jargon. Each chapter begins with background information on animal anatomy, reproduction, biological classification, geographical location, habitats and habits. Design features are discussed for each creature along with practical benefits for its survival, and also benefits to mankind.

Challenges are given to evolutionary scenarios and deep-time randomness. It may be the creature’s abrupt appearance in the fossil record with no ancestral candidates or any clue as a proposed chance origin. It may be the lack of empirical evidence of any transitional change over time. It could be obvious irreducible complexity. In some cases there is evidence for degeneration, not evolutionary progress, for so-called “vestigial” components, rather than evolutionary ancestry. There may also be inconsistencies among biochemical evaluations, molecular studies, and genetic comparisons within assumed phylogenies. Even mosaic-form organisms offer developmental dilemmas and classification conundrums to the evolution worldview.

Recommended for junior-high to adult readers, this work not only will “*steal* your heart” (and mind) as an animal lover of any age, but also will serve to *steel* your convictions to resist the onslaught of imaginative speculations and just-so stories of Darwinian propaganda that argues against these living miracles within the animal kingdom actually being the handsome handiwork of our Creator-King.

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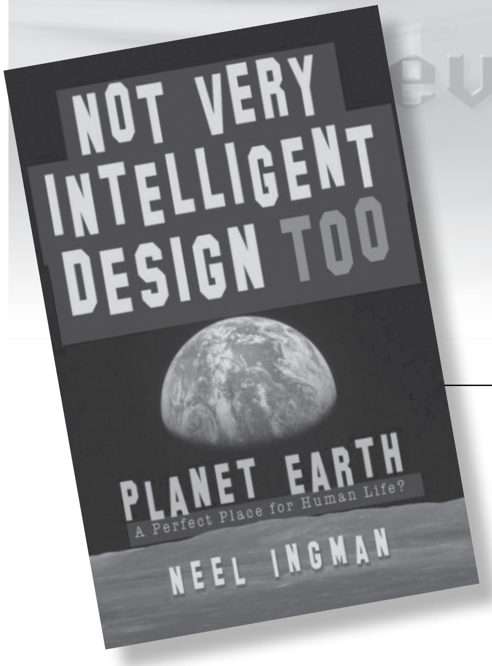

Not Very Intelligent Design Too

by Neel and Mark Ingman

Palaceno House, Auckland, New Zealand, 2018, 201 pages, $10.00

I attempt to read every book and article that covers the poor-design claim in humans in order to gain ideas to respond to their claims. A literature review of every claim consistently reveals there are good reasons for the existing designs. This book attempts to prove evolution because, as the authors claim, no one with intelligence would design the (add the name of any organ here) the way it is constructed. The book lists a large set of body parts and rates the level of design from 1–10, with10 meaning very well designed. Most body parts are rated between 1–5, with only a few given a 10. The average weighted grade is 1.8 (p. 183).

Much of the book does not cite documentation of the poor design claims but instead resorts to name-calling. As an example, the author brothers repeat Neil deGrasse Tyson's quip about the human gonad design being like building an amusement park inside of a sewage treatment plant. The authors describe this design as "breathtaking in its stupidity" (p. 107). However, no better arrangement is offered.

A further example of alleged poor design is the growth of beards on men. The Ingmans declare that facial hair has no function and requires maintenance (pp. 7–10). Of course, one functional reason for facial hair is to enhance sexual dimorphism, the important contrast between male and female faces.

It is related that eagles and owls have better vision than people, dogs have better smell, horses and pigeons have better hearing and cheetahs run much faster us. The conclusion is that human vision, smell, hearing, and legs are poorly designed. However, some senses in humans are better than in most animals. Dogs have excellent smell but poorer vision then people. Furthermore, if humans had eagle eyesight, the olfactory acuity of dogs, or the running ability of a cheetah, we would suffer from sensory overload.

Many book claims are wrong or distorted such as, "any cat can see way better than us" (p. 14). Conversely, however, cats do not see the detail or color richness of people. Furthermore, cats are nearsighted, about 20/100 to 20/200 compared to 20/20 for a healthy person. Each animal's senses are designed for a particular environment and lifestyle. To conclude that human eyes are poorly designed because we cannot see as well as a cat at night or an eagle during the day ignores the animal environment.

Our "sinuses are all bad. No reason at all for them exists" (p. 30). Actually, many important reasons exist for the practical design of sinuses in humans (Bergman, 2019a). In the book appendix, the authors repeat the long-refuted idea that "perhaps the appendix was useful to our aforementioned haruspices" (p. 92). They conclude, "The jury's still out on whether the appendix does anything useful" (p 92). No, the jury is not out; the appendix has at least five well-documented functions (Bergman, 2019b).

The author attempts at humor are mostly a distraction. Overall, they ignore the facts of design constraints, aesthetics, optimization, and systems-efficiency design considerations.

Jerry Bergman
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Bergman, Jerry. 2019a. *The "Poor Design" Argument Against Intelligent Design Falsified*. Bartlett Publishing, Tulsa.

Bergman, Jerry. 2019b. *Useless Organs: The Rise and Fall of the Once Major Argument for Evolution*. Bartlett Publishing, Tulsa.

Instructions to Authors

Submission

Electronic submissions of all manuscripts and graphics are preferred and should be sent to the editor of the *Creation Research Society Quarterly* in Word, WordPerfect, or Star-Office/Open Office (see the inside front cover for address). Printed copies also are accepted. If submitting a printed copy, an original plus two copies of each manuscript should be sent to the editor. The manuscript and copies will not be returned to authors unless a stamped, self-addressed envelope accompanies submission. If submitting a manuscript electronically, a printed copy is not necessary unless specifically requested by the *Quarterly* editor. Manuscripts containing more than 35 pages (double-spaced and including references, tables, and figure legends) are discouraged. An author who determines that the topic cannot be adequately covered within this number of pages is encouraged to submit separate papers that can be serialized.

All submitted manuscripts will be reviewed by two or more technical referees. However, each section editor of the *Quarterly* has final authority regarding the acceptance of a manuscript for publication. While some manuscripts may be accepted with little or no modification, typically editors will seek specific revisions of the manuscript before acceptance. Authors will then be asked to submit revisions based upon comments made by the referees. In these instances, authors are encouraged to submit a detailed letter explaining changes made in the revision, and, if necessary, give reasons for not incorporating specific changes suggested by the editor or reviewer. If an author believes the rejection of a manuscript was not justified, an appeal may be made to the *Quarterly* editor (details of appeal process at the Society's web site, www.creationresearch.org).

Authors who are unsure of proper English usage should have their manuscripts checked by someone proficient in the English language. Also, authors should endeavor to make certain the manuscript (particularly the references) conforms to the style and format of the *Quarterly*. Manuscripts may be rejected on the basis of poor English or lack of conformity to the proper format.

The *Quarterly* is a journal of original writings, and only under unusual circumstances will previously published material be reprinted. Questions regarding this should be submitted to the Editor (CRSQeditor@creationresearch.org) prior to submitting any previously published material. In addition, manuscripts submitted to the *Quarterly* should not be concurrently submitted to another journal. Violation of this will result in immediate rejection of the submitted manuscript. Also, if an author uses copyrighted photographs or other material, a release from the copyright holder should be submitted.

Appearance

Manuscripts shall be computer-printed or neatly typed. Lines should be double-spaced, including figure legends, table footnotes, and references. All pages should be sequentially numbered. Upon acceptance of the manuscript for publication, an electronic version is requested (Word, WordPerfect, or Star-Office/Open Office), with the graphics in separate electronic files. However, if submission of an electronic final version is not possible for the author, then a cleanly printed or typed copy is acceptable.

Submitted manuscripts should have the following organizational format:

1. Title page. This page should contain the title of the manuscript, the author's name, and all relevant contact information (including mailing address, telephone number, fax number, and e-mail address). If the manuscript is submitted by multiple authors, one author should serve as the corresponding author, and this should be noted on the title page.

2. Abstract page. This is page 1 of the manuscript, and should contain the article title at the top, followed by the abstract for the article. Abstracts should be between 100 and 250 words in length and present an overview of the material discussed in the article, including all major conclusions. Use of abbreviations and references in the abstract should be avoided. This page should also contain at least five key words appropriate for identifying this article via a computer search.

3. Introduction. The introduction should provide sufficient background information to allow the reader to understand the relevance and significance of the article for creation science.

4. Body of the text. Two types of headings are typically used by the *CRSQ*. A major heading consists of a large font bold print that is centered in column, and is used for each major change of focus or topic. A minor heading consists of a regular font bold print that is flush to the left margin, and is used following a major heading and helps to organize points within each major topic. Do not split words with hyphens, or use all capital letters for any words. Also, do not use bold type, except for headings (italics can be occasionally used to draw distinction to specific words). Italics should not be used for foreign words in common usage, e.g., "et al.", "ibid.", "ca." and "ad infinitum." Previously published literature should be cited using the author's last name(s) and the year of publication (ex. Smith, 2003; Smith and Jones, 2003). If the citation has more than two authors, only the first author's name should appear (ex. Smith et al., 2003). Contributing authors should examine this issue of the *CRSQ* or consult the Society's web site for specific examples as well as a more detailed explanation of manuscript preparation. Frequently-used terms can be abbreviated by placing abbreviations in parentheses following the first usage of the term in the text, for example, polyacrylamide gel electrophoresis (PAGE) or catastrophic plate tectonics (CPT). Only the abbreviation need be used afterward. If numerous abbreviations are used, authors should consider providing a list of abbreviations. Also, because of the variable usage of the terms "microevolution" and "macroevolution," authors should clearly define how they are specifically using these terms. Use of the term "creationism" should be avoided. All figures and tables should be cited in the body of the text, and be numbered in the sequential order that they appear in the text (figures and tables are numbered separately with Arabic and Roman numerals, respectively).

5. Summary. A summary paragraph(s) is often useful for readers. The summary should provide the reader an overview of the material just presented, and often helps the reader to summarize the salient points and conclusions the author has made throughout the text.

6. References. Authors should take extra measures to be certain that all references cited within the text are documented in the reference section. These references should be formatted in the current *CRSQ* style. (When the *Quarterly* appears in the references multiple times, then an abbreviation to *CRSQ* is acceptable.) The examples below cover the most common types of references:

Robinson, D.A., and D.P. Cavanaugh. 1998. A quantitative approach to baraminology with examples from the catarrhine primates. *CRSQ* 34:196–208.

Lipman, E.A., B. Schuler, O. Bakajin, and W.A. Eaton. 2003. Single-molecule measurement of protein folding kinetics. *Science* 301:1233–1235.

Margulis, L. 1971a. The origin of plant and animal cells. *American Scientific* 59:230–235.

Margulis, L. 1971b. *Origin of Eukaryotic Cells*. Yale University Press, New Haven, CT.

Hitchcock, A.S. 1971. *Manual of Grasses of the United States*. Dover Publications, New York, NY.

Walker, T.B. 1994. A biblical geologic model. In Walsh, R.E. (editor), *Proceedings of the Third International Conference on Creationism* (technical symposium sessions), pp. 581–592. Creation Science Fellowship, Pittsburgh, PA.

7. Tables. All tables cited in the text should be individually placed in numerical order following the reference section, and not embedded in the text. Each table should have a header statement that serves as a title for that table (see a current issue of the *Quarterly* for specific examples). Use tabs, rather than multiple spaces, in aligning columns within a table. Tables should be composed with *14-point type* to insure proper appearance in the columns of the *CRSQ*.

8. Figures. All figures cited in the text should be individually placed in numerical order, and placed after the tables. Do not embed figures in the text. Each figure should contain a legend that provides sufficient description to enable the reader to understand the basic concepts of the figure without needing to refer to the text. Legends should be on a separate page from the figure. All figures and drawings should be of high quality (hand-drawn illustrations and lettering should be professionally done). Images are to be a minimum resolution of 300 dpi at 100% size. Patterns, not shading, should be used to distinguish areas within graphs or other figures. Unacceptable illustrations will result in rejection of the manuscript. Authors are also strongly encouraged to submit an electronic version (.cdr, .cpt, .gif, .jpg, and .tif formats) of all figures in individual files that are separate from the electronic file containing the text and tables.

Special Sections

Letters to the Editor:

Submission of letters regarding topics relevant to the Society or creation science is encouraged. Submission of letters commenting upon articles published in the *Quarterly* will be published two issues after the article's original publication date. Authors will be given an opportunity for a concurrent response. No further letters referring to a specific *Quarterly* article will be published. Following this period, individuals who desire to write additional responses/comments (particularly critical comments) regarding a specific *Quarterly* article are encouraged to submit their own articles to the *Quarterly* for review and publication.

Editor's Forum:

Occasionally, the editor will invite individuals to submit differing opinions on specific topics relevant to the *Quarterly*. Each author will have opportunity to present a position paper (2000 words), and one response (1000 words) to the differing position paper. In all matters, the editor will have final and complete editorial control. Topics for these forums will be solely at the editor's discretion, but suggestions of topics are welcome.

Book Reviews:

All book reviews should be submitted to the book review editor, who will determine the acceptability of each submitted review. Book reviews should be limited to 1000 words. Following the style of reviews printed in this issue, all book reviews should contain the following information: book title, author, publisher, publication date, number of pages, and retail cost. Reviews should endeavor to present the salient points of the book that are relevant to the issues of creation/evolution. Typically, such points are accompanied by the reviewer's analysis of the book's content, clarity, and relevance to the creation issue.

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All members (categories 1–5 above) must subscribe to the Statement of Belief as defined on the next page.

Please complete the lower portion of this form and mail it with payment to CRS Membership Secretary, 6801 N. Highway 89, Chino Valley, AZ 86323, or fax for credit card payment to (928) 636-1153. Applications may also be completed online at creationresearch.org.

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Creation Research Society

History—The Creation Research Society was organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (graduate degrees in science) and about 1000 non-voting members. The *Creation Research Society Quarterly* is a peer-reviewed technical journal. It has been gradually enlarged and modified, and is currently recognized as one of the outstanding publications in the field. In 1996 the *CRSQ* was joined by the newsletter *Creation Matters* as a source of information of interest to creationists.

Activities—The Society is a research and publication society, and also engages in various meetings and promotional activities. There is no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund and research center are maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible. As part of its vigorous research and field study programs, the Society operates The Van Andel Creation Research Center in Chino Valley, Arizona.

Membership—Voting membership is limited to scientists who have at least an earned graduate degree in a natural or applied science and subscribe to the Statement of Belief. Sustaining membership is available for those who do not meet the academic criterion for voting membership, but do subscribe to the Statement of Belief.

Statement of Belief—Members of the Creation Research Society, which include research scientists representing various fields of scientific inquiry, are committed to full belief in the biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution) both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. *All members of the Society subscribe to the following statement of belief:*

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.
2. All basic types of living things, including humans, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.
3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event worldwide in its extent and effect.
4. We are an organization of Christian men and women of science who accept Jesus Christ as our Lord and Savior. The act of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.

iDINO II

Investigation of Dinosaur Intact Natural Osteo-tissue

A fragment of the *Triceratops* brow horn. Fragments, such as this one, still contain tissue and cells.

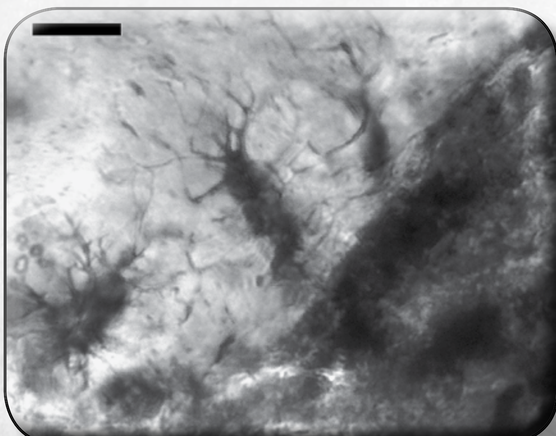
How can pliable, stretchable tissue survive inside dinosaur fossils for over 65 million years?

How can this tissue still contain intact cells and even dinosaur proteins?

How can this fragile biological material survive for so long?

The answer to these questions directly challenges the current, evolutionary-biased, geologic timescale.

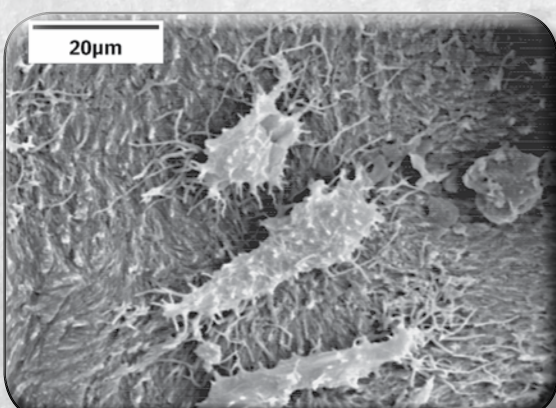
The Creation Research Society began its iDINO research initiative for the purpose of studying soft tissue in dinosaur fossils. The first phase of the project detected pliable, unfossilized tissue in a brow horn of a *Triceratops*. Within this tissue were intact osteocytes (bone cells). Some results from the iDINO project have been published in a technical microscopy journal and presented at an international microscopy conference. The Spring 2015 issue of the *Creation Research Society Quarterly* also features a special report of the iDINO project. Plus, to further spread the important information about soft tissue, the Society is developing a video (Echoes of the Jurassic).



Microscopic examination of tissue extracted from a *Triceratops* horn reveals bone cells still present.

The **second phase** of the project (iDINO II) will look more extensively at the process of tissue preservation. Evolutionists have offered various theories of how this tissue could survive for millions of years. iDINO II will methodically investigate these preservation claims, assessing their plausibility.

The iDINO results have already provided a strong challenge to the evolutionary worldview. More extensive and detailed examination may provide even stronger evidence that the age of dinosaur fossils is far less than 65 million years. To this end, the Society continues to seek those willing to fund this project with either one-time gifts or monthly donations.



Electron microscope picture of intact bone cells still in tissue extracted from a *Triceratops* horn.

For more information contact us at (928) 636-1153 or crsvarc@crsvarc.com.

Also visit http://tinyurl.com/nphm2c4 for project updates and details.