NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

MEETING ANNOUNCEMENT

DATE: **October 29, 2014**

LOCATION: **Orinda Masonic Center, 9 Altarinda Rd., Orinda**

TIME: **6:30 p.m. social; 7:00 p.m. talk (no dinner) Cost: $5 per regular member; $1 per student or K – 12 teachers**

SPEAKER: **Marcus Trotta, PG, CHg**
Sonoma County Water Agency

GROUNDWATER BASIN STUDIES AND MANAGEMENT IN SONOMA COUNTY

Sonoma County is in the northern part of the greater San Francisco Bay region, an area of Northern California that has experienced population growth over the past few decades, along with an expansion in agriculture associated with this premier wine-growing region. The county's groundwater basins provide numerous benefits to the region, including rural residential and municipal water supplies, irrigation water for agriculture, and baseflow to streams and surface water bodies. Future development and demand for water coupled with a changing climate and constraints on existing surface water sources are likely to increase stresses on the region's groundwater resources.

In recognition of the importance of characterizing, monitoring and managing the region's groundwater resources, in the early 2000's the Sonoma County Water Agency and U.S. Geological Survey began cooperating on performing hydrogeologic studies of the four largest and most heavily populated groundwater basins in Sonoma County (Alexander Valley, Petaluma Valley, Santa Rosa Plain and Sonoma Valley). The objectives of the cooperative studies include: 1) developing updated assessments of the hydrogeology and geochemistry of the groundwater basins; 2) developing a multi-aquifer groundwater flow models for select groundwater basins; and 3) evaluating the hydrologic impacts of alternative groundwater management strategies. These studies serve to provide a basis for subsequent groundwater management planning activities which emphasize local and regional coordination and collaboration.

…Continued on Back…

NCGS 2012 – 2013 Calendar

October 29, 2014; 7:00 pm
Marcus Trotta, Sonoma County Water Agency
xxxx

November 19, 2014; 7:00 pm
Christopher Lewis
Tales of the Oil and Gas Fields and Thereabouts

January 28, 2015; 7:00 pm
TBA

February 25, 2015; 7:00 pm
TBA

March 25, 2015; 7:00 pm
TBA

April 29, 2015; 7:00 pm
TBA

May 27, 2015; DINNER MEETING; 6:00 pm
B. Lynn Ingram, UC Berkeley
The West without Water

June 24, 2015; 7:00 pm
TBA

NCGS Field Trips

Friday October 24, 2014
(Trip is Full)

Calaveras Dam Replacement Project;
Greg Bartow, Goundwater Program Manager, San Francisco Public Utilities Commission

Saturday April 25, 2015

An undefined Petroleum system along the Santa Cruz County coast, California
Dr. Allegra Hasford Scheirer and Dr. Leslie B. Magoon, Stanford University, Stanford

Peninsula Geologic Society

For an updated list of meetings, abstracts, and field trips go to http://www.diggles.com/pgs/. The PGS has also posted guidebooks for downloading, as well as photographs from recent field trips at this web address. Please check the website for current details.

Bay Area Science

This website provides a free weekly emailed newsletter consisting of an extensive listing of local science based activities (evening lectures, classes, field trips, hikes, and etc). Go to: http://www.bayareascience.org/

Association of Engineering Geologists San Francisco Section

Upcoming Events

Meeting locations rotate between San Francisco, the East Bay, and the South Bay. Please check the website for current details. To download meeting details and registration form go to: http://www.aegsf.org/.

USGS Evening Public Lectures

October 30th @ 7:00 PM

Wolf and Elk Diseases in Yellowstone: Lessons on emerging pandemics

by Paul Cross, USGS Research Wildlife Biologist
More info: http://online.wr.usgs.gov/calendar/

- A WORKSHOP FOR TEACHERS –
(Let your teacher friends and contacts know!)

NCGS FIELD TRIP FOR THE NATIONAL EARTH SCIENCE WEEK

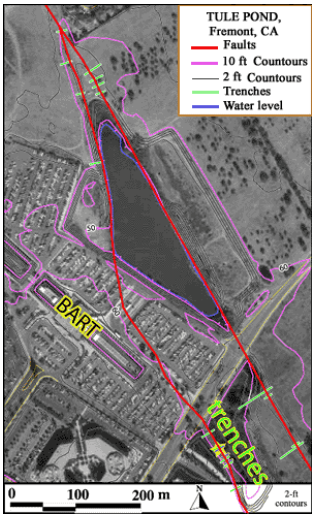
Saturday October 25, 2014

The Hayward Fault – Identifying Urban and Natural Features in the East Bay

Leader: Dr. Joyce R. Blueford, Math Science Nucleus

with Dr. Ray Sullivan, emeritus San Francisco State University

Over the last million years, the natural beauty of Fremont has been shaped by the Hayward Fault. This teacher workshop will start at Tule Ponds at Tyson Lagoon Wetland Center and end up at the Fremont Earthquake Exhibit in Central Park. Discover the "fault creep" and off sets as we walk along the Hayward fault and explore the dramatic faulting effects in both a natural and urban environment. Learn how we use the measurable movements to incorporate into lesson plans.



Both these facilities are part Fremont Learning Corridor that trace the Hayward Fault from

Fremont to Union City. The Math Science Nucleus offers a host of field trips in this area. Lesson plans on the geology and natural history along the Hayward Fault (and correlated to the Next Generation Science Standard) will be illustrated.

To learn more about both areas please consult the Math Science Nucleus website (http://msnucleus.org).

NCGS will be hosting a BBQ lunch at Tule Ponds. For registration and/or additional information please email blueford@msnucleus.org. Co-sponsored by Math Science Nucleus

2014 Website Contest Honorable Mention

NCGS member Harry Nichandros received an Honorable Mention in the 2014 Website Contest held by the American Federation of Mineralogical Societies (AFMS) for his work for the Contra Costa Mineral & Gem Society website (www.ccmgs.org). In case you were not aware, NCGS obtains liability insurance through the AFMS. **Please congratulate Harry** for the recognition of his work by the AFMS!

BUMP; Napa Valley Earthquake

NCGS member Robert Bennett undertook a project to document the August 25, 2014 M6.0 Napa Valley earthquakes rupture zone from California Highway 121 south to the Napa River just north of the epicenter. He wanted to make his photographs available to NCGS members. His observations were made at 13 key points where fault rupture was visible. Field notes and photographs were made at 8 hours after then main earthquake. Additional observations were made 14 days, 28 days and 35 days after the main earthquake. The following are a few of the photographs with a brief write-up provided by member Phil Garbutt. A poster with map, with location information, is planned for the October NCGS general meeting.

The first three photos are of en echelon fractures crossing a road, entering a vineyard, and depicting a row of vines that show an offset. The pictures were taken 8 hours after the main earthquake on August 25th.

The photo above is of a fence line showing right lateral offset near a school. To the left is a 24 inch gas transmission line which has been excavated for

inspection (?) The photo was taken 14 days after the earthquake.

The following photo is of an offsite road north of highway 121 showing right lateral offset. The photo was taken 28 days after the earthquake.

The final photo is of a fault trace (above orange sign) crossing roadway and leading along base of uplifted terrace (possibly Holocene?).

California's peaks heighten our understanding of our state

Friday, September 19, 2014, SF Chronicle, opinion

It's a hot and angry September, and your boss or your spouse has just told you to take a hike. But where?

Hiking usually means mountains, and California has more than its share of bucket-list summits. Half Dome draws the tourists. Mount Whitney is the tallest. Mount Shasta is the prettiest. And few experiences are more mystical than the tram ride up San Jacinto, above Palm Springs.

But for most Californians, these are not middle-class, everyday peaks. They are destination mountains, desired because they stand so far apart from where most of us live and work. So, while we admire their greatness, we cannot see ourselves in them.

Photo: Bek Phillips
The view from the peak of Mount Diablo encompasses all the landscapes of California and even beyond.

No, the three greatest mountains of California stand lower, but closer. They do not make most tourist guides, and many Californians have not heard of them all. But they offer panoramic views that allow us to look at ourselves, and thus help define us.

This summer, I made a point of going to the top of all three. First was my hometown peak, Mount Wilson, part of Southern California's San Gabriel Mountains, from which I peered over greater Los Angeles from 5,710 feet. I grew up in the mountain's shadow in Pasadena; my mother, not a religious sort, once suggested that if there was a God, he lived inside the mountain, which still seems as good an answer as any offered by organized religion.

Mount Wilson has the best view of Southern California's sprawl, but it also defines the narrowness of our vision here. These San Gabriel Mountains and other ranges wall off our region, making us, in the words of the late author Carey McWilliams, "an island on the land." You literally can't see the rest of California from Southern California. So we are stuck looking at ourselves. And at our stars, if you stop by the historic Mount Wilson Observatory.

A week later, I made a far lesser climb, in La Jolla (San Diego County), to the top of Mount Soledad, which stands just 822 feet above sea level. But the view from that spot, from the Pacific to the mountains to the whole of San Diego, was somewhat grander.

Mount Soledad's summit is perhaps best known as home of a landmark cross, the subject of a court battle over whether it represents an unconstitutional establishment of religion. My own revelation up there was less about the Savior and more about San Diego. Los Angeles and San Francisco are on the ocean, but those cities are oriented away from the Pacific — L.A. toward the inland valleys and San Francisco toward the bay. To see San Diego from atop Soledad is to see how this is California's true seaside city. The buildings and people strain to face the natural harbor.

I had visited Soledad and Wilson before, but I had never been to the top of the third peak, Mount Diablo, 3,849 feet above the East Bay suburbs.

If Mount Diablo remains a mystery to you, you ought to remedy that, and fast. As I learned after paying $10 to enter Mount Diablo State Park and making a 40-minute drive to the summit from Danville, there is simply no better — and no more important — view, anywhere in California.

Indeed, the 360-degree panorama is so encompassing it's hard to even list all of what lies before you. The highlights: the Golden Gate, the Peninsula, eight bridges, the Santa Cruz Mountains, a bit of the Cascades (with binoculars), the Central Valley, the Sierra, and in the foreground, the majesty of the delta, water source for our parched state.

Mount Diablo might be the closest thing California has to a geographic center. In 1851, the top of Diablo was chosen as the starting point for official land surveys. Real estate through much of California, as well as in Nevada and Oregon, is still described in legal documents based on those lines.

Mount Diablo remains a rare, and underappreciated, reference point for a state that can be hard to understand. That doesn't mean that California made sense to me as I stood on top of the mountain. It would take lifetimes to know all the places you could see from the top.

But, like Jeffrey Lebowski's rug or our university systems, Mount Diablo really ties the place together. California is all about divides and separations. But here, not too high above the fray, we meet.

Joe Mathews is the California and innovation editor of Zócalo Public Square.

Goldilocks and the Three Zones

(Part 1)

*By NCGS Member **Dr. Bill Motzer***

This article originally appeared in The Vortex from the California Section of the American Chemical Society (CALACS). Go to www.calvaryslz.org/calacs/ where you can download pdfs of the original articles and/or peruse past issues of The Vortex.

Introduction

"*Once upon a time, there was a little girl named Goldilocks. She went for a walk in the forest. Pretty soon, she came upon a house. She knocked and, when no one answered, she walked right in. At the table in the kitchen, there were three bowls of porridge. Goldilocks was hungry. She tasted the porridge from the first bowl.*

'This porridge is too hot!' she exclaimed. So, she tasted the porridge from the second bowl.

'This porridge is too cold,' she said. So, she tasted the last bowl of porridge.

'Ahhh, this porridge is just right,' she said happily and she ate it all up."

From "Goldilocks and the Three Bears"

The quote from this children's fairy tale should give you an inkling of this month's subject. It also evokes the relatively new branch of chemistry known as *cosmochemisty* or chemical cosmology, a term coined by Harold Urey (1893 to 1981, American physical chemist and 1934 chemistry Nobel Prize winner. *Cosmochemisty* is concerned with the origin and development of the chemical elements (including their isotopes) and substances throughout the universe. To date cosmochemistry's major focus is on objects within solar system (e.g., meteorites, interstellar dust, comets, asteroids, planets, and moons) but the field is also closely related to a branch of astronomy known as *astrochemistry* in which scientists measure chemical elements and compounds in stars and interstellar dusts in the Milky Way Galaxy and other nearby galaxies. It also involves the search for terrestrial-like life in the universe, based on the elements of carbon, nitrogen, phosphorous, sulfur, oxygen, and hydrogen that compose most life and 99% of the human body.

Definitions

The Goldilocks Zone, also known as the habitable zone (HZ), is commonly defined as the distance from a star that a terrestrial-like planet could maintain liquid water on its surface and consequently contain terrestrial-like life. Planets in such zones are the likeliest candidates to be "habitable," namely capable of bearing extraterrestrial life similar to our own. The HZ concept generally does not include moons, because there remains insufficient evidence and theory to speculate which moons might be habitable on account of their proximity to a planet. The most familiar HZ is within our own solar system and is commonly referred to as the circumstellar HZ or CHZ. For convenience, I've also titled this zone as HZ-1. An HZ could also occur within a galaxy (HZ-2) and there may even be regions of the universe more conducive to the development of life; these are termed as HZ-3.

Planets outside of our solar system have been detected by various methods; these are termed *exoplanets*. To date, 777 have been positively identified of which five are believed to be within an HZ.

HZ-1

Based on various scientific models, the CHZ for our solar system (Figure 1) is believed to extend from a distance of 0.958 to 1.004 AU to perhaps 0.95 to 1.37 AU (if CO_2 is included as a greenhouse gas). (The Earth is at 1.000 AUAU or 149,597,870.7. Venus is at ~0.72 AU and Mars is at ~1.52 from the Sun.). Therefore, both Venus and Mars could be considered just outside the CHZ.

We believe that Venus is too hot with no liquid water and Mars is too cold with a sparse atmosphere to sustain

complex terrestrial life, although there may be evidence of past bacterial life on Mars. On August 6, 1996, a Martian meteorite designated as ALH 84001 became newsworthy when it was claimed that it might contain trace evidence of life (see D. McKay, et al., *Science*, v. 273, pp. 924–930). An electron microscope study revealed chain-like structures attributed to fossil bacteria-like life forms similar to theoretical nanobacteria, but smaller than any known cellular life at the time of their discovery. If these structures are indeed fossilized life forms, they would be the first evidence of extraterrestrial life. NASA's new car-sized Mars Science Laboratory (MSL, or *Curiosity*) is a Mars rover launched by NASA on November 26, 2011. Curiosity successfully landed on August 6, 2012, to begin two years of scientific discovery. The rover contains instruments that may be able to detect the chemical building blocks of either past or present life (i.e, biosignatures; see ACS produced video "Chemistry on Mars" at www.bytesizescience.com).

The CHZ also depends on a star's mass and luminosity. For a star with 0.5 solar masses, the CHZ would be just inside Mercury's orbit at 0.39 AU and for 2.0 solar masses the CHZ would be just inside of Jupiter's orbit at about 5.20 AU (see an animation at:

http://library.thinkquest.org/C003763/flash/habzone1.htm).

But, even if a planet is within an HZ, it must have other criteria that would be amenable to the formation of life, particularly for advanced complex life forms similar to those found on Earth. Using Earth as a model, here are some of the important criteria:

(1) a stable metal-rich star
(2) a metal-rich rocky planet
(3) a strong constant magnetic field
(4) a stable almost circular orbit
(5) a planetary rotation with a stable axis
(6) a sufficiently dense atmosphere
(7) a world ocean
(8) continental platforms and plate tectonics

These will be discussed in more detail in subsequent articles.

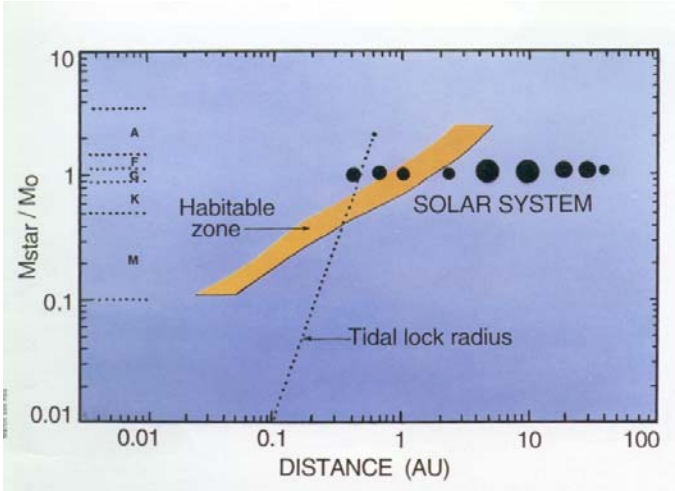


***Figure 1**: The HZ in relation to a star's mass. The solar system's planets (with the Sun as a G2 star at Mstar/Mo = 1.0 or mass of star divided by mass of Sun) are shown as solid circles beginning with Mercury on the left, proceeding (left to right) to Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto (now reclassified as a dwarf planet). Reference: Kasting et al., 1993, Icarus, v.101, p.108.*

[In remembrance of Dr. Sally Ride (1951-2012), physicist, scientist, educator, astronaut, and first American woman in space].

Reflections on a Mammoth Dig

***Former NCGS member Virginia Friedman** is helping to excavate a nearly complete Mammoth south of Dallas Texas. She will present a paper on the mammoth in Mexico this November and in Vienna Austria in 2016. After Virginia received her PhD in Paleontology from UC Davis in 2009 she went back to Texas to find and write about the abundant North Texas fossils. While in Texas, John Christian had the opportunity to see her great Texas fossil collection and go on fossil collecting trips sponsored by the Dallas Paleontological Society that we both belong to. The following article was written by Virginia. An article about the find also appeared in a Dallas area newspaper. (see: http://focusdailynews.com/local-scientist-finds-bones-in-ellis-county-p13014-1.htm)*

This is the story of a new mammoth find in North Central Texas. The story begins back in May, 2014 when the owner of a gravel and sand pit in Ellis County, while working with his backhoe, came across a big bone. He stopped his machine, came down to take a look and, with his keen eye, saw a big bone coming out of the sandy soil. The dig started soon after that and I was part of the team excavating the mammoth. The mammoth was given the name Ellie May because it was found in Ellis County and May because it was found in late May.

The owner had damaged part of the skull of the mammoth with his machinery. Otherwise, the find has proven to be a magnificent specimen of a mammoth. The skeleton was about 80 percent complete and almost all was found in anatomical position. The size of the tusks and the shape of the pelvis suggest that the mammoth

was young (subadult) and that it was a female. The lamellar frequency of the teeth exposed points to a Columbian mammoth, *Mammuthus columbi*. The linage of the mammoths in North America is *Mammuthus meridionalis* (the ancestral mammoth) --- *M. imperator* --- *M. columbi*. The woolly mammoth, *M. primigenius* was not present this far south (i.e., Texas) and it was an immediate descendant of the steppe mammoth *M. trogontherii* in Eurasia. In the Americas there was another species of mammoth, *M. exilis*, the pygmy mammoth descended from the mainland Columbian mammoth and lived on the Channel Islands of Southern California.

But, going back to our mammoth, the skeleton showed no sign of scavengers and Ellie May was found lying on her left side practically articulated. What happened to her? Nobody seems to know as yet. The age of sediments is old; they go back to the late Pleistocene (last Ice Age or Wisconsinan glaciation). It corresponds to the Rancholabrean (North American Land Mammal Age). The mammoth remains are located within the Trinity River Basin and are sands and gravels deposited by the ancestral Trinity River and its tributaries. It has not been the only mammoth remains in Ellis County. There have been at least 2 others, but they have been only isolated bones.

The stratigraphic column at the mammoth locality shows from top to bottom: Top soil, several strata of paleosols, interfingered very coarse gravels, and fine sand deposits. Ellie May came to rest at a depth of around 3 meters in this fine sand (composed of fine grains rounded and well sorted). These deposits lay unconformably on the blue-gray shales of the Upper Eagle Ford Group and/or even younger deposits. It is not uncommon to find an Upper Cretaceous faunal assemblage in the gravels: vertebrae and shark teeth of *Cretodus* sp., *Cretolamna appendiculata*, *Cretoxyrhina mantelli*, *Ptychodus whipplei P. anomymus*, *P. mammillaris*, and fragments as well as complete inoceramid pelecypods.

The sediments where the mammoth bones are encased will be dated by geochronologic methods (Optically Stimulated Luminescence). In addition, radiocarbon dating will be run on the collagen of the bones, to further confirm the age of the mammoth remains.

Most important for the paleoecology of our mammoth Ellie is that she wasn't alone, tooth fragments of another proboscidean (a gomphothere mastodon) in addition to an incomplete tusk of another mammoth have been found in the same locality. This last one appears to be much older than Ellie since it was not found at the same stratigraphic level. It was found at least 3 m deeper than the stratum where Ellis was lying.

All of this makes one's imagination fly trying to picture how was the landscape in what is now North Central Texas in the late Pleistocene: a herd of Mammoths roaming, grazing near lake shores and not far away some nearby forest where gomphothere mastodons were browsing peacefully under a clear blue sky.

The mammoth remains will be studied for a long time; new hypothesis will come to life as of the life and death of our Ellie the mammoth. But one thing is for sure, all of us lucky enough to have participated in the dig will cherish her forever. It is said that you live as long as people remember you … well Ellie will live long if only in our minds. The fossil remains will be taken to the Perot museum in Dallas and I know already of top notch specialists in mammoth research, ready to fully study her scientifically. So, long live Ellie the Mammoth!

The first scientific paper on this mammoth is going to be presented in November:

Friedman, Virginia and Steve L. Forman, 2014. *Preliminary report of a new mammoth find in Ellis County, North Central Texas (Proboscidea, Elephantidae) Mammuthus columbi*, II Symposium of Paleontology, Universidad del Mar, Puerto Escondido, Mexico. Nov 2014.

In addition, I will present further research on the mammoth in Ellis County at a congress that will take place in 2016 in Vienna, Austria.

Virginia Friedman, Paleontologist

The Earthquake Cycle in the San Francisco Bay Region: A.D. 1600–2012

Full article available (for a fee) at the Bulletin of the Seismological Society of America, June 2014 V. 104, p. 1299- 1328

1. David P. Schwartza,
2. James J. Lienkaempera,
3. Suzanne Heckera,
4. Keith I. Kelsonb,
5. Thomas E. Fumala,[*],
6. John N. Baldwinc,
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+ Author Notes; ↵* Deceased (2010).

Stress changes produced by the 1906 San Francisco earthquake had a profound effect on the seismicity of the San Francisco Bay region (SFBR), dramatically reducing it in the twentieth century. Whether the SFBR is still within or has emerged from this seismic quiescence is an issue of debate with implications for earthquake mechanics and seismic hazards. Historically, the SFBR has not experienced one complete earthquake cycle (i.e., the accumulation of stress, its release primarily as coseismic slip during surface-faulting earthquakes, its re-accumulation in the interval following, and its subsequent rerelease). The historical record of earthquake occurrence in the SFBR appears to be complete at about **M** 5.5 back to 1850 (Bakun, 1999). For large events, the record may be complete back to 1776, which represents about half a cycle. Paleoseismic data provide a more complete view of the most recent pre-1906 SFBR earthquake cycle, extending it back to about 1600. Using these, we have developed estimates of magnitude and seismic moment for alternative sequences of surface-faulting paleoearthquakes occurring between 1600 and 1776 on the region's major faults. From these we calculate seismic moment and moment release rates for different time intervals between 1600 and 2012. These show the variability in moment release and suggest that, in the SFBR regional plate boundary, stress can be released on a single fault in great earthquakes such as that in 1906 and in multiple ruptures distributed on the regional plate boundary fault system on a decadal time scale.

Is the universe a bubble? Let's check: Making the multiverse hypothesis testable

Perimeter Associate Faculty member Matthew Johnson and his colleagues are working to bring the multiverse hypothesis, which to some sounds like a fanciful tale, firmly into the realm of testable science.

Never mind the big bang; in the beginning was the vacuum. The vacuum simmered with energy (variously called dark energy, vacuum energy, the inflation field, or the Higgs field). Like water in a pot, this high energy began to evaporate -- bubbles formed.

Each bubble contained another vacuum, whose energy was lower, but still not nothing. This energy drove the bubbles to expand. Inevitably, some bubbles bumped into each other. It's possible some produced secondary bubbles. Maybe the bubbles were rare and far apart; maybe they were packed close as foam.

But here's the thing: each of these bubbles was a universe. In this picture, our universe is one bubble in a frothy sea of bubble universes.

Screenshot from a video of Matthew Johnson explaining the related concepts of inflation, eternal inflation, and the multiverse (see http://youtu.be/w0uyR6JPkz4).

Credit: Image courtesy of Perimeter Institute

That's the multiverse hypothesis in a bubbly nutshell.

It's not a bad story. It is, as scientists say, physically motivated -- not just made up, but rather arising from what we think we know about cosmic inflation.

Cosmic inflation isn't universally accepted -- most cyclical models of the universe reject the idea. Nevertheless, inflation is a leading theory of the universe's very early development, and there is some observational evidence to support it.

Inflation holds that in the instant after the big bang, the universe expanded rapidly -- so rapidly that an area of space once a nanometer square ended up more than a quarter-billion light years across in just a trillionth of a trillionth of a trillionth of a second. It's an amazing idea, but it would explain some otherwise puzzling astrophysical observations.

Inflation is thought to have been driven by an inflation field -- which is vacuum energy by another name. Once you postulate that the inflation field exists, it's hard to avoid an "in the beginning was the vacuum" kind of story. This is where the theory of inflation becomes controversial -- when it starts to postulate multiple universes.

Proponents of the multiverse theory argue that it's the next logical step in the inflation story. Detractors argue that it is not physics, but metaphysics -- that it is not science because it cannot be tested. After all, physics lives or dies by data that can be gathered and predictions that can be checked.

That's where Perimeter Associate Faculty member Matthew Johnson comes in. Working with a small team that also includes Perimeter Faculty member Luis

Lehner, Johnson is working to bring the multiverse hypothesis firmly into the realm of testable science.

"That's what this research program is all about," he says. "We're trying to find out what the testable predictions of this picture would be, and then going out and looking for them."

Specifically, Johnson has been considering the rare cases in which our bubble universe might collide with another bubble universe. He lays out the steps: "We simulate the whole universe. We start with a multiverse that has two bubbles in it, we collide the bubbles on a computer to figure out what happens, and then we stick a virtual observer in various places and ask what that observer would see from there."

Simulating the whole universe -- or more than one -- seems like a tall order, but apparently that's not so.

"Simulating the universe is easy," says Johnson. Simulations, he explains, are not accounting for every atom, every star, or every galaxy -- in fact, they account for none of them.

"We're simulating things only on the largest scales," he says. "All I need is gravity and the stuff that makes these bubbles up. We're now at the point where if you have a favourite model of the multiverse, I can stick it on a computer and tell you what you should see."

That's a small step for a computer simulation program, but a giant leap for the field of multiverse cosmology. By producing testable predictions, the multiverse model has crossed the line between appealing story and real science.

In fact, Johnson says, the program has reached the point where it can rule out certain models of the multiverse: "We're now able to say that some models predict something that we should be able to see, and since we don't in fact see it, we can rule those models out."

For instance, collisions of one bubble universe with another would leave what Johnson calls "a disk on the sky" -- a circular bruise in the cosmic microwave background. That the search for such a disk has so far come up empty makes certain collision-filled models less likely.

Meanwhile, the team is at work figuring out what other kinds of evidence a bubble collision might leave behind. It's the first time, the team writes in their paper, that anyone has produced a direct quantitative set of predictions for the observable signatures of bubble collisions. And though none of those signatures has so far been found, some of them are possible to look for.

The real significance of this work is as a proof of principle: it shows that the multiverse can be testable. In other words, if we are living in a bubble universe, we might actually be able to tell.

Video:
https://www.youtube.com/watch?v=w0uyR6JPkz4

Story Source: The above story is based on materials provided by Perimeter Institute. The original article was written by Erin Bow. *Note: Materials may be edited for content and length.*

Journal References:

1. Matthew C. Johnson, Hiranya V. Peiris, Luis Lehner. **Determining the outcome of cosmic bubble collisions in full general relativity**. *Physical Review D*, 2012; 85 (8) DOI: 10.1103/PhysRevD.85.083516
2. Carroll L. Wainwright, Matthew C. Johnson, Hiranya V. Peiris, Anthony Aguirre, Luis Lehner, Steven L. Liebling. **Simulating the universe(s): from cosmic bubble collisions to cosmological observables with numerical relativity**. *Journal of Cosmology and Astroparticle Physics*, 2014; 2014 (03): 030 DOI: 10.1088/1475-7516/2014/03/030
3. Carroll L. Wainwright, Matthew C. Johnson, Anthony Aguirre, Hiranya V. Peiris. **Simulating the universe(s) II: phenomenology of cosmic bubble collisions in full General Relativity**. *submitted to arXiv*, 2014 [link]
4. Stephen M. Feeney, Matthew C. Johnson, Jason D. McEwen, Daniel J. Mortlock, Hiranya V. Peiris. **Hierarchical Bayesian detection algorithm for early-universe relics in the cosmic microwave background**. *Physical Review D*, 2013; 88 (4) DOI: 10.1103/PhysRevD.88.043012

Facing a violent past: Evolution of human ancestors' faces a result of need to weather punches during arguments, study suggests

What contributed to the evolution of faces in the ape-like ancestors of humans?

The prehistoric version of a bar fight -- over women, resources and other slug-worthy disagreements, new research from the University of Utah scheduled for publication in the journal *Biological Reviews* on June 9 suggests.

Depiction of early human; Credit: © procy_ab / Fotolia

University of Utah biologist David Carrier and Michael H. Morgan, a University of Utah physician, contend that human faces -- especially those of our australopith

ancestors -- evolved to minimize injury from punches to the face during fights between males.

The findings in the paper, titled "Protective buttressing of the hominin face," present an alternative to the previous long-held hypothesis that the evolution of the robust faces of our early ancestors resulted largely from the need to chew hard-to-crush foods such as nuts.

"The australopiths were characterized by a suite of traits that may have improved fighting ability, including hand proportions that allow formation of a fist; effectively turning the delicate musculoskeletal system of the hand into a club effective for striking," said Carrier, lead author of the study. "If indeed the evolution of our hand proportions were associated with selection for fighting behavior you might expect the primary target, the face, to have undergone evolution to better protect it from injury when punched."

The rationale for the research conclusions came from determining a number of different elements, said Carrier.

"When modern humans fight hand-to-hand the face is usually the primary target. What we found was that the bones that suffer the highest rates of fracture in fights are the same parts of the skull that exhibited the greatest increase in robusticity during the evolution of basal hominins. These bones are also the parts of the skull that show the greatest difference between males and females in both australopiths and humans. In other words, male and female faces are different because the parts of the skull that break in fights are bigger in males," said Carrier.

"Importantly, these facial features appear in the fossil record at approximately the same time that our ancestors evolved hand proportions that allow the formation of a fist. Together these observations suggest that many of the facial features that characterize early hominins may have evolved to protect the face from injury during fighting with fists," he said.

The latest study by Carrier and Morgan builds on their previous work, which indicate that violence played a greater role in human evolution than is generally accepted by many anthropologists.

In recent years, Carrier has investigated the short legs of great apes, the habitual bipedal posture of hominins, and the hand proportions of hominins. He's currently working on a study on foot posture of great apes that also relates to evolution and fighting ability.

Research on the evolution of creatures in the genus Australopithecus -- immediate predecessors of the human genus Homo -- remains relevant today as scientists continue to look for clues into how and why humans evolved into who they are now from predecessors who inhabited Earth about 4 to 5 million years ago.

Carrier said his newly published research in *Biological Reviews* both "provides an alternative explanation for the evolution of the hominin face" but also "addresses the debate over whether or not our distant past was violent."

"The debate over whether or not there is a dark side to human nature goes back to the French philosopher Rousseau who argued that before civilization humans were noble savages; that civilization actually corrupted humans and made us more violent. This idea remains strong in the social sciences and in recent decades has been supported by a handful of outspoken evolutionary biologists and anthropologists. Many other evolutionary biologists, however, find evidence that our distant past was not peaceful," said Carrier.

"The hypothesis that our early ancestors were aggressive could be falsified if we found that the anatomical characters that distinguish us from other primates did not improve fighting ability. What our research has been showing is that many of the anatomical characters of great apes and our ancestors, the early hominins (such as bipedal posture, the proportions of our hands and the shape of our faces) do, in fact, improve fighting performance," he said.

Morgan added the new study brings interesting elements to the ongoing conversation about the role of violence in evolution.

"I think our science is sound and fills some longstanding gaps in the existing theories of why the musculoskeletal structures of our faces developed the way they did," said Morgan. "Our research is about peace. We seek to explore, understand, and confront humankind's violent and aggressive tendencies. Peace begins with ourselves and is ultimately achieved through disciplined self-analysis and an understanding of where we've come from as a species. Through our research we hope to look ourselves in the mirror and begin the difficult work of changing ourselves for the better."

Story Source: The above story is based on materials provided by University of Utah Health Sciences and ScienceDaily, June 9, 2014.

Journal Reference: David R. Carrier, Michael H. Morgan. **Protective buttressing of the hominin face**. *Biological Reviews*, 2014.

New feathered predatory fossil sheds light on dinosaur flight

A new raptorial dinosaur fossil with exceptionally long feathers has provided exciting insights into dinosaur flight. A paper published in *Nature Communications* on July 15, 2014 asserts that the fossil -- discovered by an international team led by Natural History Museum of Los Angeles County (NHM) paleontologist Dr. Luis Chiappe -- has a long feathered tail that Chiappe and co-authors believe was instrumental for decreasing descent speed and assuring safe landings.

This is an illustration of newly discovered feathered dinosaur, Changyuraptor yangi.

Credit: S. Abramowicz, Dinosaur Institute, NHM

The 125-million-year-old dinosaur, named *Changyuraptor yangi*, was found in the Liaoning Province of northeastern China. The location has seen a surge of discoveries in feathered dinosaurs over the last decade. The newly discovered, remarkably preserved dinosaur sports a full set of feathers cloaking its entire body, including the extra-long tail feathers. "At a foot in length, the amazing tail feathers of *Changyuraptor* are by far the longest of any feathered dinosaur," said Chiappe.

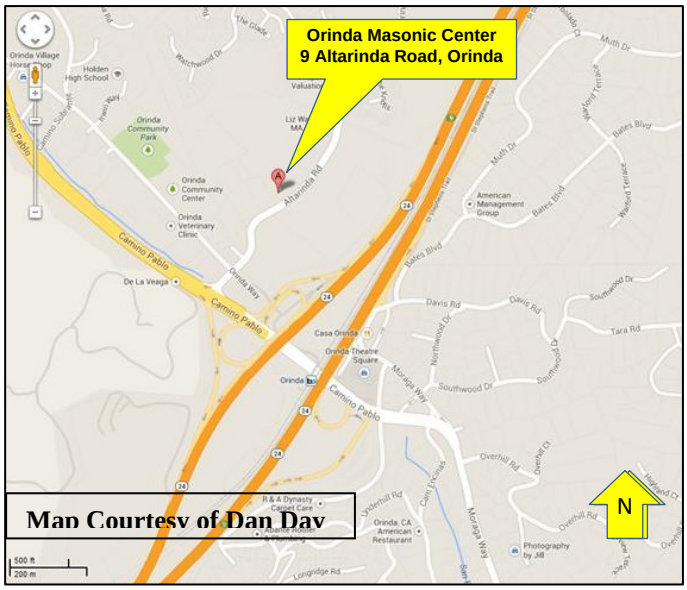
Analyses of the bone microstructure by University of Cape Town (South Africa) scientist, Dr. Anusuya Chinsamy, shows that the raptor was a fully grown adult, and tipping the scale at nine pounds, the four-foot-long *Changyuraptor* is the biggest of all four-winged dinosaurs. These microraptorine dinosaurs are dubbed "four-winged" because the long feathers attached to the legs have the appearance of a second set of wings. In fact, the long feathers attached to both legs and arms of these ancient predators have led researchers to conclude that the four-winged dinosaurs were capable of flying. "Numerous features that we have long associated with birds in fact evolved in dinosaurs long before the first birds arrived on the scene," said co-author Dr. Alan Turner of Stony Brook University (New York). "This includes things such as hollow bones, nesting behavior, feathers…and possibly flight."

How well these creatures used the sky as a thoroughfare has remained controversial. The new discovery explains the role that the tail feathers played during flight control. For larger flyers, safe landings are of particular importance. "It makes sense that the largest microraptorines had especially large tail feathers -- they would have needed the additional control," added Dr. Michael Habib, a researcher at the University of Southern California and a co-author of the paper.

The discovery of *Changyuraptor* consolidates the notion that flight preceded the origin of birds, being inherited by the latter from their dinosaurian forerunners. "The new fossil documents that dinosaur flight was not limited to very small animals but to dinosaurs of more substantial size," said Chiappe. "Clearly far more evidence is needed to understand the nuances of dinosaur flight, but *Changyuraptor* is a major leap in the right direction."

Story Source: The above story is based on materials provided by **Natural History Museum of Los Angeles County**.

Journal Reference: Gang Han, Luis M. Chiappe, Shu-An Ji, Michael Habib, Alan H. Turner, Anusuya Chinsamy, Xueling Liu and Lizhuo Han. **A new raptorial dinosaur with exceptionally long feathering provides insights into dromaeosaurid flight performance**. *Nature Communications*, 2014 DOI: 10.1038/ncomms5382



Biography: Marcus. Trotta is a hydrogeologist for the Sonoma County Water Agency's Water Resource Planning Section. The primary focus of his work at the Water Agency involves leading feasibility studies for enhanced groundwater recharge projects and managing groundwater monitoring programs and technical studies in support of collaborative groundwater management activities. His role also includes investigating the interaction and exchange of surface water and groundwater associated with the Water Agency's production facilities along the Russian River. He is a Professional Geologist and Certified Hydrogeologist in the State of California and received his Bachelor of Science degree in Geology with an emphasis in Hydrologic Science from the University of California at Davis.

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