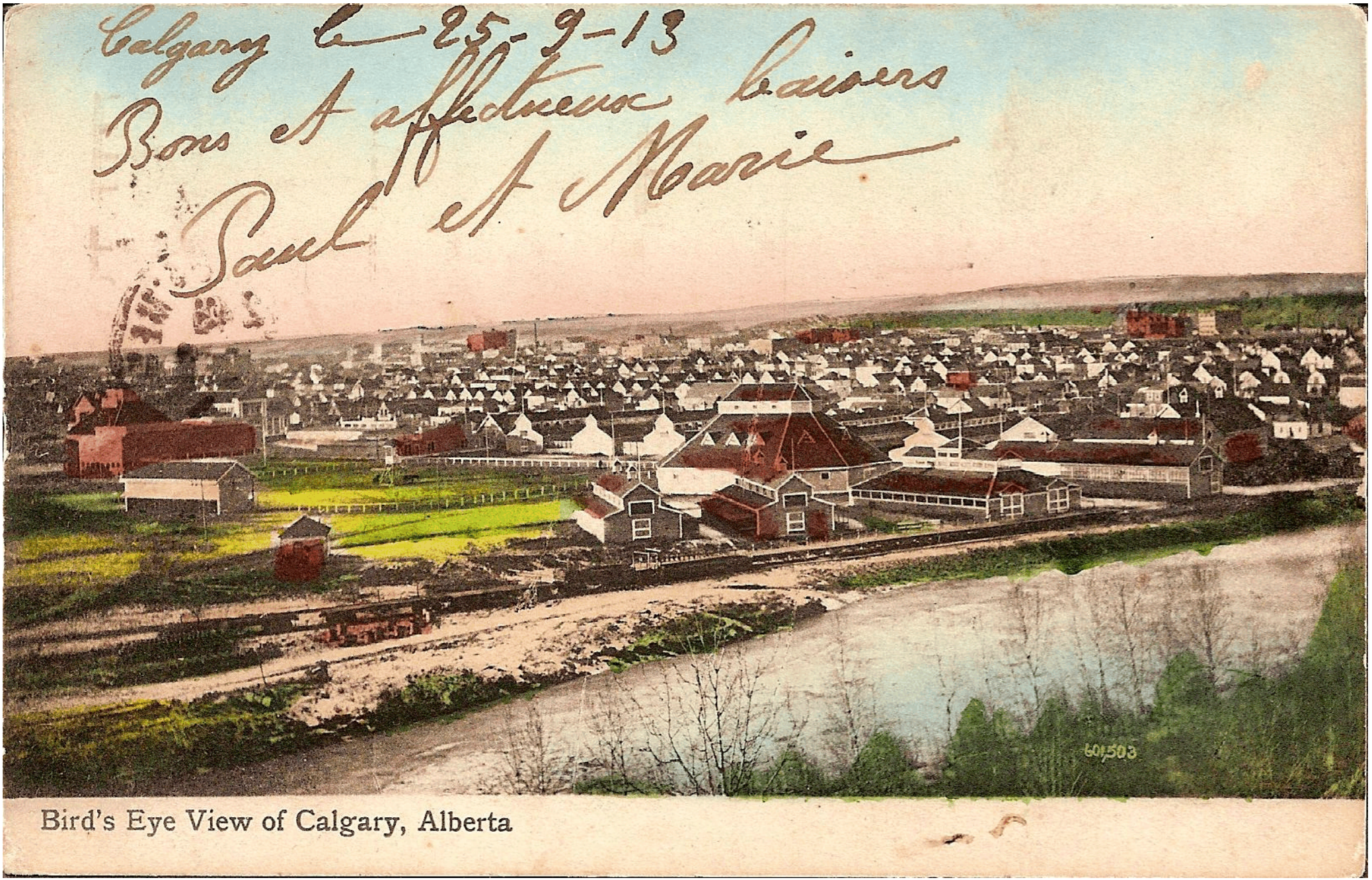
OPUNTIA 523


Calgary le 25-9-13
Bons et affectueux baisers
Saul St Marie
601503
Bird's Eye View of Calgary, Alberta

Late April 2022

Opuntia is published by Dale Speirs, Calgary, Alberta. It is posted on www.efanzines.com and www.fanac.org. My e-mail address is: opuntia57@hotmail.com When sending me an emailed letter of comment, please include your name and town in the message.

LITTLE FREE LIBRARIES: PART 7

photos by Dale Speirs

[Parts 1 to 6 appeared in OPUNTIA #378, 427, 466, 482, 489, and 502.]

In my travels about Cowtown I photograph any new Little Free Libraries I see, but have noticed some existing ones have changed. This page shows the LFL at the Baptist church on 16 Street SW in the 4300 block in Altadore. Below is how it looked in 2015 and at upper right in 2021. Business was booming.

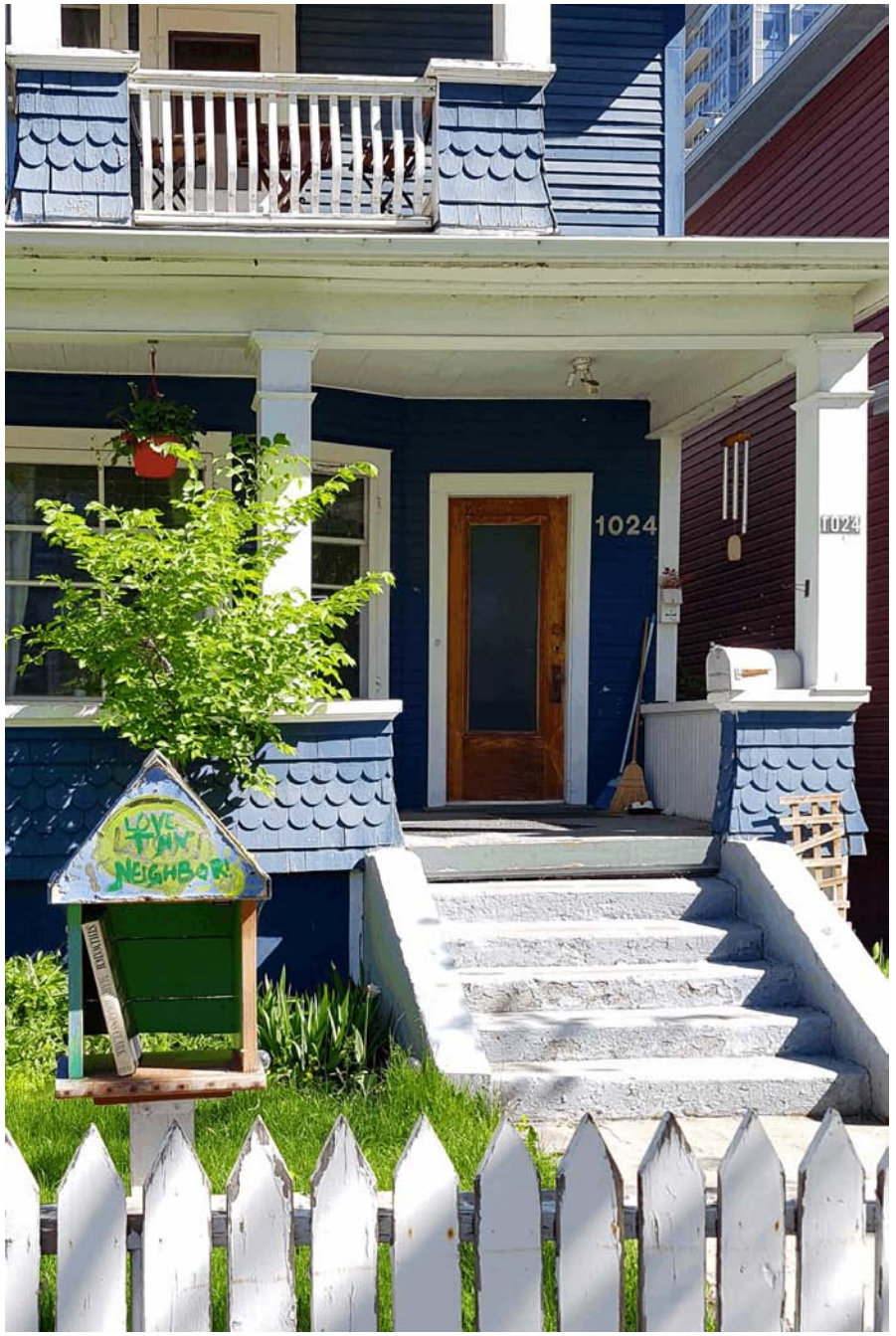
This LFL in Inglewood at 9 Avenue SE and 9 Street was unchanged.

The significance was that the building is no longer the Alexandra Writers Centre but is now a dance hall.

Look closely at the entrance in the shadows.

On 13 Avenue SW in the Beltline district of central Calgary, this house obviously had a change between 2015 and 2021.

Is there such a thing as a slum LFL?



But next door to the previous LFL was this one, brand new.

Out in the suburbs I found some new ones in my travels.
Top: The Signal Hill community association on Sienna Park Drive SW.
Bottom: A church up on Saint Andrews Place NW.

Little Free Pantries are now being seen in Calgary.

Below: Banff Trail Community Association at 20 Avenue NW and 20 Street. In 2021 they set up a LFP, the brightly coloured cabinet on the right. In the distant left of the photo is the original LFL, still operating as it did.

At right: This LFP is inside the Kerby Centre on 7 Avenue SW and 11 Street in the downtown core. This is a seniors centre. The Calgary Philatelic Society rents its meeting room from them. Anyone who can collect stamps doesn't need a LFP.

FINANCIAL FICTION: PART 5
by Dale Speirs

[Parts 1 to 4 appeared in OPUNTIAs #444, 461, 488, and 504.]

But Before That, This.

Not fiction. In Calgary, this meal cost me $17 as inflation roars on. Cheaper places such as A&W or McDonald's are about $12 for the same items albeit lesser quality. I can afford Fatburger because my investments are keeping pace with inflation, but I pity the pensioners who have only CPP and OAP.

The Wheels Go Round And Round.

LIGHTS OUT aired from 1934 to 1947, and was an anthology radio series specializing in fantasy, weird fiction, and horror. "Profits Unlimited" aired on 1943-07-20 and was written by Arch Oboler. A woman returned to the island of her family Cordé. She had never been there before because her father had fled the place and refused to discuss the matter.

The family retainer Williams, who rowed her out to the island, explained that her ancestor Pierre Cordé set up a factory run by slave labour. Her grandfather had just died but the factory still ran by itself. Williams told her that she was now in charge.

Hundreds of people worked. The end product of a chain of factories was recycled back to the first one, to be broken up and redeployed as raw input. The workers were programmed to run the assembly lines, and so they did, despite no one at the helm. They grew their own food and wove their own cloth.

Cordé tried to talk to the workers but with little success. There followed a sermon about freedom and labour, but nothing changed on the island.

Banking On Trouble.

FATHER KNOWS BEST began as a radio series in 1949 and successfully moved into television in 1954 until 1960. It was a bland family situation comedy, designed to offend no one. Margaret and Jim Anderson were the parents of Betty, Bud, and Kathy in the midwestern town of Springfield.

"Check Writing" aired on 1954-02-25. The premise was something that will probably have to be explained to the next generation as a paper Interac transaction. Cheques are still used but in increasingly fewer numbers. Myself, I only write or deposit about ten cheques a year nowadays. The concept of balancing a chequebook has mutated into tracking a spreadsheet.

Which brings us to Jim, trying to balance the joint chequing account he and Margaret used. His sums were difficult to do because Bud was upstairs trying out a new duck call.

Margaret had written a couple of cheques but didn't enter on the stubs the amount or to whom the cheque had been paid. This would make it difficult to determine how much money was left in the bank account, against which to write future cheques.

As Jim patiently discussed the imbalance with his wife, their son switched to a moose call. Bud said he and a friend named Joe were starting up the Irresistible Noises Corporation to manufacture game calls. He saw Jim with the open chequebook and tried to hit up his father for a $20 loan to cover start-up expenses.

Jim had difficulty explaining to Bud that a cheque was not the same as printing a banknote. There had to be sufficient cash in the account to cover the cheque. In the meantime, Betty had received a $25 postal money order from her aunt. Kathy then showed up demanding her allowance. Jim found himself trying to explain the banking system to his children.

Depositors, for example, are actually loaning money to the bank, which then takes their money and loans it out to others at a higher rate, plus fees. Jim had trouble explaining to his children how demand deposits and the fractional banking system work.

I'm not surprised, having had the same problem explaining to adults the difference between fiat currencies such as the dollar and cryptocurrencies on the one side, and real money, which is physical gold and silver.

Jim tied himself into knots. He decided to set up a family circle bank. The Anderson First National Trust and Savings Bank would show the children how a bank would operate, using their allowances as deposits.

Bud tried to borrow $10 for another venture to make hip waders out of old inner tubes. Jim told him the interest rate would be 6%. At this point, Betty suddenly, and correctly, realized the money Bud was borrowing was based on her account. She objected vehemently at such a risky loan.

Betty had to explain the concept of tangible collateral to Bud. He offered to put up Joe as a surety, but Jim wouldn't take him. They settled on Bud's bicycle. Again Betty objected, because she didn't want an old bicycle in lieu if Bud didn't pay back the loan based on her deposit.

The telephone rang and Betty answered. Her glee club needed $50 from her pronto for a field trip they were taking. She had $20 in the family circle, so would have to borrow $30. Bud wanted to know what physical collateral she was going to put up.

Kathy didn't like either of her siblings' financial transactions and decided to withdraw her money. That triggered a bank run. Jim suddenly found himself short of cash, so he wrote cheques to the kids on a real bank. Fortunately Margaret remembered that one of the unaccounted cheques she wrote was cash to herself, so she was able to cover the shortage. A humourous account of how the banking system operated then and still does now.

An Interesting Matter.

Compound interest grows exponentially over time. This fact has inspired more than one author to write a story about how a man deposited a single dollar into a bank account in the name of a distant descendent. The money then slowly grew exponentially until the bank, then the government that guaranteed the bank, could not pay the interest.

"John Jones's Dollar" by Harry Stephen Keeler (1915 August, THE BLACK CAT, available as a free pdf from www.archive.org) was one such story. John Jones went to a bank in 1914 and deposited $1, the accumulated interest payable to his 40th-generation descendent. No bank would accept such a deposit of course, but let the story progress.

With compound interest, by 2914 the interest payable would be $6.31 billion dollars. When this story was written in 1915, such a sum was unimaginably vast. What Keeler didn't know was that the U.S. Federal Reserve, founded in 1913, was depreciating the currency so that the federal government never had to pay off its debt.

In 1915, a good steak meal in a fine restaurant cost $1. The robber barons had fortunes valued in the millions. The idea of a billion was fantasy. By 2014, $6.3 billion was about what a large bank would earn in a month, so such a bank account would hold no terrors.

The story ended with the bank unable to pay. Fortunately the 39th generation heir never had children, so the account was non-payable. The government confiscated the money.

There are several flaws to the story. At the time it was written, there was no personal income tax. Over the centuries, the income of the savings account would be taxed at an equally exponential rate, so the money would not accumulate.

Also, the bank directors would not be stupid. As the 40th generation approached, they would transfer the account to an independent subsidiary with no other business. The subsidiary would then declare bankruptcy and not pay back even the original dollar.

Fake Fiat.

DANGER DR DANFIELD aired in 1946-47. He was an unlicenced private investigator and psychologist. Quite arrogant, abusive, and a terrible know-it-all. The series was written by Ralph Wilkinson.

"The Case Of The Bird In The Gilded Cage" aired on 1946-12-22, and was announced in the intro with that title. However the mp3 is also circulating as "The Case Of The Counterfeit $10 Bills". Bear in mind that $10 in 1946 cash would be about $100 in our depreciated currency of today.

The episode opened with Dr Daniel Danfield and his secretary Rusty Fairfax buying Christmas presents. For $3, he bought a book, using a $10 banknote. After they left, the shopkeeper Thaddeus Crispin noticed the banknote was counterfeit. He called the Secret Service, who are responsible for counterfeit detection, and told them Danfield passed it.

Later that day, a rude man barged into Danfield's office, shoving Fairfax aside. He asked about the banknote. Danfield played the idiot in an idiot plot and sarcastically said he printed currency. He then slugged the man unconscious.

Rifling through the pockets, he discovered Secret Service credentials. Leaving the man, they went to an art gallery run by Ramon Castille. Danfield had bought a $500 painting the previous day and received his change as $10 banknotes.

Castille went in back of the shop for a moment. A woman dressed only in a negligee came out and introduced herself as his wife Maria. Mrs, not Senora, as she was from Brooklyn. Castille returned and chased her away.

Getting to the business at hand, Castille showed Danfield an envelope of $10 bills he had found, as well as a newspaper clipping showing a classified ad he had run in the lost-and-found column. After Danfield left, the Secret Service man arrived but got no satisfaction.

Jump cut to Crispin talking to Maria, apparently trying to investigate on his own. One assumes she had put some clothes on to visit him. She complained her husband kept her cooped up in a gilded cage. Crispin assured her things would soon change, possibly with a murder.

Danfield switched his investigation to Crispin, who was sneaking about scheming madly. Ramon caught him in the basement with Maria and shot him through both arms. Danfield and Fairfax, arriving at the art gallery, heard the shots and rushed down into the basement. Remember that bit about idiot plots?

The printing press for the counterfeits was also in the basement. Assuming Ramon had a revolver, he had four shots remaining, with which to kill the two couples. He never got the chance as the Secret Service man reappeared.

Maria blabbed all in the epilogue, in tedious detail. Crispin added more tedious detail. Not to be outdone, Danfield, well, you get the idea.

CONVENTIONAL FICTION: PART 15

by Dale Speirs

[Parts 1 to 14 appeared in OPUNTIAs #70.1A, 270, 285, 313, 364, 385, 398, 414, 421, 439, 459, 488, 495, and 513.]

Hollywood's Idea Of Conventions.

HOT IN CLEVELAND was a television comedy series that aired for six seasons from 2010 until 2015. The show was about three women of a certain age who rented a house in Cleveland. They were Melanie Moretti, Joy Scroggs, and Victoria Chase.

"Cleveland Fantasy Con" was a Season 4 episode which aired on 2013-01-02, written by Chuck Ranberg and Anne Flett-Gierdano. Joy was dated Sean, a muscular firefighter who was a gorgeous man about 15 years younger than her.

She discovered too late that he was a sci-fi fan. Not enough to discard him after she foolishly mentioned she had never watched any Star Trek shows. He made her sit through five of the movies. Sean asked her to accompany him to the Cleveland Fantasy Con. "*There's like a hundred sci-fi booths there.*"

Joy reluctantly dressed up as a fairy princess in pink, only to discover Sean was a bronie, a group of men who were fans of the cartoon show MY LITTLE PONY. To put not too fine a point on it, he was a furry.

Melanie, meanwhile, was working for an advertising agency run by Alec and Chloe Summerlin. They had divorced but were going through an on again-off again reconciliation. Chloe was an aggressive alpha female, well played by Heather Locklear. Melanie lived in fear of her retaliation if she ever learned that Alec and Melanie were having an affair.

The agency was doing publicity for the Cleveland Fantasy Con. That would make the convention a commercial enterprise since a fan-run event would not hire an expensive ad agency.

For the opening ceremonies, everyone was to dress in costume and meet at the agency office on the 20th floor. Chloe decided she would be Seductra (basically Wonder Woman in all black costume), Alec would be Captain Invincible, and Melanie would be Scat, their pet gargoyle.

The office cat got out onto the window ledge through an open window. The critter was never in any danger since the ledge was a metre wide. Nonetheless, Melanie and Chloe went out on the ledge to retrieve the cat, then became paralyzed by fear. The cat was the smartest sentient in the episode, and wandered back inside.

Joy and Sean arrived but on the elevator ride to the office she broke up with him. She wasn't going to date a furry. They arrived at the office just as the window ledge crisis peaked. Sean stripped off his costume and rescued Chloe, while Alec rescued Melanie.

Alec inadvertently revealed his affair with Melanie. Chloe, cradled in Sean's arms, decided she could live with a bronie. None of the cast ever did get to the convention.

THE LIBRARIANS was a television series that aired from 2014 to 2018, about a magical library and its staff. The librarians quested to gather up magical artifacts and store them in The Library.

They were opposed by another group who were evil because they were gathering up magical artifacts. That got dull, so in the third season a black-budget government agency was introduced who were evil because they wanted to gather up magical artifacts.

The saving grace was that the episodes had a fair amount of humour. An attempt was made to establish rules of magic and have it behave logically, to the point that Clarke's Law was quoted.

"And The Reunion Of Evil" was a Season 3 episode that aired on 2016-12-04 and was written by Kate Rorick. Two of the librarians, Cassandra Cillian and Jacob Stone, were exploring an ice cave in Sweden to steal, pardon me, preserve an artifact called the Angrboda crystal.

The crystal was about 30 cm long and 5 cm diameter. Note that well because the point will be mentioned in the denouement. Through mischance, the crystal magically embedded itself inside Cillian's chest.

Seeking refuge, and a doctor, she and Stone staggered into a hotel out on the icefield, only to be told there was no room at the inn. The hotel was sold out for a convention of Norse gods.

Stone bluffed his way in using the name of one of the attendees who hadn't yet arrived, a Norseman named Finklestein. Cillian had a pair of goggles that showed things as they really were. The attendees looked like normal humans but through the lenses she saw they were Nordic demons. I exaggerate; they didn't look like normal humans but middle-aged attendees at a Corflu.

Unaware that Cillian and Stone knew who they were, one of the demons took Stone on a tour of the festivities. Said the demon: "*A little drinking, a little gaming, a pathological need to one-up each other*". In short, much like any science fiction convention you've ever been to. Cillian and Stone had obviously never been to a convention, so they had to bluff their way through.

The opening ceremony was a doozie but the incantations were rudely interrupted when the real Finklestein arrived. The hoorah that followed was not unexpected. Cillian and Stone returned safely to the Library since they were booked for the series.

One catch though. Cillian still had the crystal inside her. The Head Librarian, an immortal named Jenkins, reassured her that the crystal would eventually work itself out of her via her digestive system. He offered her some prune juice to speed up the process. Given the size of the crystal, she was more concerned about the painful end result, pardon the expression.

Cozy Cons.

THE FALCON ALWAYS WINGS TWICE (2020) by Donna Andrews was the 27th novel in a cozy mystery series about Meg Langslow of Yorktown, Virginia. She was a blacksmith of the arts and crafts variety and by now an experienced Miss Marple.

Meg's grandmother Cordelia was staging a Renaissance Faire in Riverton and called in all her family to assist. Grandfather (no name ever given) was a bird conservationist who brought along a cage full of wrens. People kept talking about the Ren Fest and he misunderstood. The sticky problem was that a falconer was attending with his hunting birds.

One of the re-enactors in the fair was Terrence Cox. Besides annoying the falcons, he tripped up Cordelia, not figuratively, and gave her a broken foot. Grandfather and Cox exchanged heated words in public. The latter was none too popular with others at the fair, for good and sufficient reason.

In particular, Cox was none too popular with someone who met him in Ye Olde Woods next to the fair campground. Someone who stuck a knife in him. Presumably a gunshot would not have been in keeping with the Renaissance spirit.

Assorted Langlows found him, faster than a truffle-sniffing dog. The Deppity Dawgs made Grandfather the prime suspect. Thus Meg went aMarpleing in yon shady glen. Between infodumps about falconry and life in medieval times, and the usual troubles of any renaissance fair, Meg did her sleuthing.

The culprit was an actor, a real thespian, not a re-enactor, whose stage career had been ruined by Cox. What the murderer didn't know was that these days there are hidden cameras in just about every park. Wildlife biologists set up webcams along game trails everywhere.

The denouement tied off the loose threads. The fair wrapped up minus a few casualties. No plagues though, as this novel would have been written just before the coronavirus.

EASTER FICTION: PART 3
by Dale Speirs

[Parts 1 to 2 appeared in OPUNTIAs #409 and 441.]

Cozy Easters.

EASTER BONNET MURDER (2022) by Leslie Meier was the 35th novel in a cozy series about Lucy Stone of Tinker's Cove, Maine. She had done as much sleuthing as Jessica Fletcher just down the coast in Cabot Cove. One wonders how anyone was left in either village.

Be that as it may, there was trouble down at the old folks home at Heritage House. One of the elders had gone missing during the Easter Bonnet Contest. As usual, the Deppity Dawgs weren't much use and Stone had to solve the case. Life was not as bucolic at Harvest House as in the advertising brochures.

Stone uncovered much in the way of troubling news. Insofar as clues were concerned, they ranged from a half-eaten chocolate bunny to pysankas (decorated Easter eggs). Medicare fraud was suspected, and the owner may have had something to do with war crimes during the Bosnian civil war.of 1992-95.

The denouement interfered with supper in the home's dining room. As the murderer quickly learned, a mob of hungry senior citizens can become quite angry, since meals are the highlight of their days. He was stupid enough to pull a gun in front of a Deppity Dawg. The aftermath turned the mob into a panic-stricken rabble.

The villain's war crimes were about to be exposed by the missing elder, hence her murder. He survived his encounter with the police but would stand trial for murder, then face a war crimes tribunal for his atrocities in the Bosnian war. Not a happy Easter.

TRIPLE CHOCOLATE CHEESECAKE MURDER (2021) by Joanne Fluke (pseudonym of Joanne Fsichmann) was the 30th novel in a cozy series about Hannah Swensen of Lake Eden, Minnesota. She operated The Cookie Jar bakery and was well established as the resident Miss Marple.

The plot began rolling with the murder of Mayor Richard Bascomb. He was unpopular enough that the reader will wonder how he was elected in the first instance. Hannah's sister Andrea was a suspect, so away to the amateur sleuthing.

Recipes were distributed throughout the text. After Bascomb's body was discovered there was a five-page pause for Stroganoff Light. After Chapter 4, the Triple Chocolate Cheesecake recipe followed, also five pages. And so on throughout the novel. If you buy the book, you are buying a cookbook as much as a novel.

Hannah was busy at the bakery because Easter was nigh and there was a rush. Popular items among her customers, recipes given, were Easter Bunny Whippersnapper Cookies, Chocolate Easter Egg Cupcakes, Easter Jelly Bean Nest Cupcakes, and many more.

All that was exhausting work for Hannah. Bakers set their alarm clocks for 04h00 to have fresh stock by the time the store opens. What with her Marpleing in between the steady flow of recipes, there was no wonder when Hannah kept falling asleep if she sat down for a moment.

The murder was revealed as a family feud, stretching back to who adopted whom decades ago. Bascomb's son and brother were mixed up in the death.

The book concluded with an index to the 32 recipes scattered in the novel. What puzzled me was how the Ham Spicy Mac And Cheese got in there. Perhaps it is indeed a traditional Easter dinner in Minnesota. Growing up as I did in rural central Alberta, we always had roast turkey for Easter dinner.

FREE STUFF ONLINE

You will have noticed that I provide sources for the pdfs and mp3s reviewed in this zine. Here is a summary of some good resources, all of which are free.

In particular, the "Seen In The Literature" column cites only peer-reviewed papers. For topics such as COVID-19 or social media effects, more people should be reading these papers instead of blogs where commentators confuse their opinions as being facts.

For scientific papers for which free pdfs are available, the easiest method is to Google either the title of the paper or its digital object identifier, the phrase beginning with doi.org.

Most papers are behind a paywall, so unless you have access to a university library computer, you can only get the abstract. However, the abstract is often enough to understand the gist of the article.

For zines, www.efanzines.com provides current pdf zines as well as some older ones. A club called Fanac at www.fanac.org does the reverse; they provide thousands of old zines from the 1930s to date, with a few current zines. Both sites have a free email notification service you can subscribe to.

The Old Time Radio Researchers have thousands of old-time radio shows (1930s to 1950s) covering all the genres, such as comedy, science fiction, fantasy, and mystery. Visit www.otrr.org/OTRRLibrary.

They also publish a bulletin OLD RADIO TIMES, available at www.otrr.org/?c=times, with a free email notification service. Don't pay money for audio books and listen to a droning voice when you can listen for free to full-cast shows such as Jack Benny or Inner Sanctum from the OTRR.

For pulp fiction magazines from all genres, visit www.archive.org/details/pulpmagazinearchive?&sort=-downloads&page=2

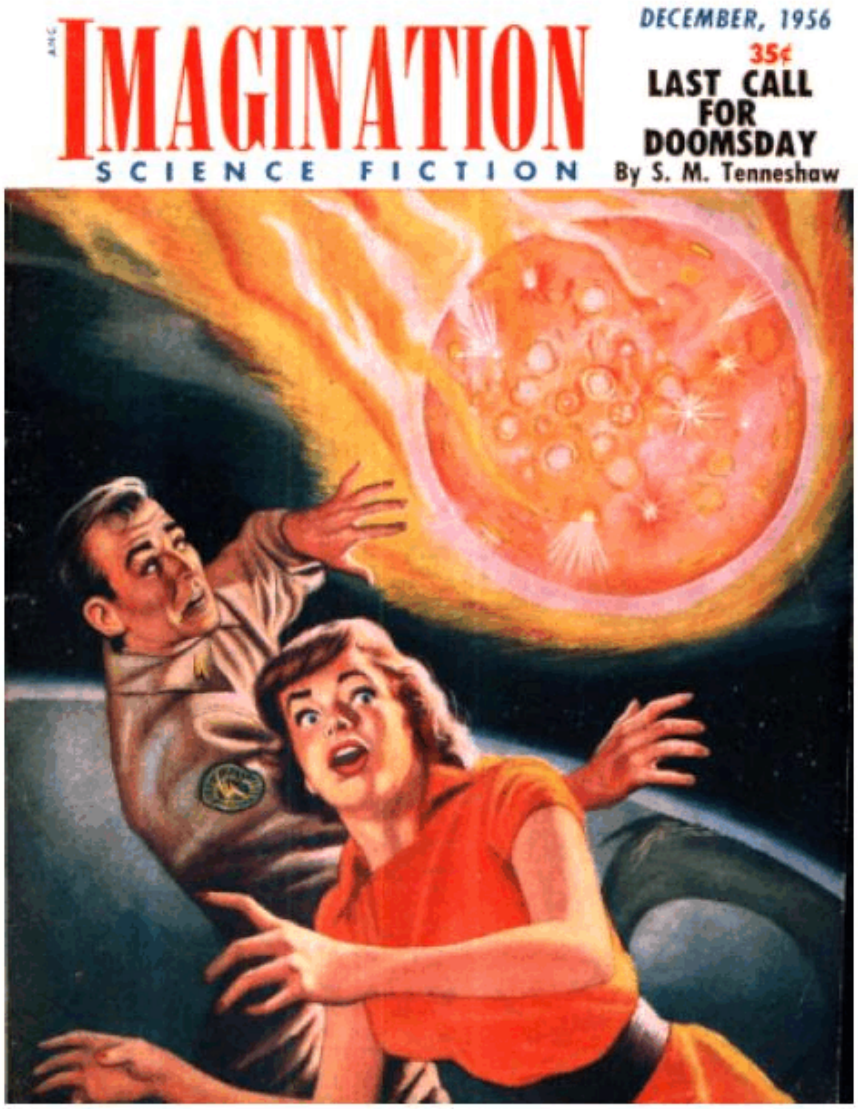
Books in the public domain are free from www.gutenberg.org

WE'LL ALL GO TOGETHER WHEN WE GO: PART 14
by Dale Speirs

[Parts 1 to 13 appeared in OPUNTIAs #249, 276, 283, 301, 312, 327, 343, 365, 417, 431, 445, 487, and 501.]

No Escape.

If an impending extinction-level asteroid impact is announced far enough in advance, the collapse of human society will kill off most humans before the actual impact.



"Last Call For Doomsday" by S.M. Jenneshaw (1956 December, IMAGINATION, available as a free pdf from www.gutenberg.org) considered an extinction-level event. The asteroid was going to intersect Earth's orbit on 1997-09-27, and nothing could be done to deflect it.

Since Earth's population was being evacuated to Mars, one doubts the premise. Any civilization with enough spaceships to export billions of humans to Mars could certainly manage to deflect a big ugly rock. The protagonist Jay Wales had been sent to find the astronomer who had first spotted the asteroid.

Wales had often wondered what Lee Kendrick had felt like when the first knowledge came to him, when the first mathematical formulae of doom came out on the calculator printing-tape. Mene, Mene, Tekel, Upharsin, spelled out in an equation. An electronic computer, passionately prophesying the end of man's world....

"In five years, the eccentricity of the asteroid Nereus will bring it finally across Earth's orbit at a point where it will collide with Earth. This collision will make our planet uninhabitable."

He well remembered the first stupefaction with which the world had received the announcement, after Kendrick's calculations had been proved beyond all doubt.

"No force available to us can destroy or swerve an asteroid so big. But in five years, we should be able to evacuate all Earth's people to Mars."

The novella concentrated on the societal breakdown. Conspiracy theorists, deniers, religious fanatics awaiting judgement, psychotics roaming free. Having read this during the pandemic, I found it a little too close to home. Indeed, all those who survived 2020 will read every disaster story in a new way.

WARNING was a 2021 movie about how the world would end, not from a virus but from a failed software update. This was not an action-adventure story but a very realistic extrapolation of modern trends. The movie was slow-paced and took its time developing its themes. Written by Agata Alexander, Jason Kaye, and Rob Michaelson, and produced in Poland.

One storyline was about a young woman totally dependent on a smart speaker to guide her life and tell her what to do. Hers was a God 2.0 model, and when

it failed a software update, she was helpless. Another was an astronaut who had been knocked out into space while attempting to upgrade a satellite and had no choice but to die slowly. A third storyline was about rich folk who could afford immortality treatments and wipe unpleasant memories with a delete command.

In the end, none of it mattered. An asteroid swarm converted Earth into a ball of molten rock. The stranded astronaut had a front-row seat as he watched the planet die while he floated away to his own death.

Gassed.

"Life Disinherited" by Eando Binder, the pseudonym of brothers Earl and Otto, (1937 March, ASTOUNDING, available as a free pdf from www.archive.org) considered another possibility of Armageddon from outer space, that of poison gases. H.G. Wells had done this before with a comet, but the Binder variation was the Red Spot of Jupiter, a cyclonic storm.

The premise was that electrostatic forces suddenly expelled the Red Spot and flung it at Earth. The gases in the Red Spot were poisonous, and wiped out most of life on Earth. There were a few human survivors. The protagonists had been down in a bathysphere at the time. The story ended with the hero finding a young woman who had survived in a cave. They would be the Adam and Eve to a brave new world.

Deflecting Bolides.

Contrary to all those Hollywood movies, the best method of dealing with an incoming Big Ugly Rock is not with nukes but to deflect it away from Earth. Blowing up an asteroid would result in Earth being blasted by a giant shotgun of debris and probably do more damage than a single bolide.

"Minus Planet" by John D. Clark (1937 April, ASTOUNDING, available as a free pdf from www.archive.org) dealt with an incoming BUR made of antimatter. The solution was to deflect it from an Earth impact by using the Moon.

All very straightforward, just put a whole lot of superscience rockets on one side of the Moon and fire it out of orbit. That life on Earth is controlled by reflected light of the Moon and that the mixing of nutrients by tides is essential, was not considered.

"*There's one projectile available that would be big enough to make quite a perceptible dent in its path: the Moon! We can spare it. All it does is produce the tides. Mount rocket tubes on the Moon, pry it up out of the solar system, and sock the intruder so that its course will be changed and it will fall into the Sun! We can do that if we hit it while it's still far enough away from the system.*"

Nevermind what happened to Earth's gravity or orbit when the Moon departed. Nonetheless the plan worked. There was one heck of a bang when the Moon hit the antimatter bolide, but the energy released did deflect it.

Out In The Real World.

ASTEROID!: THE DOOMSDAY ROCK (2003) was a DVD that I ordered from Amazon under the impression that it was a science fiction movie. When the disk arrived, I was surprised to find it was a documentary by the Canadian Broadcasting Corporation about asteroid hunting.

Although slightly out of date by now, the basic story is unchanged. Somewhere out there is a Big Ugly Rock heading for us. The documentary began with a summary of what is flying about out there. For those who were complacent, photographs were shown of the damage done by the 1908 Tunguska bolide, which exploded over Siberia with a release of at least 15 megatonnes of energy.

Numerous talking heads discussed the matter, from NASA, ESA, and JPL scientists to Apollo astronaut Rusty Schweickart. The near passage of several city-smasher asteroids helped astronomers get attention for more monitoring of asteroids and comets.

As one astronomer noted, contrary to public belief, very few if any astronomers were tracking potential Earth orbit crossers. Until the new millennium, the observational data and orbit calculations were mostly done manually. Just to calculate one asteroid's orbit was about an hour's work.

The great deficiency then and now is being able to track bolides coming from the direction of the Sun. Not only does the light blind telescopes but since we are looking at the shadowed sides of asteroids, they are black against space. The documentary reported on a city-smasher asteroid that made a near approach to Earth in 2002. Not only was it not detected coming in, the rock was not seen until three days after it passed Earth.

Contrary to all those movies which used atomic bombs to solve the problem of an incoming asteroid, blowing up a BUR will worsen matters. That will produce countless fragments traveling on the same orbit. The result would be a shotgun blast.

Consensus among astronomers was that the better method was to deflect the asteroid's orbit. Not only would this method be more doable but the asteroid's new orbit could be controlled.

And The Rock Cried Out "There's No Hiding Place Here"

GREENLAND was a 2020 movie written by Chris Sparling. Unable to release the film in theatres because of the pandemic, the movie studio sent it straight to DVD and streaming. It was a high-class production meant for the big screen, and the SFX were very well done.

A passing comet named Clarke broke apart and bombarded Earth with large fragments, many of the city-smasher and mountain leveler size. The main protagonists were John and Allison Garrity and their son Nathan, of Atlanta, Georgia.

The scriptwriter thought things through. As an example, the Garritys and their neighbours watched live coverage of a comet fragment inbound for Bermuda. It never hit, but moments later there was live coverage of Tampa, Florida, being obliterated by the multi-megatonne impact of that fragment.

Those watching the impact in Atlanta discussed it for a while. John stepped outside the house for a moment, and was knocked over by the shock wave of the impact, which took a while to travel north. Shock waves take time to travel, something far too many movies have ignored.

John received a text message ordering him and his family to report to an air base for relocation to a shelter. His neighbours did not, and he had to run their gauntlet to escape. The airfield was surrounded by a large mob demanding a seat on the planes. Crowd control was ugly and ultimately had to be done with gunfire.

The Garritys were initially admitted to a plane but bounced at the last moment when the military personnel discovered Nathan was diabetic. No one with chronic conditions would be allowed on board.

Thus began an epic journey as the Garritys ran from one rock to another, looking for a hiding place. The plot was the standard Doomsday script, a long saga driving across the country looking for shelter. Bad guys along the way, trouble and strife everywhere.

If you've seen any disaster movie taken up mostly by a cross-country trek, then you've seen the middle part of this film. Half the extras fled south and half fled north. We know that the Garritys were headed in the right direction. John received information that a flight was taking off from Osgoode, Ontario, to a bunker in Thule, Greenland.

Once they made the plane, with the usual last-second scramble, and another last-second scramble at Thule to get underground, the extinction level fragment cratered Europe. Those lucky few in bunkers around the world waited out the blast and then went out to see what was left of the planet. Not much, but the ending was set up for a sequel.

The movie was well done, better than the way Asylum studio did these things. There is no doubt that it will be judged in the context of the COVID-19 pandemic. Perhaps the panicky crowds in our timeline weren't as bad as those fighting to get on the planes, but the Great Toilet Paper Panic of March 2020 wasn't too far behind.

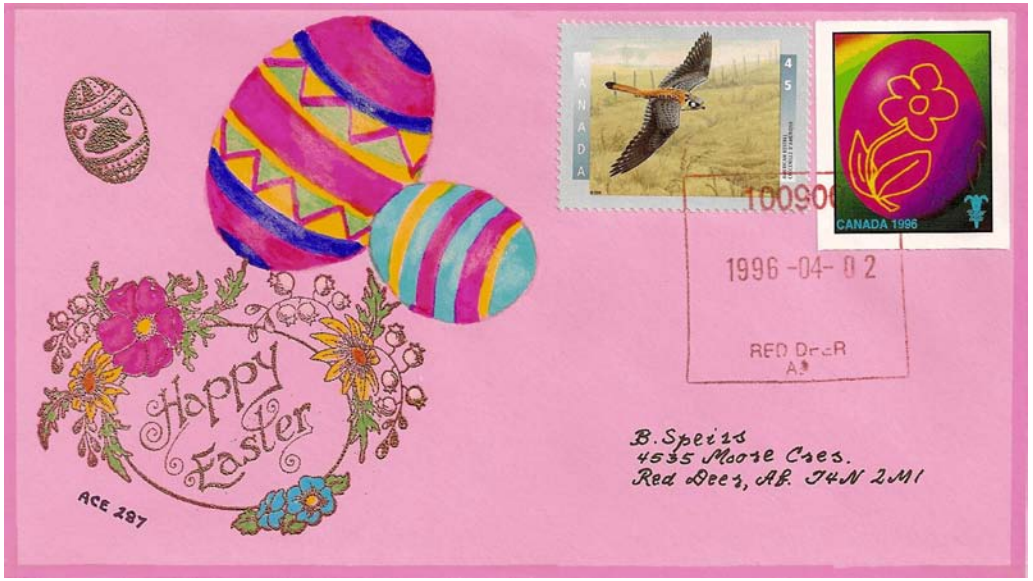
Every disaster movie made in the next few decades will have to consider how we handled the pandemic. Not very well, actually, which should influence script writers who had personal experience of a real planetary disaster. The concept of sheltering in place probably won't catch on in Hollywood because they need the epic journeys to fill the time.

MAIL ART OF BETTY SPEIRS: PART 6
by Dale Speirs

[Parts 1 to 5 appeared in OPUNTIAs #511, 514, 517, 519, and 521.]

Easter.

This year Good Friday was on April 15, so continuing on with my mother Betty's mail art, here are covers she prepared for Easter over the years.




75 years ans
Easter Seals
Timbres de Pâques
Canada 8
postes/postage
MAR 2 4 1997
RED DEER CO-OP
T4N 3P0
37 CANADA
Happy Easter
ACE 287
Betty Speirs
4535 Moore Cres.
Red Deer, Ab.
T4N 2M1

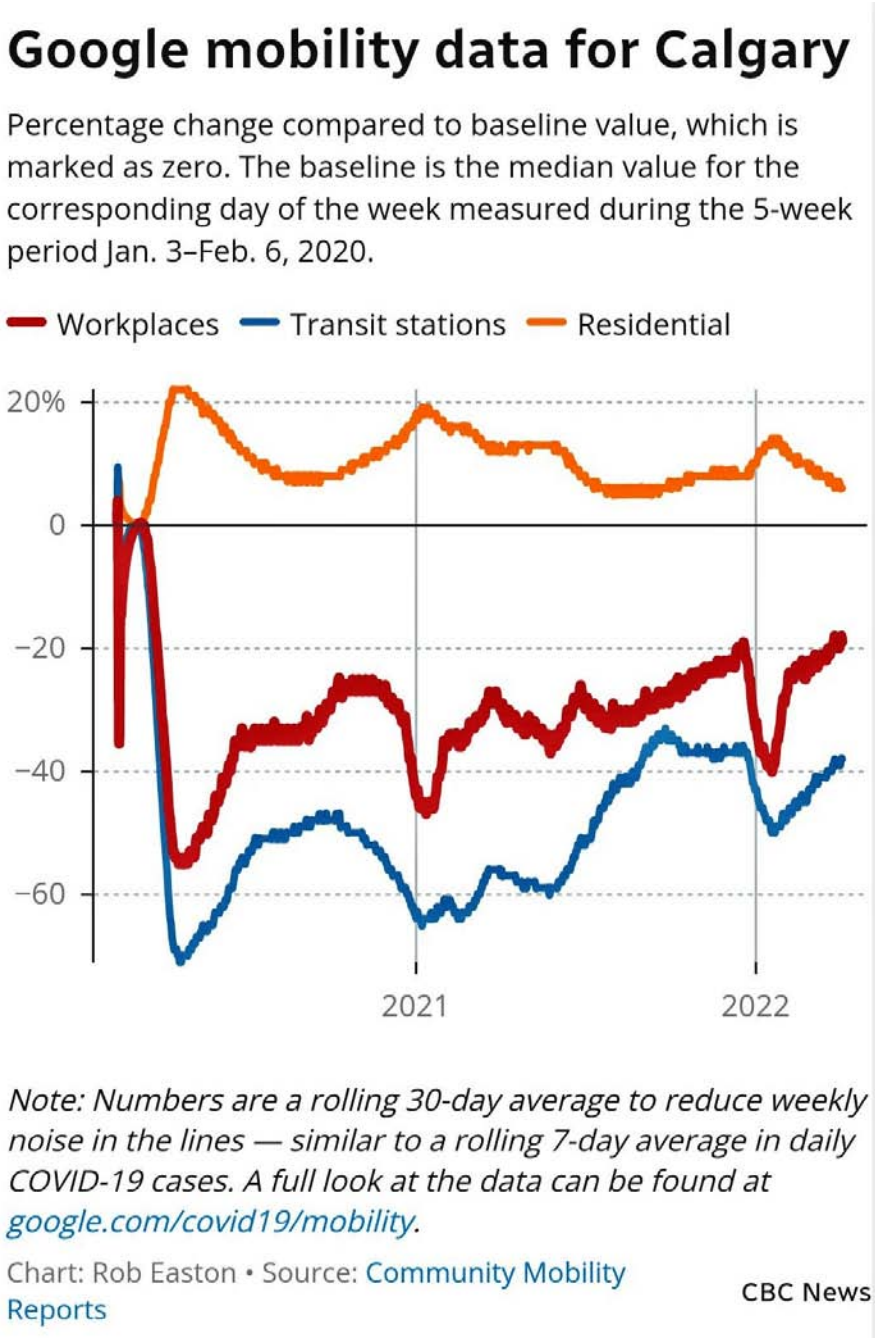

HAPPY EASTER
Easter Seals 2000
Prince Edward Island
CANADA
APR 1 4 2000
RED DEER CO-OP
T4N 3P0

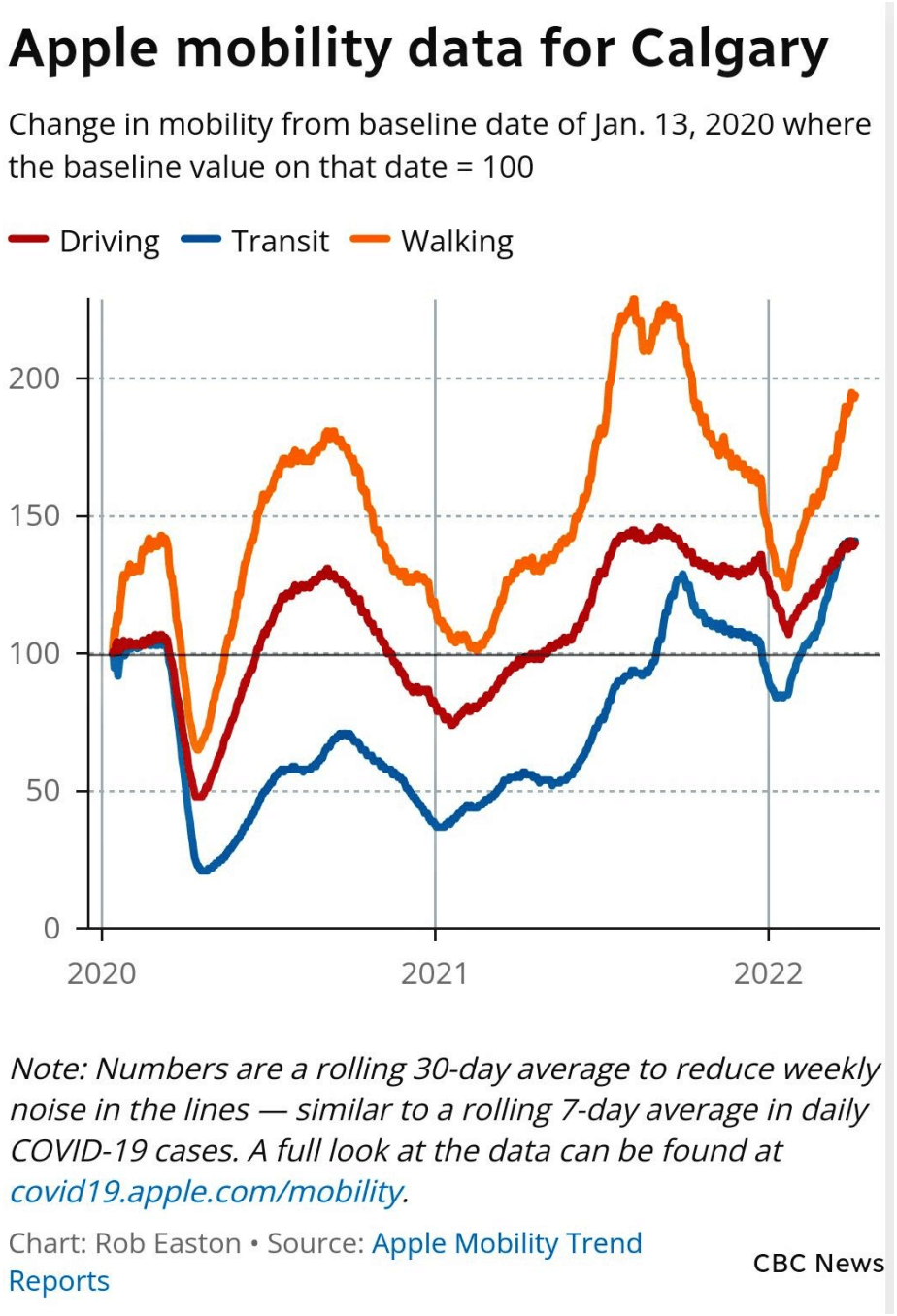
CURRENT EVENTS: PART 39
by Dale Speirs

[Parts 1 to 38 appeared in OPUNTIAs #474, 475, 479, 480, 483, 484, 488 to 503, and 507 to 522.]

Out And About.

As of April 21, the pandemic had killed 38,676 Canadians. 81.2% of the population were vaccinated. Total case loads are no longer counted by the provinces other than intensive-care admissions and deaths.





Seen In The COVID-19 Literature.

Zoonosis.

[Zoonosis is the spread of viruses between unrelated species, such as animals to humans. COVID-19 is a zoonotic disease, as is influenza, so recent papers on such viruses are very relevant to the pandemic.]

Ye, R.Z., et al (2022) **Natural infection of pangolins with human respiratory syncytial viruses.** CURRENT BIOLOGY 32:doi.org/10.1016/j.cub.2022.02.057 (available as a free pdf)

Authors' abstract: *Respiratory syncytial virus (RSV) is an enveloped non-segmented negative sense RNA virus that belongs to Orthopneumovirus genus of the Pneumoviridae family in the order Mononegavirales.*

The virus is the leading cause of severe respiratory disease in children under two years of age and is responsible for substantial disease burden in infants and elder people in both developed and developing countries.

RSV is only known to circulate among humans, though it was first isolated from chimpanzees. The virus can experimentally infect mice, rats, cotton rats, ferrets, and hamsters, but does not naturally circulate in these animal populations.

We found that Malayan pangolins (Manis javanica) were naturally infected with RSVs that have 99.4 to 99.8% genomic identity with strains circulating in humans.

Speirs: Turnabout is fair play. Pangolins gave humans COVID-19, so we gave them one of our viruses.

Temmam, S., et al (2022) **Bat coronaviruses related to SARS-CoV-2 and infectious for human cells.** NATURE 604:doi.org/10.1038/s41586-022-04532-4 (available as a free pdf)

Authors' abstract: *The animal reservoir of SARS-CoV-2 is unknown despite reports of SARS-CoV-2-related viruses in Asian Rhinolophus bats, including the closest virus from R. affinis, RaTG13, and pangolins. SARS-CoV-2 has a mosaic genome, to which different progenitors contribute.*

The spike sequence determines the binding affinity and accessibility of its receptor-binding domain to the cellular angiotensin-converting enzyme 2 (ACE2) receptor and is responsible for host range.

SARS-CoV-2 progenitor bat viruses genetically close to SARS-CoV-2 and able to enter human cells through a human ACE2 (hACE2) pathway have not yet been identified, although they would be key in understanding the origin of the epidemic. Here we show that such viruses circulate in cave bats living in the limestone karstic terrain in northern Laos, in the Indochinese peninsula.

We found that the receptor-binding domains of these viruses differ from that of SARS-CoV-2 by only one or two residues at the interface with ACE2, bind more efficiently to the hACE2 protein than that of the SARS-CoV-2 strain isolated in Wuhan from early human cases, and mediate hACE2-dependent entry and replication in human cells, which is inhibited by antibodies that neutralize SARS-CoV-2.

None of these bat viruses contains a furin cleavage site in the spike protein. Our findings therefore indicate that bat-borne SARS-CoV-2-like viruses that are potentially infectious for humans circulate in Rhinolophus spp. in the Indochinese peninsula.

Several studies also suggested the involvement of pangolin coronaviruses in the emergence of SARS-CoV-2. Since its appearance in humans, SARS-CoV-2 has evolved through sporadic mutations and recombination events, some of which correspond to gains in fitness allowing the virus to spread more widely, or to escape neutralizing antibodies.

de Camargo, M.M., et al (2022) **Evolutionary pressures rendered by animal husbandry practices for avian influenza viruses to adapt to humans.** iSCIENCE 25:doi.org/10.1016/j.isci.2022.104005 (available as a free pdf)

Authors' abstract: *Commercial poultry operations produce and crowd billions of birds every year, which is a source of inexpensive animal protein. Commercial poultry is intensely bred for desirable production traits, and currently presents very low variability at the major histocompatibility complex.*

This situation dampens the advantages conferred by the MHC's high genetic variability, and crowding generates immunosuppressive stress. We address the

proteins of influenza A viruses directly and indirectly involved in host specificities.

We discuss how mutants with increased virulence and/or altered host specificity may arise if few class I alleles are the sole selective pressure on avian viruses circulating in immunocompromised poultry.

This hypothesis is testable with peptidomics of MHC ligands. Breeding strategies for commercial poultry can easily and inexpensively include high variability of MHC as a trait of interest, to help save billions of dollars as a disease burden caused by influenza and decrease the risk of selecting highly virulent strains.

The first technological innovation in meat production, the domestication of animals during the Neolithic, fermented denser populations of humans and animals, but also created opportunities for animal viruses to acquire humans as hosts; trades spurred by these changes helped spread the new diseases across human populations.

The Disease Itself.

Keck, J.W., et al (2022) **Performance of formal smell testing and symptom screening for identifying SARS-CoV-2 infection.** PLOS ONE 17:doi.org/10.1371/journal.pone.0266912 (available as a free pdf)

Authors' abstract: *A convenience sample of emergency department patients with COVID-19 symptom screening participated in smell testing using an eight odor Pocket Smell Test (PST).*

Participants received a SARS-CoV-2 viral PCR test after smell testing and completed a health conditions survey. Descriptive analysis and receiver operating characteristic (ROC) curve models compared the accuracy of smell testing versus symptom screening in identifying SARS-CoV-2 infection.

295 patients completed smell testing and 87 (29.5%) had a positive SARS-CoV-2 PCR test. Twenty-eight of the SARS-CoV-2 positive patients (32.2%) and 49 of the SARS-CoV-2 negative patients (23.6%) reported at least one of seven screening symptoms.

SARS-CoV-2 positive patients were more likely to have hyposmia (<5 correctly identified odors) than SARS-CoV-2 negative patients. Hyposmia was 52.9% sensitive and 82.7% specific for SARS-CoV-2 infection.

Presence of >1 screening symptom was 32.2% sensitive and 76.4% specific for SARS-CoV-2 infection. The ROC curve for symptom screening had lower discriminatory accuracy for SARS-CoV-2 infection than the smell testing ROC curve. Smell testing was superior to symptom screening for identifying SARS-CoV-2 infection in our study.

The Spread Of The Pandemic.

Zachreson, C., et al (2022) **COVID-19 in low-tolerance border quarantine systems: Impact of the Delta variant of SARS-CoV-2.** SCIENCE ADVANCES 8:doi.org/10.1126/sciadv.abm3624 (available as a free pdf)

Authors' abstract: *In controlling transmission of coronavirus disease COVID-19, the effectiveness of border quarantine strategies is a key concern for jurisdictions in which the local prevalence of disease and immunity is low.*

In settings like this such as China, Australia, and New Zealand, rare outbreak events can lead to escalating epidemics and trigger the imposition of large-scale lockdown policies.

Here, we develop and apply an individual-based model of COVID-19 to simulate case importation from managed quarantine under various vaccination scenarios. We then use the output of the individual-based model as input to a branching process model to assess community transmission risk.

For parameters corresponding to the Delta variant, our results demonstrate that vaccination effectively counteracts the pathogen's increased infectiousness.

To prevent outbreaks, heightened vaccination in border quarantine systems must be combined with mass vaccination. The ultimate success of these programs will depend sensitively on the efficacy of vaccines against viral transmission.

Fefferman, N.H., et al (2022) **When do children avoid infection risks: Lessons for schools during the COVID-19 pandemic.** iSCIENCE 25:doi.org/10.1016/j.isci.2022.103989 (available as a free pdf)

Authors' abstract: *The physical closing of schools because of COVID-19 has disrupted both student learning and family logistics. There is significant pressure for in-person learning to remain open for all children.*

However, as is expected with outbreaks of novel infections, vaccines and other pharmaceutical therapeutics may not be instantly available.

This raises serious public health questions about the risks to children and society at large. The best protective measures for keeping young children in school focus on behaviors that limit transmission.

It is therefore critical to understand how we can engage children in age-appropriate ways that will best support their ability to adhere to protocols effectively.

Here, we synthesize published studies with new results to investigate the earliest ages at which children form an understanding of infection risk and when they can translate that understanding effectively to protective action.

As the past two years havemade painfully clear, keeping schools open for in-person instruction is one of the most important goals in returning societal function to normalcy.

However, normalcy can only be achieved with sufficient guarantee of everyone's personal safety in the face of ongoing circulation of COVID-19, including whatever novel strains may arise.

Non-pharmaceutical interventions are likely to remain the best means of protecting children under the age of 12 well into the academic year, and therefore also the best means to protect against schools becoming reservoirs of transmission that continue to expose those who have not been, cannot be, or do not mount sufficient immune response to be protected by having been vaccinated.

The results of the study discussed above that examined illness knowledge before and after the onset of the COVID-19 pandemic suggests that casual conversations about illness transmission at home might promote health-related behaviors in children.

However, it is important to note that although 59% of parents who were polled in this study reported that their children had a strong understanding of how to avoid illness (e.g., washing hands, avoiding contamination), only 5% of them believed their child would behave in ways that would keep them from exposure.

This disconnect might be because parents' reports of discussions with their children center around risk prevention strategies (71%) rather than causal mechanisms of illness transmission (21%).

This suggests that parents might not know how to engage their children in productive conversations about illness transmission, and thus highlights the potential need to disseminate informational guides to parents about how to talk to their children about illness most productively.

Of course, it may also be that because of responsible concern about their children's safety, parents are more likely to remember instances of failure to follow behavioral guidelines rather than average but imperfect attempts.

From an individual perspective, this is of course important, but from a public health perspective, reduction in the frequency of failure in hygienic behavior can still meaningfully improve overall societal outcomes and should still be encouraged.

Malik. O., et al (2022) **Modelling epidemic spread in cities using public transportation as a proxy for generalized mobility trends.** SCIENTIFIC REPORTS 12:doi.org/10.1038/s41598-022-10234-8 (available as a free pdf)

Authors' abstract: *We study how public transportation data can inform the modeling of the spread of infectious diseases based on SIR dynamics. We present a model where public transportation data is used as an indicator of broader mobility patterns within a city, including the use of private transportation, walking etc.*

The mobility parameter derived from this data is used to model the infection rate. As a test case, we study the impact of the usage of the New York City subway on the spread of COVID-19 within the city during 2020.

We show that utilizing subway transport data as an indicator of the general mobility trends within the city, and therefore as an indicator of the effective infection rate, improves the quality of forecasting COVID-19 spread in New York City. Our model predicts the two peaks in the spread of COVID-19 cases in NYC in 2020, unlike a standard SIR model that misses the second peak entirely.

Long-range mobility, such as traveling between cities, can cause a disease to spread through case importation across large distances. Short-range mobility, such as usage of city buses or trams, has been correlated with a higher risk of contracting acute respiratory infections and with the number of cases of COVID-19 within cities.

Accordingly, restrictions on human mobility, either directly by shutting down public transportation or indirectly by restricting public and private gatherings, which were highly effective in stopping the spread of COVID-19.

We hypothesize that alongside being a high-risk medium for infections, public transportation usage is also a good indicator for the level of short-range mobility for the entire population of a city.

When it became clear that the COVID-19 virus is highly infectious, New York City (NYC) imposed restrictions that included shutting-down non-essential businesses and forbidding large gatherings, but kept public transportation and schools open.

The usage of NYC's sprawling subway system was found to be correlated with the spread of COVID-19, and mobility patterns in general were correlated with the spread of COVID-19 within regions of the city.

Speirs: Same thing happened in Calgary. The transit system was declared an essential service and kept running. Face coverings were not mandatory until August 2020. As a result, COVID-19 quickly spread city wide.

Larsen, D.A., et al (2022) **Coupling freedom from disease principles and early warning from wastewater surveillance to improve health security.** PNAS NEXUS 1:doi.org/10.1093/pnasnexus/pgac001 (available as a free pdf)

Authors' abstract: *Wastewater provides a representative sample and can be easily collected and analyzed to understand the health of the community. Numerous infectious disease pathogens can be found in wastewater, including SARS-CoV-2. Using SARS-CoV-2 as a case study, we show that wastewater surveillance can improve health security by confirming freedom from disease transmission when a pathogen is absent from a community and provide an early warning for emerging pathogens.*

We apply these principles to SARS-CoV-2, and hypothesize that they will be useful for many other infectious disease pathogens including but not limited to HIV, tuberculosis, dengue, zika, and malaria.

From wastewater surveillance of 24 treatment plants across upstate New York from May through December of 2020, trends in the intensity of SARS-CoV-2 in wastewater correlate with trends in COVID-19 incidence and test positivity, with the greatest correlation observed for active cases and a 3-day lead time between wastewater sample date and clinical test date.

No COVID-19 cases were reported 35% of the time the week of a non-detection of SARS-CoV-2 in wastewater. Compared to the United States Centers for Disease Control and Prevention levels of transmission risk, transmission risk was low (no community spared) 50% of the time following non-detection, and transmission risk was moderate or lower (low community spread) 92% of the time following non-detection.

Wastewater surveillance can demonstrate the geographic extent of the transmission of emerging pathogens, confirming that transmission risk is either absent or low and alerting of an increase in transmission.

If a statewide wastewater surveillance platform had been in place prior to the onset of the COVID-19 pandemic, policymakers would have been able to complement the representative nature of wastewater samples to individual testing, likely resulting in more precise public health interventions and policies.

Fraser, T., et al (2022) **Social capital's impact on COVID-19 outcomes at local levels.** SCIENTIFIC REPORTS 12:doi.org/10.1038/s41598-022-10275-z (available as a free pdf)

Authors' abstract: *Over the past thirty years, disaster scholars have highlighted that communities with stronger social infrastructure, including social ties that enable trust, mutual aid, and collective action, tend to respond to and recover better from crises. However, comprehensive measurements of social capital across communities have been rare.*

This study adapts Kyne and Aldrich's county-level social capital index to the census-tract level, generating social capital indices from 2011 to 2018 at the census-tract, zipcode, and county subdivision levels.

To demonstrate their usefulness to disaster planners, public health experts, and local officials, we paired these with the CDC's Social Vulnerability Index to predict the incidence of COVID-19 in case studies in Massachusetts, Wisconsin, Illinois, and New York City.

We found that social capital predicted 41 to 49% of the variation in COVID-19 outbreaks, and up to 90% with controls in specific cases, highlighting its power as diagnostic and predictive tools for combating the spread of COVID.

SEEN IN THE LITERATURE

Astronomy.

Scaringi, S., et al (2022) **Localized thermonuclear bursts from accreting magnetic white dwarfs.** NATURE 604:447-450

Authors' abstract: *Nova explosions are caused by global thermonuclear runaways triggered in the surface layers of accreting white dwarfs. It has been predicted that localized thermonuclear bursts on white dwarfs can also take place, similar to type-I X-ray bursts observed in accreting neutron stars. Unexplained rapid bursts from the binary system TV Columbae, in which mass is accreted onto a moderately strong magnetized white dwarf from a low-mass companion, have been observed on several occasions in the past 40 years.*

During these bursts, the optical/ultraviolet luminosity increases by a factor of more than three in less than an hour and fades in around ten hours. Fast outflows have been observed in ultraviolet spectral lines, with velocities of more than 3,500 kilometres per second, comparable to the escape velocity from the white dwarf surface.

Here we report on optical bursts observed in TV Columbae and in two additional accreting systems, EI Ursae Majoris and ASASSN-19bh. The bursts have a total energy of approximately 10^{-6} times than those of classical nova explosions (micronovae) and bear a strong resemblance to type-I X-ray bursts.

We exclude accretion or stellar magnetic reconnection events as their origin and suggest thermonuclear runaway events in magnetically confined accretion columns as a viable explanation.

Gilmore, G., and G. Tausch-Pebody (2022) **The 1919 eclipse results that verified general relativity and their later detractors: a story re-told.** NOTES AND RECORDS 76:doi.org/10.1098/rsnr.2020.0040 (available as a free pdf)

Authors' abstract: *Einstein became world famous on 7 November 1919, following press publication of a meeting held in London on 6 November 1919 where the results were announced of two British expeditions led by Eddington, Dyson and Davidson to measure how much background starlight is bent as it passes the Sun.*

Three data sets were obtained: two showed the measured deflection matched the theoretical prediction of Einstein's 1915 Theory of General Relativity, and became the official result; the third was discarded as defective. At the time, the experimental result was accepted by the expert astronomical community.

However, in 1980 a study by philosophers of science Earman and Glymour claimed that the data selection in the 1919 analysis was flawed and that the discarded data set was fully valid and was not consistent with the Einstein prediction, and that, therefore, the overall result did not verify General

Relativity. This claim, and the resulting accusation of Eddington's bias, was repeated with exaggeration in later literature and has become ubiquitous.

The 1919 and 1980 analyses of the same data provide two discordant conclusions. We re-analyse the 1919 data, and identify the error that undermines the conclusions of Earman and Glymour.

We have re-analysed the Earman and Glymour 1980 paper, scrutinized their statistical analysis and conclude that it is not methodologically sound. Earman and Glymour's publication falls into the philosophical context of analyses of models of the scientific method.

In conclusion to their re-analysis of the 1919 expedition results, they claim to have found evidence against 'science as a model of objectivity and rationality'. The main purpose of their re-analysis is to strengthen a philosophical point, not a scientific one. Their 'discovery' makes no difference to the credibility of Einstein's Theory of General Relativity.

In the authors' own words, that 'theory, so far as we know, still holds the truth about space, time and gravity'; and yet the arguments they use to discredit the scientific method then applied have had influence and consequence that go beyond the philosophical debate from which they emerged, especially once they reached the wider public domain unchecked.

While acknowledging the raison d'être of the philosophical investigation that forms the background to their arguments, we show that Earman and Glymour failed to distinguish between and appreciate different areas of expertise, and have conflated arguments that belong to different fields of investigation.

Filipovi, M.D., et al (2022) **Mysterious odd radio circle near the Large Magellanic Cloud: an intergalactic supernova remnant?** MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY 512:doi.org/10.1093/mnras/stac210

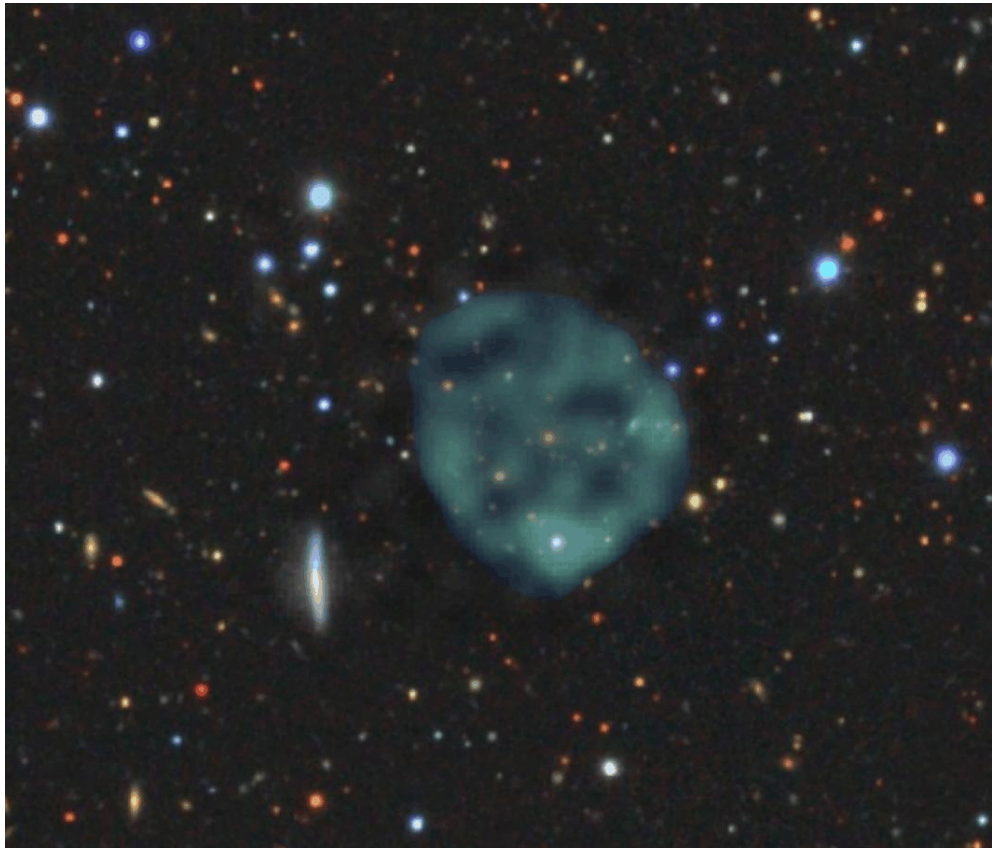
Authors' abstract: *We report the discovery of J0624-6948, a low-surface brightness radio ring, lying between the Galactic Plane and the Large Magellanic Cloud (LMC). It was first detected at 888 MHz with the Australian Square Kilometre Array Pathfinder (ASKAP), and with a diameter of ~196 arcsec.*

This source has phenomenological similarities to odd radio circles (ORCs). Significant differences to the known ORCs, a flatter radio spectral index, the lack of a prominent central galaxy as a possible host, and larger apparent size, suggest that J0624-6948 may be a different type of object.

We argue that the most plausible explanation for J0624-6948 is an intergalactic supernova remnant due to a star that resided in the LMC outskirts that had undergone a single-degenerate type Ia supernova, and we are seeing its remnant expand into a rarefied, intergalactic environment.

We also examine if a massive star or a white dwarf binary ejected from either galaxy could be the supernova progenitor. Finally, we consider several other hypotheses for the nature of the object, including the jets of an active galactic nucleus (30Dor) or the remnant of a nearby stellar super-flare.

[Image shows the radio wavelength view of the supernova explosion bubble out in intergalactic space.]



Amery, Fiona (2022) **The disputed sound of the aurora borealis: sensing liminal noise during the first and second International Polar Years, 1882-3 AND 1932-3.** NOTES AND RECORDS 76:doi.org/10.1098/rsnr.2021.0031 (available as a free pdf)

Author's abstract: *This paper discusses heightened interest in the potential audibility of the aurora borealis during the First and Second International PolarYears (IPYs) of 1882-3 and 1932-3.*

Galvanized by a growing volume of local accounts expressing belief in the elusive noises, written by the inhabitants of the Shetland Islands, northern Canada, andNorway, auroral researchers of each era were determined to establish the objectivity of auroral sound.

There was considerable speculation within the auroral research community as to whether the apparent noises were imagined or illusory, connected to discussions about the possibility of low-altitude aurorae. The anglophone auroral sound debate primarily played out within the official reports of IPY expeditions, the journal Nature, and a Shetland Island newspaper.

I argue that the embodied senses were used exclusively to register the liminal sounds of the aurora across the two periods, despite developments in sound recording technologies, the primacy of mechanical objectivity, and instruments transported to the polar regions for the investigation of visual features of the phenomenon.

This overlooked episode complicates narratives of polar science in the late nineteenth and early twentieth centuries by revealing a faith in the corporeal senses and the significant role of amateur observers.

Moons And Bolides.

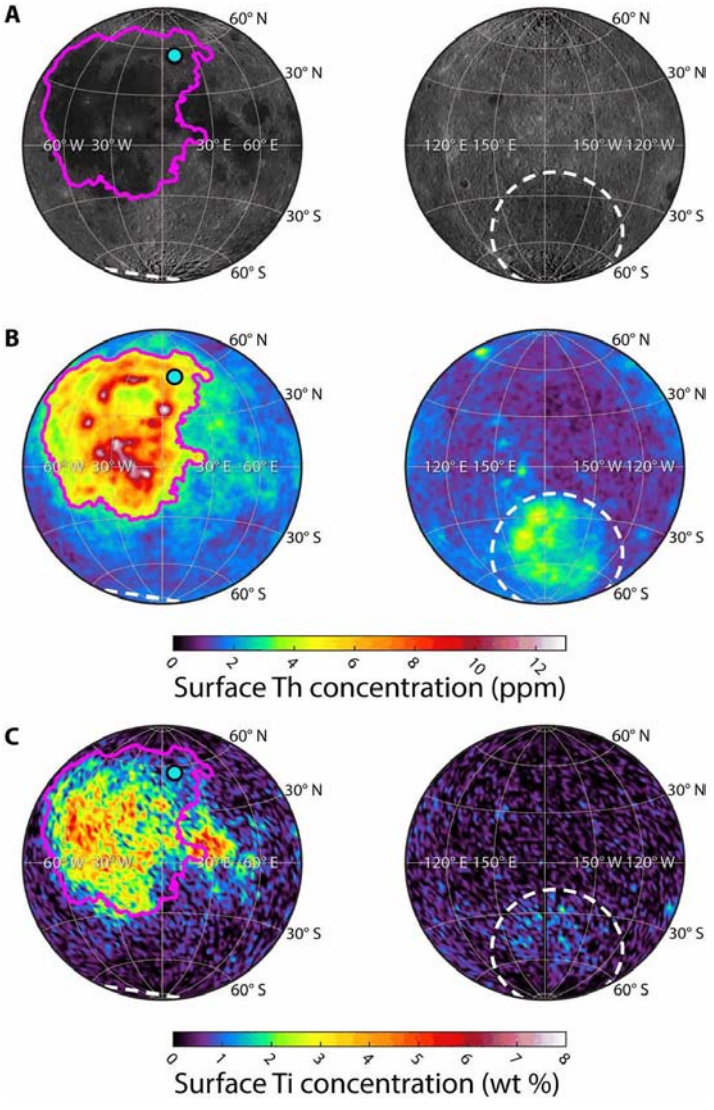
Jones, M.J., et al (2022) **A South Pole–Aitken impact origin of the lunar compositional asymmetry.** SCIENCE ADVANCES 8:doi.org/10.1126/sciadv.abm8475 (available as a free pdf)

Authors' abstract: *The formation of the largest and most ancient lunar impact basin, South Pole-Aitken (SPA), was a defining event in the Moon's evolution.*

Using numerical simulations, we show that widespread mantle heating from the SPA impact can catalyze the formation of the long-lived nearside-farside lunar asymmetry in incompatible elements and surface volcanic deposits, which has remained unexplained since its discovery in the Apollo era.

The impact-induced heat drives hemisphere-scale mantle convection, which would sequester Th- and Ti-rich lunar magma ocean cumulates in the nearside hemisphere within a few hundred million years if they remain immediately beneath the lunar crust at the time of the SPA impact.

A warm initial upper mantle facilitates generation of a pronounced compositional asymmetry consistent with the observed lunar asymmetry.



[Images are from this paper. Far side of the Moon on the right.]

Sucerquia, M., et al (2022) **Cronomoons: origin, dynamics, and light-curve features of ringed exomoons.** MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY 512:doi.org/10.1093/mnras/stab3531

Authors' abstract: *In recent years, technical and theoretical work to detect moons and rings around exoplanets has been attempted. The small mass/size ratios between moons and planets means this is very challenging, having only one exoplanetary system where spotting an exomoon might be feasible (i.e. Kepler-1625b i).*

In this work, we study the dynamical evolution of ringed exomoons, dubbed cronomoons after their similarity with Cronus (Greek for Saturn), and after Chronos (the epitome of time), following the Transit Timing Variations and Transit Duration Variation that they produce on their host planet.

Cronomoons have extended systems of rings that make them appear bigger than they actually are when transiting in front of their host star. We explore different possible scenarios that could lead to the formation of such circumsatellital rings, and through the study of the dynamical/thermodynamic stability and lifespan of their dust and ice ring particles, we found that an isolated cronomoon can survive for time-scales long enough to be detected and followed up.

If these objects exist, cronomoons' rings will exhibit gaps similar to Saturn's Cassini Division and analogous to the asteroid belt's Kirkwood gaps but instead raised due to resonances induced by the host planet. Finally, we analyse the case of Kepler-1625b i under the scope of this work, finding that the controversial giant moon could instead be an Earth-mass cronomoon.

Elvis, Martin (2022) **Research programmes arising from 'Oumuamua considered as an alien craft.** INTERNATIONAL JOURNAL OF ASTROBIOLOGY 21:doi.org/10.1017/S147355042100032X

Author's abstract: *The controversial hypothesis that 'Oumuamua (1I/2017 U1) was an alien craft dominated by a solar sail is considered using known physics for the two possible cases: controlled and uncontrolled flight. The reliability engineering challenges for an artefact designed to operate for ~10^5 to 10^6 year are also considerable.*

All three areas generate research programmes going forward. The uncontrolled case could be either 'anonymous METI' (messaging extraterrestrial intelligence) or 'inadvertent METI'. In the controlled case the nature of the origin star, trajectory guidance from the origin star to the Sun, and the identity of a destination star are all undecided.

The 'controlled' case has more strikes against it than the 'uncontrolled' case, but neither suffers a knock-out blow, as yet. Some of the issues turn out not to be major obstacles to the alien craft hypothesis, but others weaken the case for it.

Most, however, imply new studies. Some of these, e.g. intercept missions for new interstellar objects, are concepts being developed, and will be of value whatever these objects turn out to be.

Overall, these considerations show that a many-pronged, targeted, research programme can be built around the hypothesis that 'Oumuamua is an alien craft. The considerations presented here can also be applied to other interstellar visitors, as well as to general discussions of interstellar travel.

Speirs: Arthur C. Clarke said it best in his novel RENDEVOUS WITH RAMA.

Neslušan, L., and D. Tomko (2022) **The impact hazard of near-Sun comets.** MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY 512:doi.org/10.1093/mnras/stac727

Authors' abstract: *There are several groups of comets with perihelion near the solar surface known. Of these, the Marsden and Kracht groups move in orbits situated in a spatial corridor of the daytime Arietid meteoroid stream.*

The orbits of comets of the Meyer group are not very different from those of the Marsden and Kracht groups. For the purpose of our study, we thus consider a common Meyer-Marsden-Kracht (MMK) group.

Since Arietids pass close to the Earth's orbit, comets of the MMK group must also do so. We study the close approaches of the orbits of these comets with regard to the proximity of the orbit of our planet and estimate an impact hazard.

We found a concentration of approaches within an interval of solar longitude from ~72º to 84º (between June 2 and June 15). The mean time between two collisions of an MMK comet and Earth is estimated to be one to two million years, assuming a steady state during that period.

Planets.

Ning, W., et al (2022) **Archean eclogite-facies oceanic crust indicates modern-style plate tectonics.** PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES USA 119:doi.org/10.1073/pnas.2117529119 (available as a free pdf)

Authors' abstract: *Establishing when modern-style plate tectonics with deep subduction began on Earth is one of the biggest questions in geosciences today. A lack of Archean age (>2.5 billion years ago [Ga]) eclogites or eclogite-facies crustal rocks (the high-pressure equivalent of basalt or gabbro) has led to an assertion that modern plate tectonics did not operate in the Archean.*

Here, we report eclogite-facies garnet clinopyroxenite associated with metagabbro in 2.52- to 2.53-billion-y-old ophiolitic melange in the northern Central Orogenic Belt (COB) within the North China Craton.

The garnet clinopyroxenites with normal mid-ocean ridge basalt (N-MORB) geochemical signatures are relicts of oceanic crust, recording peak eclogite-facies metamorphic assemblages indicating conditions of 792 to 890 ˚C/19.8 to 24.5 kbar, supported by abundant exsolution microstructures in garnet and clinopyroxene.

Zircon U-Pb dating of the metagabbros and a granitic dike cross-cutting the metamorphic layering of the metagabbro constrain deformation and eclogite-facies metamorphism to >2.47 Ga. This finding implies that Archean oceanic crust was subducted to at least 65 to 70 km at the end of the Archean.

Together with other asymmetric subduction records in the COB, it is inferred that modern-style plate tectonics evidenced by deep and asymmetric subduction along the circa 1,600-km-long orogen was operating at least by the end of the Archean era, when the planet was making a transition to the Proterozoic, witnessing the Great Oxidation Event, widespread emergence of continents, and development of crown node eukaryotic species on a more habitable planet.

Alien Life.

Barge, L.M., et al (2022) **Determining the "biosignature threshold" for life detection on biotic, abiotic, or prebiotic worlds.** ASTROBIOLOGY 22:doi.org/10.1089/ast.2021.0079

Authors' abstract: *The field of prebiotic chemistry has demonstrated that complex organic chemical systems that exhibit various life-like properties can be produced abiotically in the laboratory.*

Understanding these chemical systems is important for astrobiology and life detection since we do not know the extent to which prebiotic chemistry might exist or have existed on other worlds. Nor do we know what signatures are diagnostic of an extant or "failed" prebiotic system.

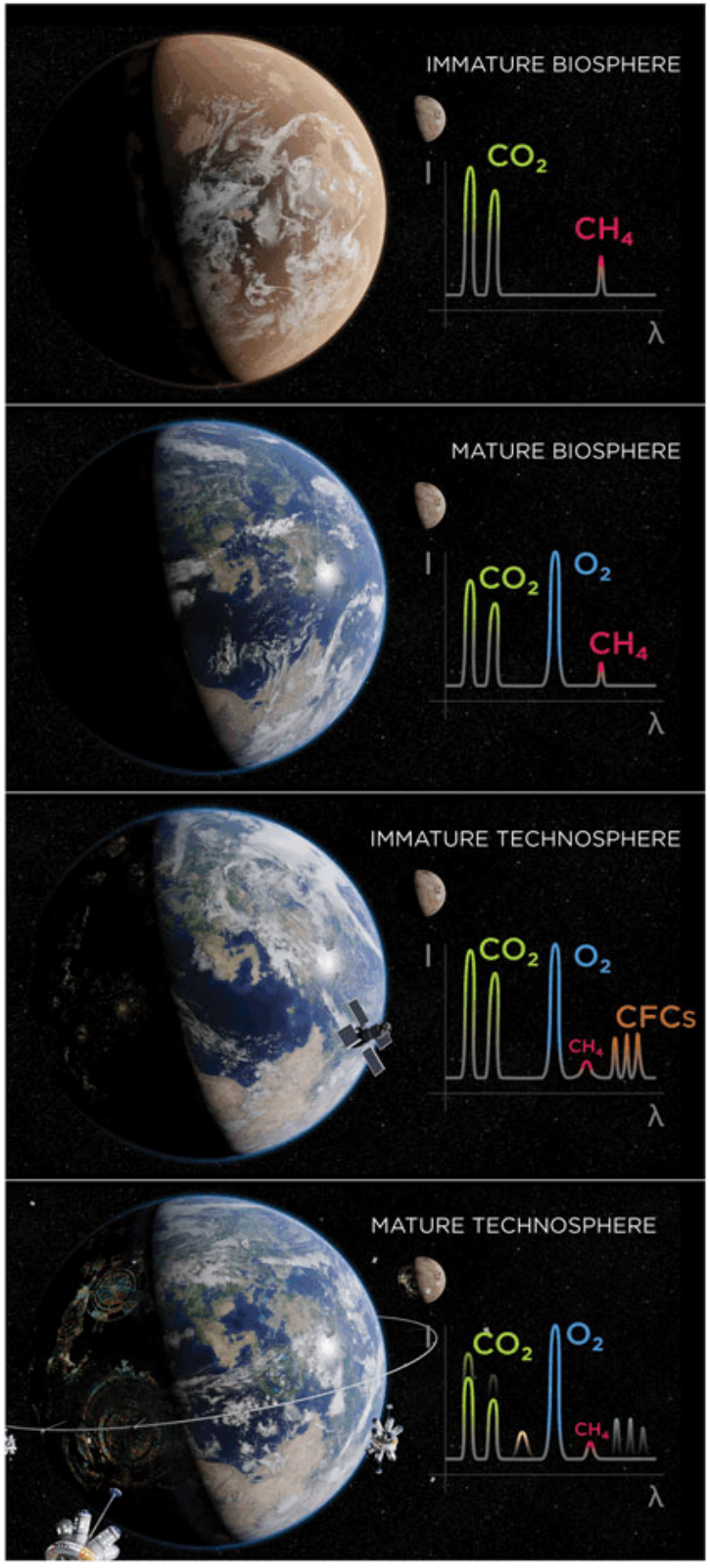
On Earth, biology has suppressed most abiotic organic chemistry and overprints geologic records of prebiotic chemistry; therefore, it is difficult to validate whether chemical signatures from future planetary missions are remnant or extant prebiotic systems.

The "biosignature threshold" between whether a chemical signature is more likely to be produced by abiotic versus biotic chemistry on a given world could vary significantly, depending on the particular environment, and could change over time, especially if life were to emerge and diversify on that world.

To interpret organic signatures detected during a planetary mission, we advocate for (1) gaining a more complete understanding of prebiotic/abiotic chemical possibilities in diverse planetary environments and (2) involving experimental prebiotic samples as analogues when generating comparison libraries for "life-detection" mission instruments.

Frank, A., et al (2022) **Intelligence as a planetary scale process.** INTERNATIONAL JOURNAL OF ASTROBIOLOGY 21:doi.org/10.1017/S147355042100029X (available as a free pdf)

Authors' abstract: *Conventionally, intelligence is seen as a property of individuals. However, it is also known to be a property of collectives. Here, we broaden the idea of intelligence as a collective property and extend it to the planetary scale.*



We consider the ways in which the appearance of technological intelligence may represent a kind of planetary scale transition, and thus might be seen not as something which happens on a planet but to a planet, much as some models propose the origin of life itself was a planetary phenomenon.

Our approach follows the recognition among researchers that the correct scale to understand key aspects of life and its evolution is planetary, as opposed to the more traditional focus on individual species.

We explore ways in which the concept may prove useful for three distinct domains: Earth Systems and Exoplanet studies; Anthropocene and Sustainability studies; and the study of Technosignatures and the Search for Extraterrestrial Intelligence.

We argue that explorations of planetary intelligence, defined as the acquisition and application of collective knowledge operating at a planetary scale and integrated into the function of coupled planetary systems, can prove a useful framework for understanding possible paths of the long-term evolution of inhabited planets including future trajectories for life on Earth and predicting features of intelligently steered planetary evolution on other worlds.

[Images are from this paper.]

Kovacevic, A.B. (2022) **On possible life-dispersal patterns beyond the Earth.** INTERNATIONAL JOURNAL OF ASTROBIOLOGY 21:doi.org/10.1017/S1473550421000379

Author's abstract: *The assumption that exoplanets are 'in equilibrium' with their surroundings has not given way to life's transmissivity on large spatial scales. The spread of human diseases and the life recovery rate after mass extinctions on our planet, on the other hand, may exhibit spatial and temporal scaling as well as distribution correlations that influence the mappable range of their characteristics.*

We model hypothetical bio-dispersal within a single Galactic region using the stochastic infection dynamics process, which is inspired by these local properties of life dispersal on Earth. We split the population of stellar systems into different categories regarding habitability and evolved them through time using probabilistic cellular automata rules analogous to the model.

As a dynamic effect, we include the existence of natural dispersal vectors (e.g. dust, asteroids) in a way that avoids assumptions about their agency (i.e. questions of existence).

Moreover, by assuming that dispersal vectors have a finite velocity and range, the model includes the parameter of 'optical depth of life spreading'. The effect of the oscillatory infection rate on the long-term behaviour of the dispersal flux, which adds a diffusive component to its progression, is also taken into account.

The life recovery rate was only included in the model as a link to macrofaunal diversity data, which shows that all mass extinctions have a 10 Myr 'speed rate' in diversity recovery.

This parameter accounts for the repopulation of empty viable niches as well as the formation of new ones, without ruling out the possibility of genuine life reemergence on other habitable worlds in the Galaxy that colossal extinctions have sterilized.

All life-transmission events within the Galactic patch have thus been mapped into phase space. We found that phase space is separated into subregions of long-lasting transmission, rapidly terminated transmission, and a transition region between the two.

We observed that depending on the amplitude of the oscillatory life-spreading rate, life-transmission in the Galactic patch might take on different geometrical shapes (i.e. 'waves'). Even if some host systems are uninhabited, life transmission has a certain threshold, allowing a patch to be saturated with viable material over a long period.

Although stochastic fluctuations in the local density of habitable systems allow for clusters that can continuously infect one another, the spatial pattern disappears when life transmission is below the observed threshold, so that transmission process is not permanent in time. Both findings suggest that a habitable planet in a densely populated region may remain uninfected.

Origin Of Life

Papineau, D., et al (2022) **Metabolically diverse primordial microbial communities in Earth's oldest seafloor-hydrothermal jasper.** SCIENCE ADVANCES 8:doi.org/10.1126/sciadv.abm2296 (available as a free pdf)

Authors' abstract: *The oldest putative fossils occur as hematite filaments and tubes in jasper-carbonate banded iron formations from the 4280- to 3750-Ma Nuvvuagittuq Supracrustal Belt, Québec. If biological in origin, these filaments might have affinities with modern descendants; however, if abiotic, they could indicate complex prebiotic forms on early Earth.*

Here, we report images of centimeter-size, autochthonous hematite filaments that are pectinate-branching, parallel-aligned, undulated, and containing Fe2+-oxides.

These microstructures are considered microfossils because of their mineral associations and resemblance to younger microfossils, modern Fe-bacteria from hydrothermal environments, and the experimental products of heated Fe-oxidizing bacteria.

Additional clusters of irregular hematite ellipsoids could reflect abiotic processes of silicification, producing similar structures and thus yielding an uncertain origin. Millimeter-sized chalcopyrite grains within the jasper-carbonate rocks have ^{34}S- and ^{33}S-enrichments consistent with microbial S-disproportionation and an O2-poor atmosphere.

Collectively, the observations suggest a diverse microbial ecosystem on the primordial Earth that may be common on other planetary bodies, including Mars.

Zayed, A.A., et al (2022) **Cryptic and abundant marine viruses at the evolutionary origins of Earth's RNA virome.** SCIENCE 376:doi.org/10.1126/science.abm5847

Authors' abstract: *Apart from their roles in human infectious diseases, we understand relatively little about RNA viruses in the wider world. Recently, the discovery curve has been spectacular and has revealed unexpected diversity.*

We optimized discovery and classification methods on Tara Oceans RNA sequence data to double the roster of known RNA virus phyla.

This is not just a numbers game; we also found a missing link in RNA virus evolution and discovered new phyla that dominate in the oceans and might infect mitochondria.

These viruses require an ancient enzyme, RNA-directed RNA polymerase (RdRp) for replication, which is thus used as a marker of deep evolutionary relationships.

In addition to the primary sequence data, information on the three-dimensional structures of the RdRp, network-based clusters, other genomic domains, and whole-genome characteristics help reshape the outlines of the evolutionary history of RNA viruses.

Whereas DNA viruses are known to be abundant, diverse, and commonly key ecosystem players, RNA viruses are insufficiently studied outside disease settings.

In this study, we analyzed ~28 terabases of Global Ocean RNA sequences to expand Earth's RNA virus catalogs and their taxonomy, investigate their evolutionary origins, and assess their marine biogeography from pole to pole.

Using new approaches to optimize discovery and classification, we identified RNA viruses that necessitate substantive revisions of taxonomy (doubling phyla and adding >50% new classes) and evolutionary understanding.

"Species"-rank abundance determination revealed that viruses of the new phyla "Taraviricota", a missing link in early RNA virus evolution, and "Arctiviricota" are widespread and dominant in the oceans.

These efforts provide foundational knowledge critical to integrating RNA viruses into ecological and epidemiological models.

Palaeobiology: Extinctions.

Lu, J., et al (2022) **Diachronous end-Permian terrestrial ecosystem collapse with its origin in wildfires.** PALAEOGEOGRAPHY, PALAEOCLIMATOLOGY, PALAEOECOLOGY 594:doi.org/10.1016/j.palaeo.2022.110960 (available as a free pdf)

[The greatest mass extinction in Earth history was the end-Permian die-off 251 megayears ago. 97% of all species became extinct.]

Authors' abstract: *The Permian-Triassic Mass Extinction (PTME) is the greatest biodiversity crisis in Earth history and while the marine crisis is increasingly well constrained, the timing and cause(s) of terrestrial losses remain poorly understood. There have been suggestions that the End-Permian Terrestrial Collapse (EPTC) pre-dated, was synchronous with, or post-dated the marine crisis, or even occurred asynchronously in different regions.*

We address these conflicting interpretations through a detailed geochemical study of a terrestrial sequence in the Liujiang Coalfield on the North China Plate in which we apply zircon U-Pb dating of tuffaceous claystone, kerogen identification, and analysis of organic carbon isotopic composition ($d^{13}C_{org}$), total organic carbon, continental weathering (via the chemical index of alteration) and Ni concentrations.

Our study constrains the Permian-Triassic boundary near the base of bed 20 in our sequence at approximately 251.9 ±1.1 Ma, immediately above a Ni anomaly also known from other terrestrial sequences and the marine PTME.

Organic carbon isotope chemostratigraphy together with evidence for algal blooms and the presence of mudstone clasts suggests that the onset of the EPTC in the North China Plate was synchronous with the crisis in low latitudes (e.g., South China), but was about 310 kyr later than the EPTC in higher southerly latitudes (e.g., Australia).

The EPTC predates the marine PTME. Kerogen macerals suggest that a phase of increased wildfire was sustained from the onset of the EPTC in the North China Plate until the marine PTME interval, implicating wildfire as a major driver of the EPTC (at least in low latitudes) that, in turn, had devastating consequences for the marine realm.

Onstein, R.E., et al (2022) **The megaherbivore gap after the non-avian dinosaur extinctions modified trait evolution and diversification of tropical palms.** PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON 289B:doi.org/10.1098/rspb.2021.2633 (available as a free pdf)

Authors' abstract: *The Cretaceous-Palaeogene (K-Pg) extinction of the non-avian dinosaurs (66 megayears ago) led to a 25 million year gap of megaherbivores (>1000 kg) before the evolution of megaherbivorous mammals in the Late Eocene (40 Ma).*

The botanical consequences of this 'Palaeocene megaherbivore gap' (PMHG) remain poorly explored. We hypothesize that the absence of megaherbivores should result in changes in the diversification and trait evolution of associated plant lineages.

We used phylogenetic time- and trait-dependent diversification models with palms (Arecaceae) and show that the PMHG was characterized by speciation slowdowns, decreased evolution of armature and increased evolution of megafaunal (>4 cm) fruits.

This suggests that the absence of browsing by megaherbivores during the PMHG may have led to a loss of defence traits, but the absence of megaherbivorous seed dispersers did not lead to a loss of megafaunal fruits.

Instead, increases in PMHG fruit sizes may be explained by simultaneously rising temperatures, rainforest expansion, and the subsequent radiation of seed-dispersing birds and mammals.

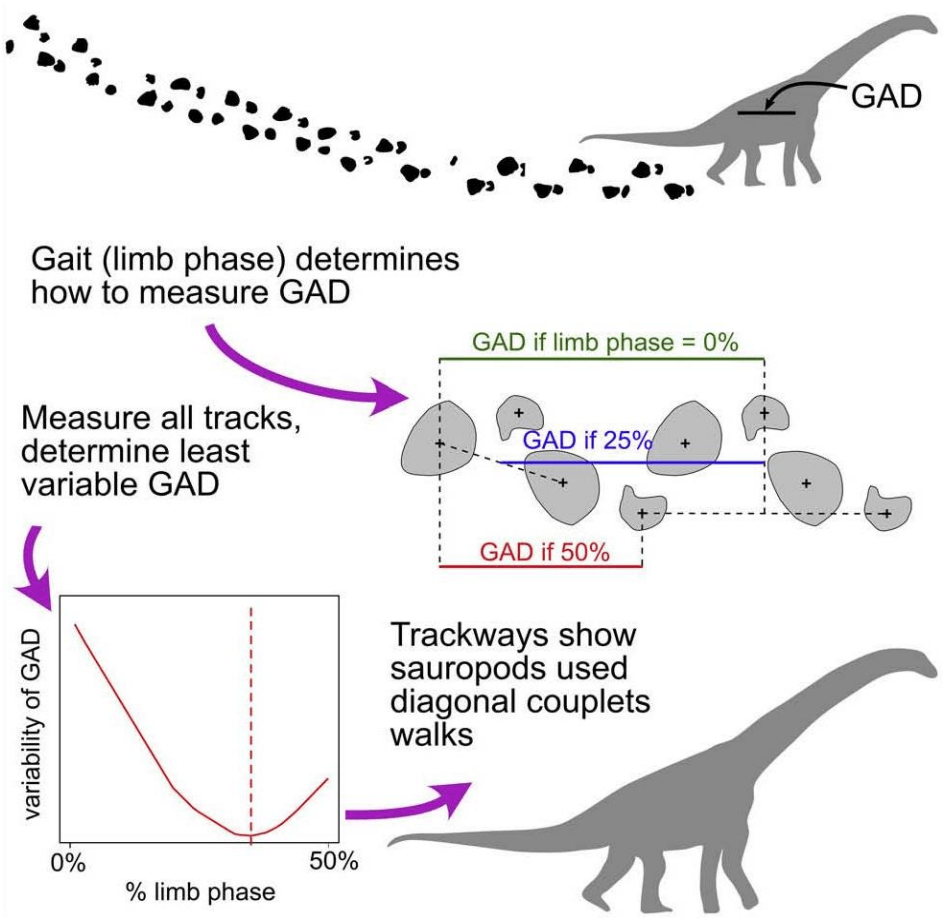
We show that the profound impact of the PMHG on plant diversification can be detected even with the overwriting of adaptations by the subsequent Late Eocene opening up of megaherbivore-associated ecological opportunities.

Palaeobiology: Dinosaurs.

Lallensack, J.N., and P.L. Falkingham (2022) **A new method to calculate limb phase from trackways reveals gaits of sauropod dinosaurs.** CURRENT BIOLOGY 32:doi.org/10.1016/j.cub.2022.02.012

Authors' abstract: *Limb phase, the timing of the footfalls in quadrupedal locomotion that describes common gaits such as the trot and the pace gait, is widely believed to be difficult or even impossible to estimate for extinct tetrapods.*

We here present a fundamentally new approach that allows for estimating limb phase based on variation patterns in long trackways. The approach is tested on trackways of modern mammals, where the estimates generally correspond well with the actually employed limb phase. We then estimate limb phases of giant wide-gauged sauropod dinosaurs based on three long trackways from the Lower Cretaceous of Arkansas, USA.



Gait selection at the largest body sizes is of considerable interest given the lack of modern analogs. Contrary to previous assumptions, our estimates suggest lateral sequence diagonal couplet walks, in which the footfalls of the diagonal limb pairs (e.g., right hind and left fore) are more closely related in time than those of the same side of the body (e.g., right hind and right fore).

Such a gait selection allows for efficient walking while maintaining diagonal limb support throughout the step cycle, which is important for a giant, wide-gauged trackmaker. Estimations of limb phase may help to constrain other gait parameters, body size and shape, and, finally, potential trackmaker taxa.

[Images are from this paper.]

Cincotta, A., et al (2022) **Pterosaur melanosomes support signalling functions for early feathers.** NATURE 604:doi.org/10.1038/s41586-022-04622-3 (available as a free pdf)

[Melanosomes are skin pigment cells. With reference to the third paragraph, birds are technically theropod dinosaurs, the only lineage to survive the asteroid.]

Authors' abstract: *Remarkably well-preserved soft tissues in Mesozoic fossils have yielded substantial insights into the evolution of feathers. New evidence of branched feathers in pterosaurs suggests that feathers originated in the avemetatarsalian ancestor of pterosaurs and dinosaurs in the Early Triassic, but the homology of these pterosaur structures with feathers is controversial.*

Reports of pterosaur feathers with homogeneous ovoid melanosome geometries suggest that they exhibited limited variation in colour, supporting hypotheses that early feathers functioned primarily in thermoregulation.

Here we report the presence of diverse melanosome geometries in the skin and simple and branched feathers of a tapejarid pterosaur from the Early Cretaceous found in Brazil.

The melanosomes form distinct populations in different feather types and the skin, a feature previously known only in theropod dinosaurs, including birds.

These tissue-specific melanosome geometries in pterosaurs indicate that manipulation of feather colour, and thus functions of feathers in visual communication, has deep evolutionary origins. These features show that genetic regulation of melanosome chemistry and shape was active early in feather evolution.

Feathers are remarkable integumentary innovations that are intimately linked to the evolutionary success of birds and occur in diverse non-avian dinosaurs from the Middle Jurassic onwards. The early evolutionary history of feathers, however, remains controversial as relevant fossils are rare.

Integumentary appendages in pterosaurs, traditionally termed pycnofibres, were recently reinterpreted as feathers on the basis of preserved branching but their homology with feathers is debated and their functions remain unclear.

The small size and lack of secondary branching in pterosaur feathers precludes functions in active flight, but their dense packing and distribution over the body are consistent with thermoregulation. This in turn is consonant with functional hypotheses for small, simple feathers in theropod dinosaurs.

Even simple unbranched feathers in theropods, however, functioned in visual signalling, as evidenced by melanosome-based colour patterning. Whether feathers in earlier-diverging taxa also functioned in patterning is unclear: feathers and filamentous integumentary structures in non-coelurosaurian dinosaurs and pterosaurs are rare and their taphonomy is difficult to interpret.

As a result, the timing and phylogenetic and ecological context of the evolution of melanin-based colour patterning in feathers is unknown. Resolution of this issue requires evidence of colour patterning, including spatial zonation of melanosomes, but this could be a taphonomic artefact.

More definitive evidence includes variation in the morphology of melanosomes, as this is linked to feather colour in extant birds. Previous observations of feather melanosomes in pterosaurs have revealed indiscriminate ovoid geometries.

These resemble melanosome geometries in the skin of extant reptiles (where visible colour is independent of melanosome geometry) and preserved melanosomes in the skin of fossil non-dinosaurian reptiles.

These data indicate that within Avemetatarsalia, the ability to vary melanosome geometry (and control the colour of integumentary appendages) is unique to theropods.

Variable melanosome geometries in extant mammals, however, suggest earlier origins for this feature in a common amniote ancestor and a secondary loss in pterosaurs. Here we resolve this issue using a new specimen of an adult tapejarid pterosaur from the Lower Cretaceous Crato Formation17 (Araripe Basin, Brazil).

The specimen comprises an incomplete cranium associated with preserved skin, monofilaments and branched integumentary structures. These integumentary tissues preserve melanosomes that show tissue-specific geometries, a feature previously known only from theropod dinosaurs, including extant birds.

Collectively, these results confirm that branched integumentary structures in pterosaurs are feathers and provide evidence that tissue-specific partitioning of melanosome geometry, critical for melanin-based plumage patterning, has deep evolutionary origins in ancestral avemetatarsalians in the Early to Middle Triassic.

[Image is from this paper. The feathers were on the bottom edge of the crest. The actual colours of the feather pigments are unknown, so the drawing is only in shades of grey, brown, and black.]

D'Anastasio, R., et al (2022) **Histological and chemical diagnosis of a combat lesion in *Triceratops*.** SCIENTIFIC REPORTS 12:doi.org/10.1038/s41598-022-08033-2 (available as a free pdf)

Authors' abstract: *In the collective imagination derived from scientific and popular literature, Triceratops often faced each other in combat. Thus, from the second half of the twentieth century, these ceratopsids were described as pugnacious animals. This arises primarily from the interpretation of extracranial fenestrae in ceratopsids being the result of combat trauma.*

However, the diagnosis of the traumatic nature of these anatomical variants of their neck frill requires evidence of bone healing and remodelling by microscopy analysis. Here, we present the case of the Triceratops horridus known as Big John, which is one of the largest specimens discovered in the Hell Creek Formation (Upper Cretaceous; MT, USA).

Its right squamosal bone shows an extrafenestra with irregular margins and signs of inflammation. Microscopy analysis revealed newly formed and healing bone, with histological signs typical of the bone remodelling phase.

Chemical analysis revealed sulphur that was derived from glycosaminoglycan's and sulphated glycoproteins of the preosseous osteoid substance present in the healing phases of a bone trauma.

Histological and microanalytical analyses confirm that the squamosal fenestra of Big John is the result of a traumatic event, which might indeed have occurred during combat with another Triceratops.

[Images are from this paper and show the wounds.]

Palaeobiology: The Tertiary Era, After The Asteroid.

Li, Z., et al (2022) **Early evolution of diurnal habits in owls (Aves, Strigiformes) documented by a new and exquisitely preserved Miocene owl fossil from China.** PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES USA 119:doi.org/10.1073/pnas.2119217119

[The Miocene was 23.0 to 5.33 megayears ago.]

Authors' abstract: *Owls, with their largely nocturnal habits, contrast strikingly with the vast majority of diurnal birds. A new spectacular late Miocene owl skeleton from China unexpectedly preserves the oldest evidence for daytime behavior in owls.*

The extinct owl is a member of the clade Surniini, which contains most living diurnal owl species. Analysis of the preserved eye bones documents them as consistent with diurnal birds, and phylogenetically constrained character mapping coincides with a reconstruction of an early evolutionary reversal away from nocturnal habits in this owl group.

These results support a potential Miocene origin of nonnocturnal habits in a globally distributed owl group, which may be linked to steppe habitat expansion and climatic cooling in the late Miocene.

Nocturnal owls exhibit adaptations thought to be evolutionarily associated with their diets, morphologies (sensory and flight), and diel activity patterns. However, that evolutionary history is not so simple, as demonstrated by an exquisitely preserved partial skeleton of an owl from the late Miocene of China that represents the first fossil evidence for diurnal behavior among owls.

The fossil from the high-elevation Liushu Formation preserves most of the skeleton including the scleral ossicles. Osteological features place the holotype specimen as a member of the strigid clade Surniini.

In contrast to the largely nocturnal owls, nonnocturnal (diurnal and crepuscular) species are concentrated within the Surniini as a likely evolutionary reversal in diel activity patterns.

Analyses of the preserved scleral ossicles in the fossil demonstrate that it exhibits a large exterior scleral ossicle ring diameter with a large orbital length, supporting the hypothesis that this extinct owl was largely diurnal in its habits.

Furthermore, stochastic character mapping, combined with Bayesian ancestral state reconstruction of the activity patterns of extant birds, demonstrates higher posterior probabilities of diurnal behavior among early diverging Surniini, and the addition of this extinct taxon into analyses enhances the hypothesis of this clade's diurnal origin.

The fossil and associated analyses of the eye and behavioral evolution point to a long evolutionary history of nonnocturnal behavior among owls that has yet to be studied in detail. This diurnal owl joins a growing Liushu avifauna that would have hunted small mammals in the savanna-like habitats adjacent to the rising Tibetan Plateau.

Cohen, A.S., et al (2022) **Plio-Pleistocene environmental variability in Africa and its implications for mammalian evolution.** PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES USA 119:doi.org/10.1073/pnas.2107393119

[The Pliocene era lasted from 5.33 to 2.58 megayears ago and the Pleistocene ice ages from 2.58 to 0.01 megayears ago. Humans began evolving during the late Pleistocene as a result of massive climate change.]

Authors' abstract: *We have developed an Africa-wide synthesis of paleoenvironmental variability over the Plio-Pleistocene. We show that there is strong evidence for orbital forcing of variability during this time that is superimposed on a longer trend of increasing environmental variability, supporting a combination of both low- and high-latitude drivers of variability.*

We combine these results with robust estimates of mammalian speciation and extinction rates and find that variability is not significantly correlated with these rates.

These findings do not currently support a link between environmental variability and turnover and thus fail to corroborate predictions derived from the variability selection hypothesis.

Understanding the climatic drivers of environmental variability (EV) during the Plio-Pleistocene and EV's influence on mammalian macroevolution are two outstanding foci of research in African paleoclimatology and evolutionary biology.

The potential effects of EV are especially relevant for testing the variability selection hypothesis, which predicts a positive relationship between EV and speciation and extinction rates in fossil mammals.

Addressing these questions is stymied, however, by
1) a lack of multiple comparable EV records of sufficient temporal resolution and duration, and
2) the incompleteness of the mammalian fossil record. Here, we first compile a composite history of Pan-African EV spanning the Plio-Pleistocene, which allows us to explore which climatic variables influenced EV.

We find that EV exhibits
1) a long-term trend of increasing variability since ~3.7 Ma, coincident with rising variability in global ice volume and sea surface temperatures around Africa, and
2) a 400-ky frequency correlated with seasonal insolation variability. We then estimate speciation and extinction rates for fossil mammals from eastern Africa using a method that accounts for sampling variation.

We find no statistically significant relationship between EV and estimated speciation or extinction rates across multiple spatial scales. These findings are inconsistent with the variability selection hypothesis as applied to macroevolutionary processes.

Botany.

Lam, E., and T.P. Michael (2022) ***Wolffia*, a minimalist plant and synthetic biology chassis.** TRENDS IN PLANT SCIENCE 27:doi.org/10.1016/j.tplants.2021.11.014 (available as a free pdf)

Authors' abstract: *Wolffia is the smallest of duckweeds, at 1 mm diameter, with reduced morphology, lacking roots as well as vasculature but retaining key anatomical features and core pathways found in other plants, making it a potential synthetic plant biology chassis.*

Wolffia australiana has a minimal gene set at about 15,000 that represents a nonredundant catalog of core plant proteins, which facilitates characterization of gene function and can provide opportunities to introduce new pathways.

Wolffia doubles in less than a day due in part to relaxed time-of-day gating of growth and, since it is an aquatic plant that is partially submerged, it enables more precise manipulation and speed for experiments.

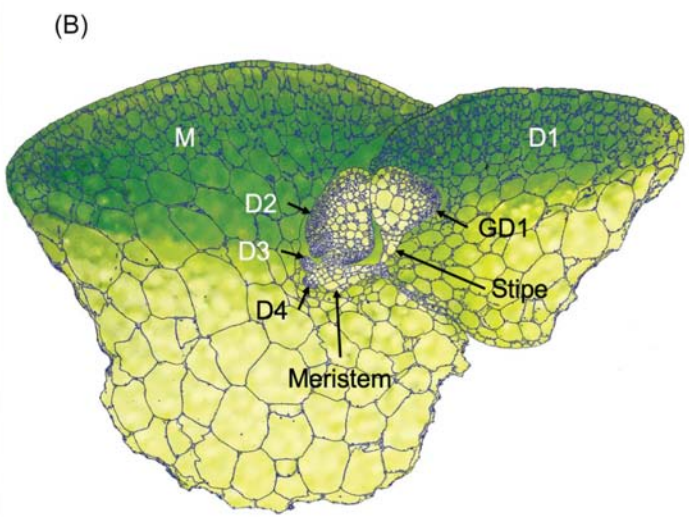
Wolffia has features that make it ideal for bottom-up and top-down plant genome engineering, which could usher in a detailed description of cellular function and facilitate synthetic plant construction.

A highly simplified species for genome engineering would facilitate rational design of a synthetic plant. A candidate species is the aquatic, non-grass monocot wolffia (Wolffia australiana) in the Lemnaceae family.

Commonly known as watermeal, wolffia is a rootless ball of several thousand cells the size of a pinhead and the fastest growing plant known on Earth. Its extreme morphological reduction is coupled to transposon-mediated streamlining of its transcriptome, which represents a core set of nonredundant protein coding genes.

Despite its body plan and transcriptome being highly specialized for continuous growth, wolffia retains cell types relevant to higher plants. Systems level studies with this species could enable the creation of a defined biological chassis for synthetic plant construction.

[Images on the next page are from this paper. Meristems are the growing points of plants from whence new growth arises. Stipes are somewhat like stems but have no veins. They are support structures in primitive plants but are not genuine stems.]



Lin, M.T., et al (2022) **Improving the efficiency of Rubisco by resurrecting its ancestors in the family Solanaceae.** SCIENCE ADVANCES 8:doi.org/10.1126/sciadv.abm6871 (available as a free pdf)

[The Solonaceae family includes the potato, tomato, and nightshade. Rubisco is the first step in post-photosynthesis metabolism whereby plants convert carbon dioxide into sugars. All plants use Rubisco as the first step in storing sugars.]

[The problem is that Rubisco then breaks down some of those sugars in a process known as photorespiration, thereby reducing the amount of food a plant produces.]

Authors' abstract: *Plants and photosynthetic organisms have a remarkably inefficient enzyme named Rubisco that fixes atmospheric CO_2 into organic compounds. Understanding how Rubisco has evolved in response to past climate change is important for attempts to adjust plants to future conditions.*

In this study, we developed a computational workflow to assemble de novo both large and small subunits of Rubisco enzymes from transcriptomics data. Next, we predicted sequences for ancestral Rubiscos of the (nightshade) family Solanaceae and characterized their kinetics after coexpressing them in Escherichia coli.

Predicted ancestors of C_3 Rubiscos were identified that have superior kinetics and excellent potential to help plants adapt to anthropogenic climate change. Our findings also advance understanding of the evolution of Rubisco's catalytic traits.

The catalytic mechanism of Rubisco first arose more than 2.5 billion years ago before the Great Oxidation Event at a time when there was no need to distinguish CO_2 from oxygen.

As the O_2 level rose, evolution resulted in an increase in Rubisco's specificity for CO_2, but the enzyme could no longer eliminate its oxygenase activity, which leads to a counterproductive process called photorespiration and lowers the photosynthetic efficiency.

In addition, Rubisco is a slow enzyme with a typical turnover number (kcat) of about 2 to 5 s^{-1} in terrestrial plants, necessitating investment of immense plant resources to produce Rubisco in abundance.

Since Rubisco is a major bottleneck in photosynthesis, understanding how its kinetics evolved in response to changing CO_2 and O_2 levels is crucial to improving its catalysis in crops

Suissa, J.S. (2022) **Fern fronds that move like pine cones: humidity-driven motion of fertile leaflets governs the timing of spore dispersal in a widespread fern species.** ANNALS OF BOTANY 129:doi.org/10.1093/aob/mcab137 (available as a free pdf)

Author's abstract: *The sensitive fern, Onoclea sensibilis, is a widespread species in eastern North America and has an atypical timing of spore dispersal among temperate ferns. During early summer, this dimorphic species produces heavily modified spore-bearing fronds with leaflets tightly enveloping their sporangia and spores.*

These fronds senesce and persist above ground as dead mature structures until the following early spring when the leaflets finally open and spores are dispersed. While this timing of spore dispersal has been observed for over 120 years, the structural mechanisms underpinning this phenology have remained elusive.

Based on field observations, growth chamber manipulations and scanning electron microscopy, the mechanisms underlying this distinctive timing of spore dispersal in the sensitive fern were investigated.

I show that fertile leaflets of the sensitive fern move in direct response to changes in humidity, exhibiting structural and functional parallels with multicellular hygromorphic structures in seed plants, such as pine cones.

These parallels include differences in cellulose microfibril orientation in cells on the abaxial and adaxial sides of the leaflet. The dynamics of this hygroscopic movement concomitant with regular abscission zones along the pinnules and coordinated senescence lead to the specific timing of early spring spore dispersal in the sensitive fern.

While hygroscopic movement is common in seed-free plants, it mostly occurs in small structures that are either one or a few cells in size, such as the leptosporangium. Given its multicellular structure and integration across many cells and tissues, the movement and construction of the sensitive fern pinnules are more similar to structures in seed plants.

The evolution of this complex trait in the sensitive fern efficiently regulates the timing of spore release, leading to early spring dispersal. This phenology likely gives gametophytes and subsequent sporophytes an advantage with early germination and growth.

Zoology.

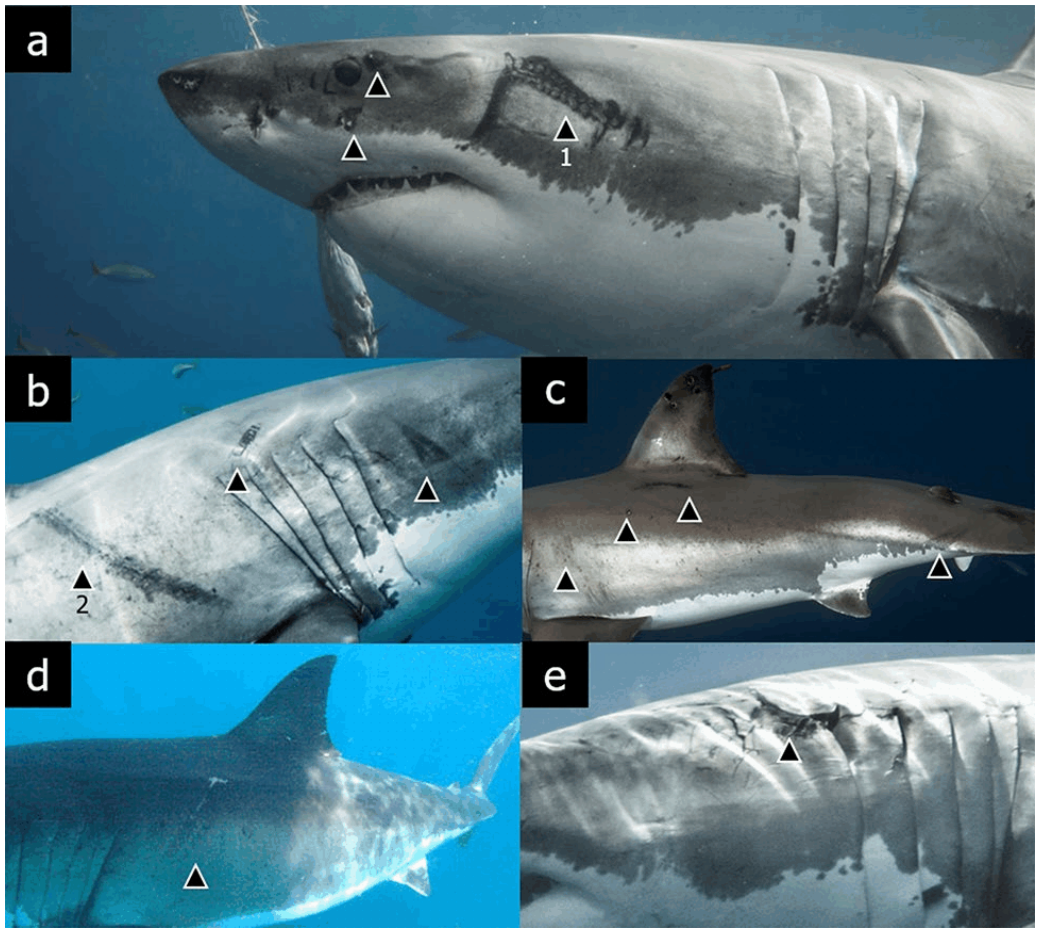
Becerril-García, E.E., et al (2022) **Evidence of interactions between white sharks and large squids in Guadalupe Island, Mexico.** SCIENTIFIC REPORTS 12:doi.org/10.1038/s41598-020-74294-4 (available as a free pdf)

Authors' abstract: *Shark-cephalopod interactions have been documented in trophic ecology studies around the world. However, there is little information about the encounters between white sharks Carcharodon carcharias and squids in the eastern North Pacific Ocean.*

Here we provide evidence of interactions between white sharks and large squids in the waters of Guadalupe Island, Mexico. Through the use of non-invasive techniques, we found the presence of evident scars made by large squids on the body of the white sharks, mainly on the head and trunk, of at least 14 sharks recorded during August to December in the years 2008, 2012, 2013, 2017 and 2019.

The mean length of the white sharks was 3.7 metres, although the majority of the sharks with scars were adult and subadult males. One of these males was photographically recaptured during the same season in which the individual showed new scars, confirming that the squid-white shark interaction likely occurs near Guadalupe Island.

Our results highlight the importance of the twilight zone for white sharks and the use of shared habitat and trophic interactions between squid and white sharks, in which future ecosystem studies should consider both species for management and conservation purposes.



The interactions between sharks and cephalopods are fundamental in coastal and oceanic ecosystems. Cephalopods can represent up to 98% of the diet biomass of species such as the blue shark Prionace glauca, the scalloped hammerhead Sphyrna lewini (68%), or the pelagic thresher Alopias pelagicus (69%), because they provide nutrients in terms of proteins, carbohydrates and fatty acids.

In some species such as the white shark Carcharodon carcharias, previous studies have suggested that cephalopods are an important component of their diet, since large amounts of squids have been found in their stomachs, and are reflected in the isotopic values of their muscle.

In the eastern North Pacific Ocean, the white sharks evidence migratory patterns that involve their presence in an oceanic zone known as the Shared Offshore Foraging Area (SOFA) from February through June, and in the waters surrounding Guadalupe Island from July to February, with some sharks moving to Hawaii, the coast of Baja California and the Gulf of California.

Although feeding is not documented, the vertical movements of white sharks in deep waters have been identified as potential foraging behaviour by diving at average depths of 442 to 498 metres in the SOFA7, and >300 metres in Guadalupe Island.

[Images are from this paper and show squid scars on sharks.]

Gulry, E.J., et al (2022) **Four millennia of long-term individual foraging site fidelity in a highly migratory marine predator.** COMMUNICATIONS BIOLOGY 5:doi.org/10.1038/s42003-022-03310-2 (available as a free pdf)

Authors' abstract: *Theory and field studies suggest that long-term individual foraging site fidelity (IFSF) may be an important adaptation to competition from increasing population. However, the driving mechanisms and extent of long-term IFSF in wild populations of long-lived, migratory animals has been logistically difficult to study, with only a few confirmed instances.*

Temporal isotopic datasets can reveal long-term patterns in geographical foraging behaviour. We investigate the isotopic compositions of endangered short-tailed albatross (Phoebastria albatrus) over four millennia leading up to their near-extinction.

Although not exhibited by short-tailed albatross today, we show past sub-populations displayed a high-degree of long-term IFSF, focusing on the same locations for hundreds of generations.

This is the first large-scale evidence for the deep antiquity of long-term IFSF and suggests that it's density-driven. Globally, as populations of species like short-tailed albatross continue to recover from overexploitation, potential for resurgence of geographic specialization may increase exposure to localized hazards, requiring closer conservation monitoring.

The short-tailed albatross (Phoebastria albatrus), a large North Pacific seabird, is currently undergoing a population recovery. Once numbering in the millions, the species was brought to the brink of extinction by feather hunters between the 1880s and 1930s, which left no functioning breeding colonies intact.

While still classified as Vulnerable by the IUCN5 and Japan, Threatened by Canada, and Endangered by the United States, careful conservation efforts aimed at monitoring and protecting these birds both at breeding colonies and across much of their foraging range have resulted in exponential population growth over recent decades.

Despite these gains, the species remains at less than 1% of its pre-collapse population levels and continued progress will be dependent, in part, on our ability to anticipate evolving relationships between potential threats (e.g., fisheries by-catch) and behavioural patterns of short-tailed albatross that may be shifting in response to population growth.

Saito, R., et al (2022) **Monitoring of radioactive cesium in wild boars captured inside the difficult-to-return zone in Fukushima Prefecture over a 5-year period.** SCIENTIFIC REPORTS 12:doi.org/10.1038/s41598-022-08444-1 (available as a free pdf)

Authors' abstract: *Following the Fukushima Daiichi Nuclear Power Plant accident in 2011, tissue samples from wild boar (Sus scrofa) outside the evacuation zone (difficult-to-return zone, DRZ) tended to show high activity concentrations of cesium-137 (^{137}Cs).*

Understanding the ^{137}Cs dynamics of wild boar populations inside the DRZ is necessary because they affect ^{137}Cs dynamics and wild boar management in areas outside the DRZ.

Since few detailed, long-term studies have been conducted inside the DRZ, we measured ^{137}Cs activity concentrations in 221 wild boar muscle samples obtained from wild boar caught inside the DRZ and surrounding areas over a 5-year period.

Our results showed that the ^{137}Cs activity concentration in wild boar from inside the DRZ were higher than those in wild boar outside this zone. No significant difference was observed between muscle and soil ^{137}Cs levels, but significant correlations were observed between muscle ^{137}Cs activity concentrations and body length and body weight in the low-activity-concentration season, but not between all seasons and the high activity-concentration seasons.

It is considered that the size effects observed during the low-activity concentration season may be due to factors related to metabolism and changes in food habit. This is the first long-term survey of ^{137}Cs in wild boar inside the DRZ.

Human Prehistory.

Timmermann, A., et al (2022) **Climate effects on archaic human habitats and species successions.** NATURE 604:doi.org/10.1038/s41586-022-04600-9 (available as a free pdf)

Authors' abstract: *It has long been believed that climate shifts during the last 2 million years had a pivotal role in the evolution of our genus Homo.*

However, given the limited number of representative palaeo-climate datasets from regions of anthropological interest, it has remained challenging to quantify this linkage.

Here, we use an unprecedented transient Pleistocene coupled general circulation model simulation in combination with an extensive compilation of fossil and archaeological records to study the spatiotemporal habitat suitability for five hominin species over the past 2 million years.

We show that astronomically forced changes in temperature, rainfall and terrestrial net primary production had a major impact on the observed distributions of these species. During the Early Pleistocene, hominins settled primarily in environments with weak orbital-scale climate variability.

This behaviour changed substantially after the mid-Pleistocene transition, when archaic humans became global wanderers who adapted to a wide range of spatial climatic gradients.

Analysis of the simulated hominin habitat overlap from approximately 300 to 400 thousand years ago further suggests that antiphased climate disruptions in southern Africa and Eurasia contributed to the evolutionary transformation of Homo heidelbergensis populations into Homo sapiens and Neanderthals, respectively.

During the past 5 million years (Ma), a gradual transition in climate conditions has occurred from the warmer and wetter Pliocene (5.3 to 2.6 Ma) to the colder and drier Pleistocene (2.6 to 0.011 Ma).

During this time, tropical savannahs and open grasslands expanded in central-eastern Africa, which, according to the savannah hypothesis and variants thereof, contributed to the early evolution of our human ancestors.

Milankovitch cycles in solar insolation and climate, particularly the eccentricity-modulated precessional cycle, further created multiple human migration corridors from sub-Saharan Africa into northern Africa, the Arabian Peninsula and Eurasia. The existence of these corridors is well supported by fossil, archaeological and genetic evidence.

A possible effect of astronomical forcings on early hominin evolution has been suggested in the context of the variability selection hypothesis, which posits that early hominin evolution, selection and speciation were influenced by alternating periods of high and low variability in climate and resources.

Redwood, S.D., et al (2022) **Submarine volcanic activity and giant amygdale formation along the Panama island arc as a precursor to 6,000-year-old agate exploitation on Pedro González Island.** GEOLOGICAL MAGAZINE 159:doi.org/10.1017/S0016756821001229

Authors' abstract: *An extensive deposit of agate occurs in Pedro González Island in the Gulf of Panama. Previous archaeological research showed that the agate was exploited between 6,200 and 5,600 cal BP to make stone tools found at the oldest known Preceramic human settlement in the Pearl Island archipelago.*

We constrain here the origin and geological context of the agate through a geological and geochemical study of the island. We show that it includes primary volcanic breccias, lavas, and tuffaceous marine deposits with sedimentary conglomerates and debris flow deposits, which we define as the Pedro González Formation.

This formation records submarine to subaerial volcanic activity along an island arc during the Oligo-Miocene, confirming previous regional models that favour progressive emergence of the isthmus in the early Miocene. The igneous rocks have an extreme tholeiitic character that is interpreted to reflect magmatic cessation in eastern Panama during the early Miocene.

The agate is hosted in andesitic lavas in unusually large amygdales up to 20 to 40 cm in diameter, as well as small amygdales (0.1 to 1.0 cm) in a bimodal distribution, and in veins. The large size of the agates made them suitable for tool manufacture.

Field evidence suggests that the formation of large amygdales resulted from subaqueous lava-sediment interaction, in which water released from unconsolidated tuffaceous deposits at the base of lava flows rose through the lavas, coalesced, and accumulated below the chilled lava top, with subsequent hydrothermal mineralization. These amygdales could therefore be regarded as an unusual result of combined peperitic and hydrothermal processes.

Salazar, D., et al (2022) **Did a 3,800-year-old Mw ~9.5 earthquake trigger major social disruption in the Atacama Desert?** SCIENCE ADVANCES 8:doi.org/10.1126/sciadv.abm2996 (available as a free pdf)

Authors' abstract: *Early inhabitants along the hyperarid coastal Atacama Desert in northern Chile developed resilience strategies over 12,000 years, allowing these communities to effectively adapt to this extreme environment, including the impact of giant earthquakes and tsunamis.*

Here, we provide geoarchaeological evidence revealing a major tsunamigenic earthquake that severely affected prehistoric hunter-gatherer-fisher communities ~3,800 years ago, causing an exceptional social disruption reflected in contemporary changes in archaeological sites and triggering resilient strategies along these coasts.

Together with tsunami modeling results, we suggest that this event resulted from a ~1000-km-long megathrust rupture along the subduction contact of the Nazca and South American plates, highlighting the possibility of Mw ~9.5 tsunamigenic earthquakes in northern Chile, one of the major seismic gaps of the planet.

This emphasizes the necessity to account for long temporal scales to better understand the variability, social effects, and human responses favoring resilience to socionatural disasters.

Barrett, J.H., et al (2022) **Walruses on the Dnieper: new evidence for the intercontinental trade of Greenlandic ivory in the Middle Ages.** PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON 289B:doi.org/10.1098/rspb.2021.2773 (available as a free pdf)

Authors' abstract: *Mediaeval walrus hunting in Iceland and Greenland, driven by Western European demand for ivory and walrus hide ropes, has been identified as an important pre-modern example of ecological globalization.*

By contrast, the main origin of walrus ivory destined for eastern European markets, and then onward trade to Asia, is assumed to have been Arctic Russia.

Here, we investigate the geographical origin of nine twelfth-century CE walrus specimens discovered in Kyiv, Ukraine, combining archaeological typology

(based on chaîne opératoire assessment), ancient DNA (aDNA) and stable isotope analysis.

We show that five of seven specimens tested using aDNA can be genetically assigned to a western Greenland origin. Moreover, six of the Kyiv rostra had been sculpted in away typical of Greenlandic imports to Western Europe, and seven are tentatively consistent with a Greenland origin based on stable isotope analysis.

Our results suggest that demand for the products of Norse Greenland's walrus hunt stretched not only to Western Europe but included Ukraine and, by implication given linked trade routes, also Russia, Byzantium and Asia.

These observations illuminate the surprising scale of mediaeval ecological globalization and help explain the pressure this process exerted on distant wildlife populations and those who harvested them.

Modern Humans.

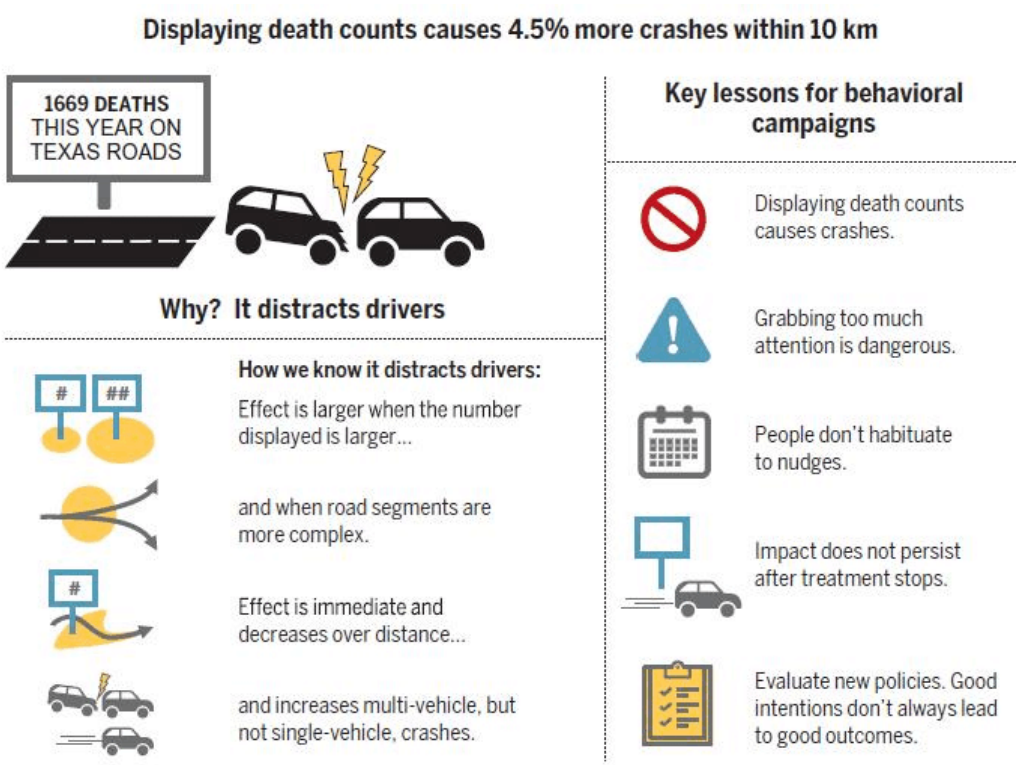
Hall, J.D., and J.M. Madsen (2022) **Can behavioral interventions be too salient? Evidence from traffic safety messages.** SCIENCE 376:doi.org/10.1126/science.abm3427 (available as a free pdf)

Authors' abstract: *Although behavioral interventions are designed to seize attention, little consideration has been given to the costs of doing so. We estimated these costs in the context of a safety campaign that, to encourage safe driving, displays traffic fatality counts on highway dynamic message signs for 1 week each month.*

We found that crashes increase statewide during campaign weeks, which is inconsistent with any benefits. Furthermore, these effects do not persist beyond campaign weeks.

Our results show that behavioral interventions, particularly negatively framed ones, can be too salient, crowding out more important considerations and causing interventions to backfire, with costly consequences.

We estimated these costs in the context of a widespread, seemingly innocuous behavioral campaign with the stated objective of reducing traffic crashes.



A traffic safety campaign that leads to more crashes.

This campaign displays the year-to-date number of statewide roadside fatalities (fatality messages) on previously installed highway dynamic message signs (DMSs) and has been implemented in 28 US states.

We estimated the impact of displaying fatality messages using data from Texas. Texas provides an ideal setting because the Texas Department of Transportation (TxDOT) decided to show fatality messages starting in August 2012 for 1 week each month: the week before TxDOT's monthly board meeting (campaign weeks).

This allows us to measure the impact of the intervention, holding fixed the road segment, year, month, day of week, and time of day. We used data on 880 DMSs and all crashes occurring in Texas between 1 January 2010 and 31 December 2017 to investigate the effects of this safety campaign.

Contrary to policy-makers' expectations, we found that displaying fatality messages increases the number of traffic crashes. Campaign weeks realize a

1.52% increase in crashes within 5 km of DMSs, slightly diminishing to a 1.35% increase over the 10 km after DMSs.

[Images are from this paper.]

Coutrot, A., et al (2022) **Entropy of city street networks linked to future spatial navigation ability.** NATURE 604:104-110

Authors' abstract: *The cultural and geographical properties of the environment have been shown to deeply influence cognition and mental health. Living near green spaces has been found to be strongly beneficial, and urban residence has been associated with a higher risk of some psychiatric disorders, although some studies suggest that dense socioeconomic networks found in larger cities provide a buffer against depression.*

However, how the environment in which one grew up affects later cognitive abilities remains poorly understood. Here we used a cognitive task embedded in a video game to measure non-verbal spatial navigation ability in 397,162 people from 38 countries across the world. Overall, we found that people who grew up outside cities were better at navigation.

More specifically, people were better at navigating in environments that were topologically similar to where they grew up. Growing up in cities with a low street network entropy (for example, Chicago) led to better results at video game levels with a regular layout, whereas growing up outside cities or in cities with a higher street network entropy (for example, Prague) led to better results at more entropic video game levels.

This provides evidence of the effect of the environment on human cognition on a global scale, and highlights the importance of urban design in human cognition and brain function.

Speirs: I question these results. I'm a farm boy but on the Canadian prairies the roads are almost entirely grid roads because the land was surveyed into square sections. My ability to navigate the twisting illogical street system of Calgary's suburbs doesn't seem to be impaired.

Wessel, Jan (2022) **Cycling in the dark: the impact of Standard Time and Daylight Saving Time on bicycle ridership.** PNAS NEXUS 1:doi.org/10.1093/pnasnexus/pgab006 (available as a free pdf)

Authors' abstract: *Cycling impacts positively on people's health, and entails benefits for both society and environment. Increasing the number of cyclists is, therefore, considered an important means of promoting more sustainable mobility.*

We find that bicycle use is significantly affected by the level of daylight and twilight. This has important consequences for the debate on abolishing the bi-annual clock change, which was decided in the EU in 2018, but has not yet been implemented.

Using German data, we show that an all-year Daylight Saving Time would lead to higher levels of cycling than an all-year Standard Time, or the current time regime with a bi-annual clock change. We also provide lower-bound estimates for the economic consequences of implementing all-year time regimes.

Against this backdrop, we analyze how daylight and twilight affect the sustainable transport mode of cycling, and find that better daylight conditions generally lead to higher levels of cycling.

The extent of this effect depends on the type of traffic and the time of day. An all-year implementation of Daylight Saving Time would then lead to an increase in overall cycling levels of around 3.14 % to 3.37 %, compared to an all-year Standard Time. This would imply an increase of around 1.27 to 1.36 billion cycled kilometers per year in Germany alone. Additionally, we provide monetary estimates for the external effects of such changes in cycling levels.

Bottalico, P., et al (2022) **Lombard effect, intelligibility, ambient noise, and willingness to spend time and money in a restaurant amongst older adults.** SCIENTIFIC REPORTS 12:doi.org/10.1038/s41598-022-10414-6 (available as a free pdf)

Authors' abstract: *Dining establishments are an essential part of the social experience. However, they are often characterized by high levels of background noise, which represents a barrier to effective communication. This particularly affects people suffering from hearing problems.*

Moreover, noise level exceeding normal conversational levels causes a phenomenon called the Lombard Effect, an involuntary tendency to increase the amount of vocal effort when talking in the presence of noise. Adults over 60 years represent the second largest population in the US and the majority of them suffer from some degree of hearing loss.

The primary aim of the current study was to understand the effect of noise on vocal effort and speech intelligibility in a restaurant setting for adults over 60 years old with and without hearing loss. The secondary aim was to evaluate their perception of disturbance in communication and their willingness to spend time and money in a restaurant was affected by the varying levels of background noise.

The results of this study showed background noise levels lower than 50 dB(A) will allow senior customers to minimize their vocal effort and to maximize their understanding of conversations, even for those with moderate to severe hearing loss. By setting a limit, it will also keep perceived disturbance low and willingness to spend time and money high among dining patrons.

Beyond the basic purpose of restaurants to provide food and drink, restaurants have, historically, fulfilled a human need for connection and shaped social relations. However, restaurants are often characterized by high level of background noise that negatively affect the communication.

Before the 1990's, "excessive" restaurant noise was not negatively perceived by diners and critics because it was supposed to add to the atmosphere of the eating establishment.

A restaurant's atmosphere is vital to keeping and enticing new patrons, which can cause the diners to increase their overall bill at a restaurant. However, depending on the age group, several individuals might recall the noisy environment more than the food.

This is especially problematic for patrons aged 60 and older suffering from hearing loss, as background noise interferes with the comprehension of conversations.

In recent years, there has been increased awareness towards the acoustics of eating establishments with the goal of improving speech intelligibility. Restaurants are designed to look aesthetically pleasing and modernized, which often is portrayed with a lack of materials used to absorb sound. The lack of these materials tends to increase the overall noise level in the restaurant which has caused diners, critics, audiologists and researchers to take notice.

In 2018, a repeated restaurant survey revealed noise was the primary complaint of restaurant patrons. Restaurants have a wide range of noise during hours of operation, which has caused restaurant critics to carry sound level meters to evaluate the noise levels to include in their reports.

Typical restaurant noise can fluctuate throughout the course of an evening ranging from 65 dB(A) up to as high as 85 dB(A). This causes increased difficulty to be heard and understood by anyone.

The main source of noise in a restaurant is caused by the patrons, as a consequence several researches suggested that dining establishments should no longer be thought to have "maximum capacity" but rather "acoustical capacity".

Speirs: Not just the old fogeys either. Even as a young man there were certain establishments I would never enter a second time because the noise was so loud I couldn't hear myself think.

Simchon, A., et al (2022) **Troll and divide: the language of online polarization.** PNAS NEXUS 1:doi.org/10.1093/pnasnexus/pgac019 (available as a free pdf)

Authors' abstract: *We argue that trolls (including foreign actors) use social media to sow discord among Americans through political polarization.*

We developed and validated an open-source linguistic tool to gauge polarized discourse on social media and found that three distinct troll populations, which hold anti-American views, used polarized language more than the average American user.

The affective animosity between the political left and right has grown steadily in many countries over the past few years, posing a threat to democratic practices and public health. There is a rising concern over the role that "bad actors" or trolls may play in the polarization of online networks.

In this research, we examined the processes by which trolls may sow inter-group conflict through polarized rhetoric. We developed a dictionary to assess online polarization by measuring language associated with communications that display partisan bias in their diffusion. We validated the polarized language dictionary in four different contexts and across multiple time periods.

The polarization dictionary made out-of-set predictions, generalized to both new political contexts (#BlackLivesMatter) and a different social media platform (Reddit), and predicted partisan differences in public opinion polls about COVID-19. Then we analyzed tweets from a known Russian troll source (N = 383,510) and found that their use of polarized language has increased over time.

We also compared troll tweets from three countries (N = 79,833) and found that they all utilize more polarized language than regular Americans (N = 1,507,300) and trolls have increased their use of polarized rhetoric over time.

We also find that polarized language is associated with greater engagement, but this association only holds for politically engaged users (both trolls and regular users).

THE TURF WILL ABIDE
photo by Dale Speirs

The display below was in the TD Square atrium in downtown Calgary for Earth Day on April 22. The impact was somewhat lessened by the fact that the sign and the floor covering were artificial turf made of plastics.