

OPUNTIA 389

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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.

ROCKY MOUNTAIN WAY: SMOKE ON THE WATER

photos by Dale Speirs

After the Calgary Stampede rodeo ended, I was all set to do some more mountain hiking. Unfortunately, almost to the day the Stampede ended, forest fires began burning in southeastern British Columbia. In the summer, the prevailing winds are out of the west, which caused the mountain parks and southern Alberta, including Calgary, to become as smoky as Beijing.

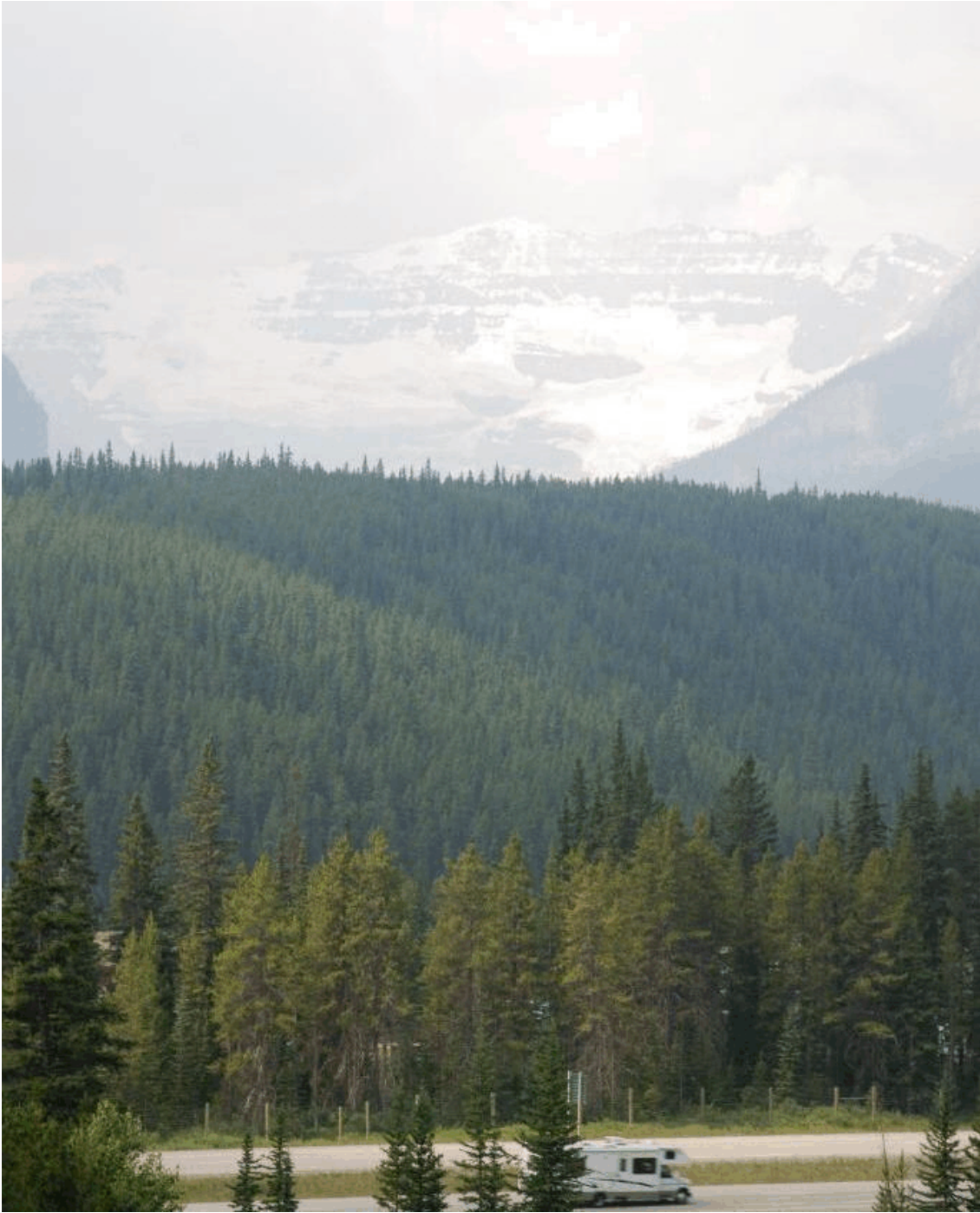
Quite often the Sun appeared a bright red during the day when high up in the sky. Not the fuzzy deep orange of typical sunsets, but more like the red of stained glass. The photo at right was taken in Calgary in the middle of the day.

The weather forecast for July 19 was an easterly wind, which meant that the smoke would blow back into British Columbia where it belonged. I thought I'd take a chance and try a mountain hike near Banff. Alas, the wind shifted to southwest by the time I drove there. The outlines of the mountains were visible only in hazy silhouette, so that scratched that.

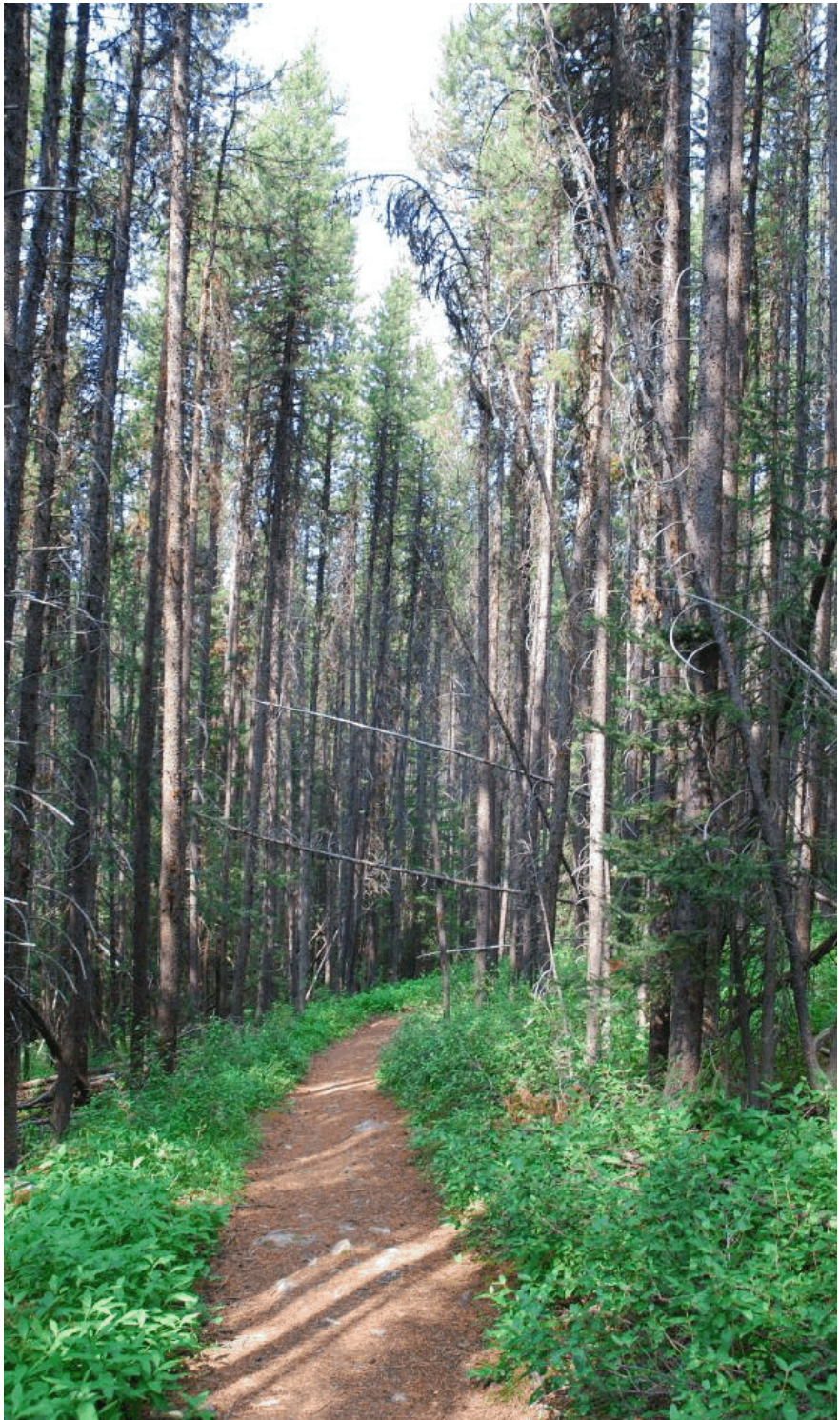
I had a back-up plan though. Mud Lake is on the opposite side of the Bow River valley from Lake Louise. The latter gets a million visitors per year, while Mud Lake is an obscure trail through spruce forest, with no scenic views. I discovered it by chance several years ago while looking at a topographical map. The hike was boring but I noted a profusion of wildflowers, so I decided to give it a second try this time around.



The view below is looking west from the Mud Lake trailhead. The Trans-Canada Highway is in the foreground, and Lake Louise is on the other side of the spruce-covered ridge. Mount Victoria, at the west end of the lake, is obscured by the smoke. For a comparison on a clear day, see OPUNTIA #376.



Going up the trail to Mud Lake. If you've seen one spruce tree, then you've seen them all.



Scenic views, if you'll pardon the expression, of Mud Lake. Technically it is a pond, since it is fed by overland drainage and rising groundwater. A lake is fed by a stream or river.

The notch in the far distance is the outlet, where Mud Creek begins.



You can see how Mud Lake got its name.



It is, however, a nice place for wildflowers. Below is *Heracleum lanatum*, with giant leaves the size of umbrellas.



Arnica cordifolia



Below: *Aster pansus* (white flowers), *Heterotheca villosa* (yellow flowers)



Epilobium angustifolium



Castilleja miniata



Left: A rare orchid, *Habenaria dilatata*



Cornus canadensis (white flowers), *Aquilegia flavescens* (pastel yellow flowers)



MATTHEW 24:6: PART 1

by Dale Speirs

Conspiracy theory and end-of-the-world prophecy are great fun for many people because the facts are not allowed to get in the way of a good story. For some, it is their life, because they have nothing else. I have always considered conspiracy theory to be a branch of abnormal psychology.

Having said that, Doomsday does make a popular subject for movies and novels. This column looks at the wilder End Times, not asteroids or earthquakes but the over-the-top versions that bring in Stonehenge, solar flares, or the Book of Revelation.

The Light Of The Sun Shall Be Sevenfold.

SUPERNOVA is a title used by several movies. The first one that I review herewith is a 2005 release by Silverstar Ltd, written by Steven H. Berman, and starring Peter Fonda.

The movie opens with a prologue set several megayears ago, according to the subtitles, when a distant supernova blows its planets into 8-bit CGI fragments. One of them, a one-quarter chunk of a planet, sets off on a journey that ends when it plunges into our Sun in the present day.

That apparently set the stage for massive solar flares. Contrary to the movie title, the Sun cannot go supernova. The minimum mass required for any type of supernova is 1.44 solar masses. Everyone in the movie keeps referring to supernovas, but all that ever happens is solar flares.

The astronomer Dr. Austin Shepard is the first to discover the problem. Like all Hollywood movies, he does his calculations on computers that have clickety-clack keyboards, instead of silent keys like the rest of the world. His computer screen shows assorted integral equations and Fourier transforms that have nothing to do with supernovas. Shepard decides to suppress his discovery, and hides on a tropical island to await Doomsday.

The island is said to be Maldives, which are an archipelago of low-lying atolls not more than 2 metres above sea level. However, the background shows soaring volcanic mountains. Shepard spends his time sitting at the bar getting drunk and flirting with the barmaid.

Irresponsible, but it doesn't matter because there are other astronomers on our planet, who also have clickety-clack computers and integral equations. The Men In Black (and one woman, also in black) are already on the case, desperately trying to develop a plan to save civilization. Kudos to them, usually portrayed as bad guys, and boo-hiss to Shepard, the ostensible good guy.

The geography of this movie is horrible. It is supposedly set in Australia, but only two or three characters have the Strine accent. The background population alternates for no reason between whites with American and British accents, and blacks with South African accents. Sydney, Australia, is regularly depicted without its famous bridge but with a flat-topped mountain that is obviously Table Mountain beside the city of Capetown, South Africa.

The first solar flare hits Earth. In keeping with time-honoured tradition, it aims for a well-known landmark, in this case the Eiffel Tower. This fits in with my belief that if you hear on the news that a disaster is imminent, head for an obscure village where nothing ever happens. For western Canadians, I recommend my birthplace of Eckville, Alberta, a rural village that is the same today as it was when I was born there in 1955. Americans should try for Ten Sleep, Wyoming, and the British could run for Calgary Bay, Scotland, a hamlet on the Isle of Mull after which the Canadian city was named. Whatever you do, don't go near the Statue of Liberty or the Big Ben clock tower. That's just asking for it.

There is a completely unnecessary subplot about an escaped convict taking a woman and her daughter hostage. He was being transported in a prison van when it was taken out by a solar flare, the second one, which for unknown reasons avoided any landmarks. The SFX clearly show the flare plunging down into central Africa, but the prisoner manages to get to Australia the next day by road to terrorize his victims. Fast-forward through this subplot since it contributes nothing to the story.

Meanwhile an Australian television reporter is chronicling the End Times. She interviews people in the know in order to expose the full extent of the coming disaster, all the better to spread panic and trigger riots. Airplanes crash around the world as their electronics are taken out by electromagnetic pulses. Telecommunications fade and blank out from static. Scientists gather to deal with the situation, but no one seems to be verifying Shepard's equations. The military and politicians begin populating deep underground shelters that can hold ten thousand people, yet the construction of which was kept secret.

The next flare scores a direct hit on the Gateway Arch in Saint Louis, Missouri. Unaccountably, it leaves the sports stadium intact. Meteorites begin hammering the planet everywhere. Where did they come from? Solar flares are pure energy, not big ugly rocks.

The meteorites do serve one important function. One of them scores a direct hit on the beachfront cabin in the Maldives where Shepard was sitting with his girlfriend, gazing out to sea and watching all the bolides pass overhead out over the ocean. The SFX that shows the hit on the cabin is of a meteorite traveling inland, the opposite direction from all the others. It destroys the cabin but leaves the surrounding jungle vegetation intact.

The third flare hits the Sahara Desert and vitrifies the sand, but the fourth one sticks to the script and takes out the Taj Mahal. Sydney, Australia, the real one this time, is showered by a cluster of meteorites, which riddle the skyscrapers but leave the Opera House and its bridge alone.

As the entire planet is pockmarked by bolides, one scientist remarks: “*At this point, a supernova is almost academic.*” Since he should know better, namely that the Sun can’t supernova, one wonders about him.

Better qualified scientists begin going through Shepard’s calculations, as they should have done earlier. It is too late to ask Shepard why he didn’t post a preprint online for peer review. This matters because it turns out that Shepard made a mistake. One of his equations has an exponent with a plus sign instead of a minus sign. All the difference in the world.

How much difference? As soon as the mistake is discovered, the flares and meteorites dissipate. Sure, there is still a lot of search and recovery work to be done, but those are details. The subplot with the escaped prisoner takes up most of the epilogue but it can safely be fast-forwarded over.

A movie worth viewing once for the SFX, which are reasonably good, as long as you keep your finger on the fast-forward button. If you’re an Australian, take your blood pressure pills before watching the scenic views of Capetown qua Sydney.

2012: SUPERNOVA is a 2009 movie written by Jonathan Macy. The opening scene shows a supernova 200 years ago, that is, 200 light years away, going off in a spray of fireworks pyrotechnics. I don’t mean that figuratively; the SFX

actually were Roman candles and chrysanthemum bursts. That sets the pace for the rest of the movie.

Flash forward to today, as a wave of energy vapourizes an Earth-orbiting satellite, again with fireworks pyrotechnics. Apparently the wave was the harbinger of the main supernova blast. At 200 light years away, all the supernova should do at most is cause some spectacular auroras at Earth’s poles, mess with cellphone reception, and possibly give some humans a bad sunburn. But of course then there would be no movie.

Next up is a shower of meteorites zapping skyscrapers. That is a mystery, since a supernova would have nothing to do with meteors. Earthquakes shake the planet, which makes even less sense because supernova radiation would not affect tectonic plates. Tornados sweep the California deserts, without a J-hook storm anywhere. The SFX do help the idiot subplots, mostly involving the hero’s wife and daughter. There are bad guys chasing the hero for some unknown reason, and someone is trying to sabotage the project from within.

It has been determined that the supernova is sending a burst of gamma rays that will sterilize Earth. The hero has a plan, involving the nukes of the USA, Russia, and China being deployed just inside the magnetosphere to boost it enough to deflect the gamma ray burst. Several space shuttles are needed to deploy the bombs, but one of them is taken out by a harbinger wave, so the plans have to be recalculated.

The shuttle SFX are sloppily edited. The interior shots of the shuttle show it in low Earth orbit, judged by the view out the window, with a normal horizon. The view never changes in any of the shuttle shots, and is obviously a NASA stock photo pasted behind the window. The exterior shots show the shuttle still in the atmosphere, in the upside-down phase of its boost.

As the subplots unfold, helped along by money-saving shots of characters explaining the plot to each other over cellphones, there are additional SFX of the supernova wave entering the Solar System. It shatters Pluto into low-resolution computer-rendered fragments, then the moons of Jupiter, and sweeps away the rings of Saturn.

The plan works with zero seconds to spare, and the nukes detonate high up in space. The hero’s wife and daughter watch from the desert where an errant tornado has stranded them. The nukes produce a booming sound in the

atmosphere, notwithstanding the fact that sound does not travel in a vacuum. That's all right though, as it means a happy ending. Earth is saved, and off we go to the end credits, listing all the Z-list actors who participated in this straight-to-video effort.

SUPERNOVA is a 2000 movie written by David Campbell Wilson according to the credits, but rewritten by so many others that it turned into a flop. The plot begins with a medical ship answering a distress call 3,000 light years away via a hyperspace jump. They arrive at Titan 37, orbiting a blue giant star. It is referred to as a moon but is a planet from the long views of it.

The ship arrives in a debris cloud and is badly damaged. It will be pulled into the blue giant unless its drive units can be recharged in time. The computer says there will be 11 minutes to spare. Not to worry then. Meanwhile, something has happened on Titan 37, and only one survivor exists. He comes on board, carrying with him an alien artifact he discovered.

The artifact has magical powers to regenerate humans and make them young again. The ship's computer says it operates in 9 dimensions, which seems strange because quantum theory specifies 11 dimensions. It transpires that the device is a bomb planted by unknown aliens as a honeypot.

Any advanced civilization finding it will naturally take it home for study, at which point the bomb, made of pure energy, flies off into the home star and detonates it as a supernova. This will eliminate the competition for galactic rule. We never see the aliens, just their lethal calling card.

Many alarms and excursions later, only two crew members survive. They dump the bomb into the blue giant and scam, just as the star goes supernova. All is well except for the mention that the supernova shock wave will reach Earth in 51 years. That tells us the distance of the blue giant. It might have been good for a sequel except the movie lost huge amounts of money.

KNOWING is a 2009 movie written by Ryne Douglas Pearson. It is about John Koestler, who deciphers a coded message which is a list of disasters that have or will hit Earth. No details on what the disaster is, just the date, time, latitude, and longitude.

While trying to decode the list, Koestler inadvertently discovers the list's purpose when he happens to be on the exact spot a disaster occurs. A passenger

jet clips power lines and cartwheels into a field. (And well done with excellent SFX and live-action staging.) It wasn't the only one at the time, as several other jets across the country crashed, all of them when something fried their avionics.

There are two disasters left on the list. Koestler meets up with the daughter of the woman who wrote the message. Her daughter and his son both hear ghostly voices, so something is up.

Koestler goes hunting for the second-last disaster, which turns out to be a subway train crash in Manhattan, again a spectacular SFX. He got too close to the action and barely survived it. The co-ordinates of the last disaster are a cabin in the woods where the prophet woman lived. It is there that he finds out the reason why the list stops; it is the end of the world.

Solar flares are annoying the planet, and it becomes obvious what the final disaster will be. In the midst of this, aliens arrive in mother ships and begin taking children and assorted animals for their Noah's ark.

With one day to go, the American government announces that a giant flare will hit Earth. Somehow they knew about it; perhaps the aliens told them. They have their own deep bunkers, and who knows if other governments were informed, much less how did they keep it a secret. The population is told to seek shelter in basements or subway tunnels. Useless, but it prevents mass panic if people think they can survive the superflare.

Koestler and his family, minus his son who was taken by the aliens, wait for The End and have a group hug. The solar flares build up one by one until the final one arrives. A satellite view of the superflare sweeping north up the length of Manhattan is shown, which is puzzling because the superflare in space is moving east to west. Everyone dies, even those in Eckville, Ten Sleep, and Calgary Bay.

END OF THE WORLD: NOTHING CAN STOP IT is a 2013 movie written by Jason Bourque and Sydney Roper. The heroes are video store operators. They watched so many disaster movies that they have become experts on what to do in case of the End Times. The video store includes a survival bunker in the back room and a huge rack of canned Spam meat.

Now the end of the world begins. In the movie, this means blobs of energy that look and hit like meteors except they don't leave craters, only circular burn

marks. They vapourize anyone they hit and melt engine blocks in automobiles. Except the van owned by nerds who put tinfoil around the engine. A Faraday cage, I suppose, but they are shown just wrapping parts of the engine, whereas a Faraday cage has to completely surround it to work.

The bolides take out anyone who is more than five steps behind the lead characters. The lead actors always manage to thread the minefields while the supporting players and extras are carbonized.

Motor vehicles that still operate become targets for gangs. Following the tradition of these movies, the crowd extras in the north flee to the south, and those in the south run for the north. Lots of idiot subplots, including the lead characters. Several characters stand about whimpering, while the lead actor screams at them to move. He is very angry and annoyed throughout the movie, and I don't blame him. Natural selection will weed out many of the supporting characters, who fortunately have not yet had children to pollute the gene pool.

The gist of the problem is eventually explained. An interstellar wave of ionized energy is collapsing the heliosphere in on itself, compressing it back into the inner Solar System. This causes the bolts of energy that punch through Earth's magnetic field.

The man who has a plan to save the world is in an asylum. The video store owner springs him, and they're off to save the world. The mad scientist leads the video nerds to his high-tech bunker. One of the funniest moments in any disaster movie then occurs just outside. The scientist tells the heroes: "*The thing we need to remember is ...*", at which point he is obliterated by a bolide, leaving the heroes completely frustrated.

They manage to get inside the bunker and begin brainstorming. The decision is that they need a nuclear bomb, and head off to get one, leaving the heroine behind. They also left the door open, which rather negates the idea of having a secure bunker. This matters because a bad guy shows up and walks in.

Not a big deal, as the nerds elsewhere successful infiltrate a missile silo and steal the warhead. Civilians with no military experience not only figure out how to launch the missile but aim it into an open-pit copper mine. The detonation of the warhead lofts the copper ore into low orbit, where it acts as a shield against the heliosphere implosion.

Earth is saved by video nerds. Well, the SFX were good, even if the plot was ridiculous. Some of the characters were so weak-willed that it was a relief when they were taken out by bolides. The casting didn't help; a femme fatale would not be attracted to a fat video store clerk.

"The Day The Sun Exploded", written by Arch Oboler, was a 1945 episode of the old-time radio series LIGHTS OUT. (This and hundreds of other OTR shows are available as free mp3s at www.archive.org) It was set in September 1945, the time of the original broadcast.

There is a peace conference underway, in fact the one that would produce the United Nations. All is harmony and friendship. There are endless speeches from delegates of formerly combatant nations. One radio actor after another trots out his foreign accents, all of them atrocious. The Harry Truman impersonator was particularly bad. It's a surprise that the Democratic Party didn't sue Oboler.

As one speech after another rolls by, the listener wonders when something will happen. Finally, the United Nations treaty is signed. Seconds later, the Sun explodes. A one-trick episode, not helped by Oboler giving away the punch line in the title.

FAR SPEAKING STORIES: PART 6

by Dale Speirs

[Parts 1 to 5 appeared in OPUNTIA's #313, 327, 337, 361, and 372.]

The telephone is our most science fictional invention. What was until a century ago only pure fantasy is now so commonplace that few people think about it, that we can talk instantaneously with someone on the far side of the planet.

Alternative Telephones.

"Alexia And Graham Bell" by Rosaleen Love (1986, APHELION #5) supposes that in 1870 Alexander Graham Bell emigrated from Scotland not to Canada but to Australia. The telephone was therefore not invented in Brantford, Ontario,

in 1876 as in our timeline but in 1986 by his great-grandson Graham, who modified a teletype to produce sounds. The telegraph soon falls to the new invention. People notice their lives are speeding up enormously as a result of the telephone. Graham’s sister Alexia doesn’t like it, and sets out to slow down the flow of time.

No Call For Murder.

BOSTON BLACKIE was an old-time radio (OTR) series about a supposedly reformed jewel thief. (This and hundreds of other OTR shows are available as free mp3s at www.archive.org) Supposedly, because Blackie doesn’t have a day job, yet always has money, a comfortable apartment, and a girlfriend to go detecting with and annoy Homicide Inspector Faraday.

“Joe Crane, Hired Killer” was a 1947 episode wherein Blackie is imposed upon by Bill Smith, who is desperately seeking a \$50,000 loan to keep his company afloat. He can’t get one from a local bank because a prominent businessman is blocking him in order to take over Smith’s company.

Meanwhile, just to muddy the waters, hitman Joe Crane is hired by the businessman to knock off his wife. Instead, the businessman is shot, but Crane says he didn’t do it. At the time the murder was done, Blackie had telephoned Smith at his residence thirty miles away from the crime scene, so Smith had an alibi.

Eventually Blackie figured out the method of operation. Smith had arranged to have his phone calls forwarded to the businessman’s apartment, talked with Blackie, shot the victim, and then cancelled the forwarding service. Blackie browbeats Smith into a confession in front of Faraday. If Smith had remained silent, he still would have been done in by the telephone company records.

Forwarding calls to a different number is a procedure almost extinct in today’s world of voice mail and cellphones. This murder mystery has been made obsolete by the march of time.

Other murderers have tried to use telephones as alibis. “20 Minute Alibi” is a 1947 episode of the OTR series CASEY, CRIME PHOTOGRAPHER, written by Robert Sloane. Casey was a newspaper photographer who dashed about taking pictures of murder victims and then solving the case for the police.

This episode begins with an insurance agent receiving a telephone call at 17h45 from a man named Preston, whose life policy was to expire at midnight if the premium was not paid that day. The agent hears a gunshot and calls the police, suspecting it was suicide to collect on the policy. Preston is found dead in his apartment with a gunshot wound and powder burns on what is left of his head.

Casey arrives at the scene and with his usual confidence tells the detective in charge that it was murder. He sets about to solve the case but runs into a problem. Every suspect has an alibi for 17h45, while the insurance agent’s testimony cinches the case.

After spending most of the episode running around in circles, Casey visits the telephone exchange nearest to Preston’s apartment and talks to the operator who looked after that building’s calls. Her logbook shows that the last call Preston made was before 16h00 and nothing thereafter. (For Millennials, this might be incomprehensible. It will have to be explained to them what a telephone exchange was, why human operators handled calls, and why they kept handwritten records.)

It turns out that it was murder done just after 16h00 by Preston’s father-in-law, who didn’t like how Preston had been cheating on his daughter. He blabs a confession, whereas if he had remained silent, nothing could have been proven.

The phone call to the insurance agent didn’t come from Preston, it came from the father-in-law’s place. He impersonated Preston, then fired a blank from a gun and hung up. Had everyone accepted the suicide verdict, no one would have bothered to look at the operator’s logbook for the father-in-law’s phone.

Another example of obsolete technology. Today it is much easier to track telephone calls. Undoubtedly the insurance agent would have caller ID on his cellphone.

Crossed Lines.

“Direct Wire” by Clee Garson (1943 January, AMAZING) is about two bookies who begin receiving telephone calls from someone who wants Adolf and Benito. Naturally the bookies think it is a gag, but then realize none of their regular customers have been phoning in bets. The lines are obviously crossed, but the difficulty is that they can’t report the problem to the telephone company.



Attempts to get the caller off the line fail. He says he is the Angel Gabriel, and if Adolf and Benito won't come to the telephone, then the two bookies must deliver his message to them.

They leave for the European theatre, but what the message is and whether it was delivered is left for the reader to guess. Remember that this story was published in 1942 December (magazines are always dated ahead) when the outcome of the war wasn't a given.

"The Time Telephone" by Adam Roberts (2002, INFINITY PLUS Website) is about a system that enables people to telephone the past or the future, albeit with a number hundreds of digits long at a cost of 18,000 euros for the call. The hand-waving explanation is that the telephone sends anti-electrons along billions of kilometres of landlines thousands of times, which somehow gets them arriving before they started. Time paradoxes are also hand-waved away.

The system works until it doesn't, when a warning comes from the future about some sort of imminent catastrophe that can only be preempted by action taken in the past. The man for whom the telephone call is intended, and who must take action immediately to alter the future, doesn't answer the telephone because he is on his way to a party.

This fellow was standing next to me at the 2017 Stampede parade, so I asked him if I could take a photo of his shirt.

SEEN IN THE LITERATURE

Sørensen, M., et al (2017-08-28) **Near-Earth supernova activity during the past 35 Myr.** arXiv:1708.08248v1 [astro-ph.SR] Preprint at www.arxiv.org

Authors' abstract: *Here we combine observations of open clusters (OCs) with single- and binary population synthesis models and a Galactic potential to reconstruct the supernova activity of these OCs during the past 35 megayears. We find that several OCs potentially hosting supernova progenitors have passed within 100 parsecs [1 parsec = 3.26 light years] of the Sun during the past 35 Myr. In particular we find that ASCC 19, NGC 1981, and NGC 1976 are likely to have hosted one or more supernovae while passing within 200 pc of the solar system in the period 17 to 12 Myr before present (BP) which might have affected Earths' geology and climate.*

Besides the stellar history of the individual OCs we also compute

- 1) a spatial and temporal 2D-probability density map showing the most likely position and time of supernovae from our sample of OCs within 1 kiloparsec during the past 35 Myr,*
- 2) the time series of the supernova rate per volume and*
- 3) the relative supernova rate compared with today and corrected for OC evaporation of older generations.*

The supernova rate today from core collapse is estimated to be $37.8 \pm 6.1 \text{ kpc}^{-3} \text{ Myr}^{-1}$. During the past 35 Myr we find a peak supernova rate around 10 Myr before present where the rate was 40% higher relative to the past 1 Myr. Finally we discuss possible effects of binary stellar evolution in relation to the history of SN production in the solar neighbourhood and the detected ^{60}Fe signal in terrestrial geological samples induced between ~ 2.2 to 2.8 Myr BP.

Wurz, P., et al (2017) **An impacting descent probe for Europa and the other Galilean moons of Jupiter.** EARTH, MOON, AND PLANETS 120:113-146

Authors' abstract: *We present a study of an impacting descent probe that increases the science return of spacecraft orbiting or passing an atmosphere-less planetary bodies of the solar system, such as the Galilean moons of Jupiter.*

The descent probe is a carry-on small spacecraft (<100 kg), to be deployed by the mother spacecraft, that brings itself onto a collisional trajectory with the targeted planetary body in a simple manner.

A possible science payload includes instruments for surface imaging, characterisation of the neutral exosphere, and magnetic field and plasma measurement near the target body down to very low-altitudes ($\sim 1 \text{ km}$), during the probe's fast ($\sim \text{km/s}$) descent to the surface until impact. The science goals and the concept of operation are discussed with particular reference to Europa, including options for flying through water plumes and after-impact retrieval of very-low altitude science data.

Turbet, M., et al (2017) **CO₂ condensation is a serious limit to the deglaciation of Earth-like planets.** EARTH AND PLANETARY SCIENCE LETTERS 476:11-21

Authors' abstract: *It is widely believed that the carbonate-silicate cycle is the main agent, through volcanism, to trigger deglaciations by CO₂ greenhouse warming on Earth and on Earth-like planets when they get in a frozen state. Here we use a 3D Global Climate Model to simulate the ability of planets initially completely frozen to escape from glaciation episodes by accumulating enough gaseous CO₂. The model includes CO₂ condensation and sublimation processes and the water cycle.*

We find that planets with Earth-like characteristics (size, mass, obliquity, rotation rate, etc.) orbiting a Sun-like star may never be able to escape from a glaciation era, if their orbital distance is greater than ~ 1.27 Astronomical Units (Flux < 847 W m^{-2} or 62% of the Solar constant), because CO₂ would condense at the poles, here the cold traps, forming permanent CO₂ ice caps. This limits the amount of CO₂ in the atmosphere and thus its greenhouse effect.

Furthermore, our results indicate that for

- (1) high rotation rates ($P_{\text{rot}} < 24 \text{ h}$),*
- (2) low obliquity (obliquity < 23.5°),*
- (3) low background gas partial pressures (<1 bar), and*
- (4) high water ice albedo (H₂O albedo > 0.6),*

this critical limit could occur at a significantly lower equivalent distance (or higher insolation).

For each possible configuration, we show that the amount of CO₂ that can be trapped in the polar caps depends on the efficiency of CO₂ ice to flow laterally as well as its gravitational stability relative to subsurface water ice.

We find that a frozen Earth-like planet located at 1.30 AU of a Sun-like star could store as much as 1.5, 4.5 and 15 bars of dry ice at the poles, for internal heat fluxes of 100, 30 and 10 mW m⁻², respectively. But these amounts are in fact lower limits. For planets with a significant water ice cover, we show that CO₂ ice deposits should be gravitationally unstable. They get buried beneath the water ice cover in geologically short timescales of about 104 yrs, mainly controlled by the viscosity of water ice.

CO₂ would be permanently sequestered underneath the water ice cover, in the form of CO₂ liquids, CO₂ clathrate hydrates and/or dissolved in subglacial water reservoirs (if any). This would considerably increase the amount of CO₂ trapped and further reduce the probability of deglaciation.

Pitblado, B.L. (2017) The role of the Rocky Mountains in the peopling of North America. QUATERNARY INTERNATIONAL doi.org/10.1016/j.quaint.2017.07.009

Author's abstract: This paper argues that the Rocky Mountains played a significantly more important role in the process of the peopling of the New World than archaeologists have traditionally recognized. Although First Americans did not reach the Rockies before they set foot in any other New World region, they could not have, regardless of their point of entry, by Clovis time, evidence suggests that Clovis people knew the Rocky Mountain landscape intimately.

Archaeologists should have long anticipated this, given the many resources the Rocky Mountains offer that adjacent, albeit archaeologically better-known regions such as the Plains and some parts of the Far West do not; at least not as ubiquitously. These include plentiful water in the form of streams, lakes, snowpack, and glaciers; high-quality sources of obsidian, chert, quartzite and other knappable stone; and a vertically oriented landscape that maximizes floral and faunal diversity within comparatively condensed space.

Two other non-economic characteristics likely contributed significantly to the appeal of the Rocky Mountains to some First Americans: the power and sanctity

nearly all humans attribute to mountains, and the seemingly little-recognized fact that northeast Asian Upper Paleolithic people who populated the New World during the terminal Pleistocene occupied mountainous landscapes for some 45,000 years prior to their departure. For many First Americans, mountains, not the flat, windswept tundra of Siberian stereotypes, had always been home.

Evidence for the familiarity of Clovis groups with the Rocky Mountain landscapes comes principally from three Clovis caches: Anzick, Fenn, and Mahaffy. All three caches are located in the Rockies, collectively contain artifacts made from ten of the highest-quality stone raw materials available in the Southern, Central and Northern Rockies, and at least one of the caches accompanies the burial of a young child who appears to have been interred intentionally on a prominent and likely sacred landform in a mountain valley.

Bringing the paper's argument full circle, that same child's genetic profile shows a direct link to that of another youngster buried thousands of years earlier at the Late Glacial Maximum Mal'ta site in the mountainous Trans-Baikal region of Siberia.

Speirs: The myth that humans couldn't cross over into North America until the Bering land bridge formed during the Ice Ages is on its last legs. More and more evidence is demonstrating the Asian humans had coastal boats that could easily cross the Bering Straits and travel down the Pacific coast of the Americas. Even today, it isn't impossible to paddle across the water or walk over on the ice after freeze-up. DNA evidence demonstrates that the earliest humans didn't come from the Siberian plains but from the northern Asian interior.

Shuman, B.N., and M. Serravezza (2017) Patterns of hydroclimatic change in the Rocky Mountains and surrounding regions since the last glacial maximum. QUATERNARY SCIENCE REVIEWS 173:58-77

Authors' abstract: The paleohydrologic record of western North America since the last glacial maximum reveals a wide range of hydroclimatic variability in time and space. To improve the understanding of abrupt hydroclimatic shifts and millennial-scale hydrologic changes in the central Rocky Mountains, we reconstruct the lake-level histories of two small lakes in the Beartooth and Bighorn Mountains in northern Wyoming over the past 17 ka [thousand years

ago]. To do so, we use ground-penetrating radar (GPR) and sediment cores to track the elevations of shoreline sediments within the lakes through time.

We compare the stratigraphies with those from four other lakes in Wyoming and Colorado, and find widespread evidence for a Terminal Pleistocene Drought from 15 to 11 ka, an early Holocene humid period from 11 to 8 ka, and mid-Holocene aridity from 8 to 5.5 ka. The northern Wyoming lakes also provide evidence of high levels in the Pleistocene, possibly before ca. 15 ka, and rapid hydroclimatic changes that may have correlated with Heinrich Event 1 (ca. 16.8 ka).

We place the changes in a broad context by summarizing and mapping water-level changes from 107 additional, previously studied lakes. Important patterns include 1) extensive drying across the western U.S. after 15 ka; 2) sub-regional differences during the Pleistocene-Holocene transition; 3) a north-south contrast from 9 to 6 ka consistent with a northward shift in storm tracks as the influence of the Laurentide Ice Sheet diminished; and 4) rapid increases in effective moisture across much of western North America from 6 to 4 ka.

Speirs: Major climate changes are nothing new in Earth's history, even in the last few thousand years. Humans have survived worse than what present-day doomsayers are predicting.

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