SCIENCE FICTION

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EDITOR'S COMMENTS: This is written and edited by Dale Cozort for the February 2007 distro of FAPA. All original writing in this zine is copyrighted of course.

I've never missed an issue of any APA I've joined, but this one is going to be a challenge. I spaced out on the deadline until 3:30 in the morning on February 2nd. I happened to wake up, and couldn't go back to sleep, with hundreds of random thoughts racing through my head. One of those thoughts was "You know, it's been quite a while since the last FAPA. I wonder when the deadline is." It is now 3:56 am on February 2nd, and I'm trying to figure out how I'm going to put together, print, and mail a 20 page zine by February 7th at the latest. That's five days and with the Bears and the Colts in the Superbowl, Sunday is toast. I'm not really a football fan, but I'm obligated to watch this time

Time's a-wasting, so on with the zine. Fortunately, I can recycle from POD. Nobody except the other Dale will even be aware of the recycling, and I'll include enough new stuff to keep him interested.

First, I want to tie up a few loose ends from the last couple of issues. I'm almost done writing about solar cells for the time being, but I do have a few thoughts. Sharp, the world's largest solar cell manufacturer, has gone from a 300 megawatt annual capacity to a 700 megawatt annual capacity in about a year and a half, and that will be going up again this year. Other companies are adding huge amounts of

capacity too. In the next three or four years we could see an ironic situation: several multi-billion dollar solar cell companies, but with a laughably small impact on our energy picture.

The unknowns pile up for solar cells after about 2010. The biggest wild card is the DARPA project for 50% efficient terrestrial solar cells. Their goal was small scale production of 50% efficient cells 50 months from the start of the program in late 2005/early 2006. That means 50% efficient cells by 2010. They are working with a company that already produces 36% efficient cells for satellites, so 50% may be reachable. Getting costs (literally) down to earth may be tougher.

Another wild card is China. Chinese solar cell production capacity rose from 50 megawatts in 2005 to 1 gigawatt in 2007. The Chinese tend to push prices way down in any industry they get into, though their costs of production are now rising rapidly.

Other loose ends from my first two issues: If youreally got into David's Voice, I'm sorry but that's all I've written so far. I will tell you that in real life the resolution of the cliff-hanger was anti-climactic. The guys in the pickup truck didn't chase me around the farm or beat me up, though their behavior seemed threatening enough that my sister called 911. They claimed to be scrap dealers trying to buy old farm machinery, They left before the sheriff arrived. That doesn't make quite as good of a story, but in real life I'm too old to enjoy getting chased around or beat up. I'm not sure if they were what they claimed to be, but if they were their timing stunk.

If you want the background behind the story you can find some of it by doing a Google search for "Lillie Lenstrom". The case made the local newspapers and got picked up by national legal news services. I'll tell you more about the situation in future issues.

I'm going to continue Char this issue, and I am quite willing to share any of my stories with you on an individual basis in exchange for feedback. I guess I can't put entire stories in the zine without risking making them less valuable for publication, so I'll have to restrict myself to excerpts in the zine itself. Too bad. I enjoy sharing the stories.

This issue I put in another short story excerpt. I also start an ongoing column called Cocktail Party Science, where I share facts and speculation that I think might be of interest to science fiction fans and writers.

I'm not sure how much commenting I'll have time to do. I skimmed through the zines when I got the distribution, and was impressed by the layout of several of them. I envy some of your design skills. I was also a little disappointed with the amount of comments in most of the zines. I guess I'm spoiled by POD. On the other hand, I can't complain too much because my comments for this issue will probably be minimal and hasty.

I looked at my last zine, and was appalled at the way it looked. I cram stuff in my 20 pages and don't leave much margin for error. The issue looked fine when I printed it off, but when I took it to a copier service, their machines offset the copies by a quarter of an inch, which cut off the bottoms of the boxes around my page numbers and did other bad things to the layout. I'll leave more margin this time.

In any case, enjoy the zine.

Back at the farmhouse, Erik looked at the woman. "No change except she's drooling and her leg's bleeding again. We need to get that stopped."

Ken shook his head. "You have no idea what you're setting yourself up for. Court system's going to chew you up and spit you out. I know."

Erik said, "Trying to save someone's life isn't quite the same as drug possession, or beating your wife."

"The drugs were a long time ago, and I paid the price. I would have been a pro running back now if I hadn't screwed up. Never beat my ex-wife, not that it's any of your business."

Erik shrugged. "Bruce, I'm going to tear an old T-shirt into strips, boil the strips so they're sterile, and try to stop the bleeding.

There was still no answer. Erik rummaged in a toolbox and found a pipe wrench. The heavy wrench felt reassuring in his hands. He turned on the big flashlight and ran up the stairs with it in one hand and the wrench in the other. The balcony door stood open. He made sure no one was on the balcony, then closed the door. He started to lock it, and then hesitated, not sure he wanted to cut off his line of retreat.

Erik flashed the light down the hallway, then went to the upstairs bedroom. The bed was empty, with Bruce slumped beside it, head resting on the pillow. There was no sign of Ken or the woman. Erik checked behind the door, then went over to Bruce. He got a good look at the other side of Bruce's head, and quickly felt for a pulse. "Come on! Give me a pulse."

He didn't feel one at the neck. He tried the wrists, and then straightened up. "Didn't think so."

Erik looked around the room. He thought he missed some magazines. The paintball guns and all four pairs of the night vision goggles were missing, along with the blanket from the bed and several items of clothing. He noticed that the old laptop was no longer on the desk.

"So you saw what I did with the computer, did you weasel boy? And I'd be willing to bet that there'll be a shovel missing from my shed, and a shallow grave somewhere on the farm—not that it'll do you any good."

Erik looked at his watch and was surprised to see that only twenty minutes had gone by since he noticed the cat's reaction. He heard someone open the back door and ran downstairs. "Rick. Did you get the sheriff?"

"On her way, along with an ambulance."

"Didn't hear your car coming."

Rick shrugged. "Just pulled up."

Erik nodded. "We've got a problem. I'm pretty sure Bruce is dead. No pulse, and the side of his head's—well, not good. The woman's gone. So is Ken."

The blood drained from Rick's face. "What happened?"

"I was downstairs. I assume Ken figured he'd knock Bruce out and dump the woman's body. He hit Bruce too hard," Erik said. "I didn't hear anything though, and all I saw was a shadow. Could have been anybody."

"Well, actually it could have been one of two people, and one them was pretty close to dead," Rick said. "That leaves—well speak of the devil."

Ken walked down the stairs toward them. Erik picked up his wrench. Rick picked up an iron skillet and positioned himself so that Ken couldn't face both of them at once. Erik said, "You didn't have time to get to the river and back, so you must have borrowed a shovel. They'll find her anyway, and even if they don't they'll get you for killing Bruce."

Ken looked at them, and then sat down on the stairs. "Believe what you want. I'm not saying word one until I talk to a lawyer, and if you're smart you'll do the same thing."

Rick hefted the skillet and moved a step toward Ken. Erik shook his head. "Not worth it."

Rick stopped. "Probably not." He paused and listened. "Sounds like the sheriff's here anyway."

Chapter three

Sheriff Francine Hart yawned. She studied the young man sitting across the desk from her in the improvised interview room she had set up in the basement of the farmhouse. His driver's license put Erik Davis at twenty-six years old. He looked quite a bit older, and somehow weather-beaten, though Sheriff Hart didn't see any gray in his blonde hair nor fat on his wiry 6-foot tall frame. He looked tired and shaken.

The sheriff looked at her notes. "So the four of you were playing paintball. How do your cows like it when you do that?"

"They don't. We keep them in the barn when we play."

"Do you play paintball out here often?"

"Not much anymore. I've been too busy since mom and dad died. Actually this is the first time Ken has been up here."

The sheriff looked at her notes again. "I was wondering about that. You and your cousin—Rick Blair is it?"

"Yes."

"You two and the deceased have an apartment together in town, but I'm not sure where this Ken List fits in."

"It was Bruce's idea to bring him up here. Rick and Ken knew each other in high school and didn't particularly like each other. Bruce knew them both and I guess he figured they'd get to be friends if they got to know each other."

The sheriff nodded. "How badly did they not like each other?"

Erik said, "Not seriously—just high school stuff. Ken was the star running back and Rick didn't give him the worship he thought he deserved."

"Nothing more recent?"

"Nothing serious. Ken's dating the girl Rick would like to be dating, but Rick's pretty laid back about things like that."

"What's the girl's name?"

"Dawn Regan."

The sheriff yawned again as she looked at her notes, and then shook her head. "That's the difference between twenty-seven and—well thirty-something."

"What?"

"Just thinking out loud. Ten years ago I would have still been up at one o'clock in the morning," Sheriff Hart said. "Why didn't you go after the person you saw jump down from the balcony and run behind your shed?"

"He had a knife. All I had at the time was a pan of scalding water. You can't run with something like that."

The sheriff nodded. "You said 'he had a knife.' Did you see this person well enough to identify them?"

"No."

"Well enough to know it was a man?"

"Not really."

"Why not? Why couldn't you see well enough to identify him or her?"

"He—they flashed one of those big car-headlight flashlights in my eyes."

"And then shot you with a paintball." The sheriff looked at Erik's shirt. "Looks like they hit you right at where your heart is. Why did they do that?"

"I don't know."

The sheriff looked at her notes. "You're a farmer and a mechanic. You look like you're a pretty strong guy. Any reason you couldn't kill somebody by hitting them over the head with a big flashlight?"

Erik said, “I didn’t. I don’t have anything physically wrong with me, if that’s what you’re asking.”

“Ever see the woman that was here before?”

“No.”

“Any idea how she got out here or what she was doing on your farm?”

Erik shrugged. “I’m figuring she was some kind of ‘live off the land’ survivalist but that’s just a guess.”

“Was she Indian?”

“I don’t think so. If anything she looked like she might have had a little Australian Aborigine in her, but her skin was lighter than mine.”

The sheriff looked at her notes again. “Hair dyed red. Shaved up the sides. Hair thick and long at the top. Bigger-than-life tattoo of a wolf on her upper body. Wouldn’t be too out of place in Chicago but people would notice her out here in the sticks. Anything else?”

“Yeah. She moved wrong.”

“Your cousin said that too. He couldn’t explain it though.”

“Neither can I. She didn’t walk right and she didn’t run right either.”

“Was she hurt?”

“Yes, but it didn’t slow her down. Moved fast.”

The sheriff shrugged. “Did Bruce have anybody special female-wise?”

“This week?” Erik asked. “Bruce had a problem. He would get into relationships and then he’d get scared and want to get out, but he hated conflict, so he’d just not be available. Eventually the girl would get the message.”

“Sounds like a jewel of a guy. Any of these girls mad enough to kill him?”

“Not that I know of.”

The sheriff motioned for the deputy who had been witnessing the interview to come over. She stepped out of Erik’s earshot and said, “Get someone in here to witness and take over. You need to get names and contact info on next of kin and whoever else needs to be notified. Get a detailed list of what he thinks is missing, then take him down to the river and diagram what he says happened. Be careful with my crime scene. When you get done with him, take Rick Blair down separately and diagram what he says happened. Oh, and get names and addresses of any girlfriends the deceased dumped in the last year.”

“Aren’t many women strong enough to do what they did to him.”

“You’d be surprised at what a woman who’s been dumped can do.”

“Maybe. Am I doing an interview or an interrogation?”

“Don’t know yet. I hope he’s a friendly. He’s either a world-class actor or he’s pretty shaken up. Is the coroner done upstairs?”

“Yeah. I saw him coming down. He’s probably looking for you.”

She slapped the deputy on the back and went upstairs to the main floor. She saw the coroner start out the door as she got to the head of the stairs. “Aren’t going to leave without saying goodbye, are you?”

“I thought you were tied up with the questioning. Report’s done. I left a copy for you.”

“I like hearing things straight from the horse’s mouth. Let’s go up and walk through what happened.”

The coroner looked at his watch, shrugged and walked upstairs to the bedroom with her. He pointed to a bookcase by the door. “The deceased was standing over here. He was facing his assailant. He partially blocked at least one of hits, almost certainly the first one. He took it on his left arm, but the momentum carried it into his head. Second hit was probably to the Adam’s apple with the flat of a hand. Caused quite a bit of damage. It might have even killed him eventually by itself. Third hit caught him in the side of his head and probably killed him instantly.”

The sheriff looked at the bookcase. “Let’s see if I can follow that little bit of Sherlocking. Body had two wounds on the head from getting hit with the light. One was a lot more damaging than

the other. There was a wound from the light on his arm. Blood on the bookcase says it happened over here. Right so far?"

"Yep."

"How did he get over by the bed?"

"Assailant picked him up and put him down. Couldn't have dragged him. No drag marks and not enough blood."

"Why do that?"

"There's a rug there. Less chance of a thump."

"Bruce would have weighed a good 230 pounds, maybe 250. Fireman's carry?"

"Nope. Not enough blood. Assailant picked him up and shifted him. You're looking for a very strong man."

"Or woman."

"Or a woman Olympic-class weight-lifter."

The sheriff grinned. "Sexist. A semi-pro football player would be a pretty strong guy, wouldn't he? Anything else?"

"Time of death was around midnight—give or take enough time to make it pretty much useless in ruling people in or out in this case. Rest is in the report."

The sheriff walked the coroner out, and then went down to the main area of the basement. She grinned when she saw Deputy Al Brantley coming out of one of the side rooms. The lanky deputy walked up to her, a little too nonchalant and asked. "Been back in the side rooms?"

"The ones with the doors that blend with the basement walls and the electric outlets two feet apart? Yeah, the previous owners had a little basement hydroponics operation. They got careless distributing the drugs and that's why the house was for sale."

The deputy showed no sign of deflation. Pity, the sheriff thought. Out loud she asked, "Ken List still not talking?"

"Not a word. He has a nice goose-egg of a bump on the right side of his head. I made sure that was in one of the room pictures we took. I noticed that Rick Blair has a pretty nice lump on his forehead too. Are you buying this story about the girl with the tattoos?"

The sheriff shrugged. "If there was a girl here we'll find evidence of it. Supposedly she bled on the sheets, so that'll prove it one-way or the other if nothing else does."

"Are you buying them just finding her wandering around in the woods?"

"Don't have enough evidence to say."

"Give you five to one that she came out here with them if she existed at all. Probably things got too rough for her and she tried to leave."

"That doesn't explain how Bruce died."

"Others may have been afraid he would talk. Or maybe it was all this Ken List's idea to get rid of the girl's body and Bruce wouldn't go along with it. Then again the other two are cousins and they may be protecting each other. Could have even been a 'most dangerous game' scenario."

The sheriff laughed. "Not in my county. You've been watching too much TV."

Deputy Brantley said, "Well, one thing I can tell you is that someone's built a nice little crime scene for us to find down by the river."

"You've been down there?"

"Yep. Don't worry. I was careful. There are bare footprints out there leading into the river, and they're good fakes, but they are fakes. Big toe's too big. Other toes are too small. Feet didn't land quite right. Stride's too long for a short woman. Whoever made the tracks had to weigh almost as much as I do. Some other things don't fit either."

"You need to stop traipsing around in my crime scene. We do this systematically."

Deputy Brantley shrugged. "I know enough not to destroy evidence."

He turned, and started to walk away. The sheriff asked, "Have the guys in town searched the apartment there yet?"

"Bruce's part of it. They found some hot e-mails on his computer, but they may have just been Spam come-ons. Nothing threatening."

"Odd about the faked footprints. That would make Rick and Erik both liars. Neither of them are strong enough to be our murderer though, unless they did it together."

Deputy Brantley shook his head. "If you need your suspect to be strong, don't rule out Rick Blair. Just between you and me, one of the town guys peeked into his room. He's got quite a set of weights, including 80 pound dumbbells."

"That doesn't sound like too much."

"Yeah, until you figure that you lift dumbbells with one hand and according to the chart in his room he does sets of twenty."

"I'll keep that in mind. Hang tight a second or two. I'll be back."

The sheriff turned, and walked out to the front yard. She touched base with the deputy in charge of searching the nearby roads and driveways for any out-of-place cars. She also sent a deputy to contact nearby farmhouses and alert the neighbors to be on the lookout for the woman. She looked at her watch. She wasn't surprised to see that it was after three in the morning. She saw lightning in the distance and delegated someone to gather tarps to cover the important parts of the crime scene if necessary. She went back over to Deputy Brantley. "Grab some tarps. Let's take a look at this phony crime scene of yours before the rain wipes it out."

They walked toward the river. Deputy Brantley pointed, "That's where they supposedly crossed paths. All four of the guys were moving around down here tonight. Pattern's consistent with Ken List hiding and the other three hunting for him."

"And the woman?"

"Well, there's a trail. It just isn't real."

"Show me. Just don't get too close until I get pictures and sketch it out."

Deputy Brantley walked over and pointed. "Best tracks I could find."

Sheriff Hart took pictures from several angles, and then sketched the scene, working in from the periphery. She pointed at a set of tracks that came within a couple of feet of the trail. "Yours, I assume."

"Had to get there somehow."

Sheriff Hart asked, "Trace it all the way down to the river?"

"Yep."

"And it looks like whoever made the trail went into the river?"

"Oh yeah."

Sheriff Hart stood up and looked down Deputy Brantley's trail. "Find where somebody shot a bunch of paintballs down there?"

"Yep."

"So you've tramped all over my crime scene?" Sheriff Hart asked.

"Found the key evidence. Did my job."

Sheriff Hart shrugged. "Not much we can do about it now. Did you follow the trail back from here?"

"Not yet."

"And not ever. I'll follow it back. Get down to the river and cover up as much of the scene as you can in case the rain hits."

Sheriff Hart worked her way back along the trail away from the river. She found dried blood a couple of times and collected it. She finally followed the trail back to a mudhole around twenty-five yards in diameter. She worked in from the outskirts, first circling and looking for any point where someone might have entered or left. She found one other point where the grass appeared to have been disturbed on a trail either to or away from the edge of the mudhole, and what appeared to be the print of a large bare foot in the mud.

She finally worked her way into the mudhole, following the trail. It was easy to follow in the mud, but the trail ended abruptly in the center of the mudhole. Sheriff Hart systematically photographed, measured, and charted the scene. She re-examined the footprints, looking for any hint of overlaps that might indicate that someone had walked backwards into the mud and then walked back out stepping in the same footprints. Finally she stood up and looked around. She shook her head. "I hate mysteries."

What is cocktail party science? It combines fact and speculation in ways that no real scientist would ever try to get past peer review. It is not careful to document and footnote every fact and to label every speculation as such. Is it really science? At its best it can be. In these columns I will do my best to combine fact and speculation in a way that will hopefully let you walk away with new knowledge, hopefully not painfully obtained. Do keep in mind that I'm a computer programmer, not a real scientist and these articles spring from wide eclectic reading and thought rather than any real training in the subjects involved.

The only real data we have on how brains and intelligence develop come from the only animals whose brains and intelligence we can actually sort of measure—the ones here on Earth. Do those brains give us any useful principles we can apply to creating science fiction aliens? I think so.

We humans, or at least some of us, value our brains. Brains are what differentiate us from the animals and allows us to dominate the planet. So if brains are so important, why are we the only species around with human-level brains? After all, presumably every other species has had just as much time to develop big brains. Why didn't they? What makes one animal grow a larger brain than another? I'll give you some general thoughts on the whys of growing large or small brains, then I'll share some insights and data from a spreadsheet I put together of over 200 mammal brain and body sizes.

First, brains are expensive for an animal. Supporting a brain takes a little over twenty times the calories that it takes to support an equivalent weight of muscle. There is a huge incentive for an animal to get by with as small of a brain as possible. If an animal's niche doesn't require a large brain it won't have one. If an animal's food supply is limited or of poor quality, there will be enormous pressure for brain sizes to stay small or even shrink over the generations. That usually doesn't happen because there are equally enormous pressures for brain size to grow, and generally mammal brains have grown over the generations.

Mammal brain sizes have grown on average a little over four-fold since the end of the time of the dinosaurs, though not in the rodent-like and small insectivore niches that mammals inhabited during the time of the dinosaurs. Apes and fruit-eating monkeys on average have brains a little over twice the size of carnivores or hoofed animals in their size range. Humans outclass apes by a factor of three to four times in the brain-size department. In the few cases where dolphins are in the same size range as monkeys and apes, dolphins tend to have around 1.5 times the brain size as the apes, and roughly half the size you would expect for a human that size. Some dolphins do have larger brains than humans, but in a considerably larger body.

So, how is that extra brain-size paying for itself in mammals in general and especially in monkeys, apes and humans? Presumably through increased intelligence, but what is that? Intelligence in animals isn't a single set of abilities. It isn't necessarily tool use or ability to communicate. I see intelligence as the ability to use memory and brain processing power to alter behavior in a way that makes the animal more effective in its environment.

Brain size by itself doesn't automatically do much for an animal. It takes the increased brain size, plus the mechanisms to use that additional brain size in some way. Think of it in computer terms. When you add memory to a computer, the computer may run a little faster or a little more reliably, but the real payoff is that now you can do things that really weren't practical before like video editing or 3D animation.

In animal terms, the larger brain allows more flexible behavior. At a certain point it allows learned behaviors to be passed on from generation to generation. The next step is allowing learned behaviors to be passed from generation to generation without having to be demonstrated to the next generation. That's where we are to a certain extent.

As the high cost of brains implies, intelligence isn't necessarily the most adaptive way to go. I use cockroaches and elephants to illustrate the tradeoff involved. Elephants are very long-lived, and very intelligent in their own way. Cockroaches are short-lived and rely mostly on instinctive behavior to survive. If something new comes into an elephant's environment, it has to be able to adapt to that something new. If something new comes into a cockroach's environment, the individual cockroaches have far less ability to adapt to it, but that doesn't matter because they can quickly breed new cockroaches that are adapted to it. Elephants simply can't do that because it takes too long to make a new elephant.

In computer terms, the individual cockroach has a highly polished set of routines in read-only-memory to call on. If those routines don't work in a new environment, then new cockroaches come along with slightly altered routines that do work in the new environment. In computer terms elephants have a lot of memory and very elaborate and flexible routines to make use of that memory in order to modify behavior. They have to be able to adapt to changes in their environment over their seventy-year life-spans, and they are.

Most animals are somewhere between cockroaches and elephants in this tradeoff. For instance, a gerbil has some elements of flexibility and some elements that are inflexible. I had gerbils and way too much free time on my hands in high school, so I can tell you more than you probably want to know about their behavior. One rather odd thing about gerbils is that they have no natural fear of predators. A gerbil that has never encountered a cat before will attack it. As near as I can figure out, gerbils figure out what is dangerous in their environment either by personal encounters or by having older gerbils in the colony drum their feet when something dangerous approaches. That's flexible, maybe even too flexible for the gerbil's own good.

On the other hand, in some ways gerbil behavior is very inflexible. Gerbils love to explore, so I tried a couple of experiments when I was back in high school (remember, way, way too much free time).

I put a gerbil in a container shallow enough that it could jump out, but deep enough that the jump was difficult. I set the container next to the arm of the couch. Then I waited. The gerbil would inevitably jump up onto the couch arm and pause there to look around. I would then pick it up at set it gently back down in the container. This would go on for 10 to 15 cycles with absolutely no variation. Then, usually after the 12th time, the gerbil would stop, wash its face and look over the situation. It would then repeat the jump and pause one more time. After I put it back it would jump again, but this time it would dodge as soon as it landed. I was ready for that, grabbed the gerbil and put it back. The gerbil would repeat the new set of actions 10 to 15 times, then repeat the face-washing and looking things over. It would then repeat the set of actions one more time, then add a new variation—usually jump, dodge, then run.

The new tactic was always added onto the existing sequence, and it was always a logical answer to the challenge. This would go on until I either found something better to do, or the tactics got effective enough that I was afraid the gerbil would get away. As I recall it, gerbils would retain their new set of tactics for a couple of weeks or maybe a month. A more 'intelligent' animal would probably develop the more effective tactics much more quickly, and that undoubtedly does have survival benefits..

Is an elephant better or worse adapted overall than a cockroach? It depends on how stable the environment is. Elephant-style adaptation tends to work well in relatively stable environments and cockroach-type animals tend to be marginalized. In extremely unstable environments the cockroach approach seems to work better. Want to bet on which type is most likely to recover from a catastrophic asteroid strike? Elephant-style adaptability is also expensive. As I mentioned earlier, big brains take an enormous

amount of energy to support, so animals don't grow them without having a very good reason to. The brain has to allow the animal to access enough additional energy sources to offset the energy drain, or selective pressures will lead to smaller brains.

So what kind of animal grows large brains here on earth? As I mentioned earlier, fruit-eating and omnivorous monkeys and apes generally outclass most carnivores and herbivores at a given size. Monkeys with a diet mainly of leaves tend to be intermediate between fruit-eating monkeys and carnivores, probably because their relatively poor quality diet makes really large brains too expensive. Dolphins have noticeably larger brains than apes. Seals overlap the bottom of the monkey/ape range. So do bears, though in the case of the bears, the overlap is entirely due to the Malaysian Sun Bear (Helarctos malayanus), which is almost exactly in the middle of the ape/monkey range.

Among marsupials, opossums and the Australian marsupial carnivores do very poorly in the brain department, with brain sizes for opossums averaging around 14 percent of the brain you would find in a comparably-sized monkey and the Australian marsupial carnivores (Dasyures) in the 14 to 21 percent range. That puts them at about half the brain size of a typical carnivore at best, though some of the weasels and some of the members of the mongoose family come close to overlapping the marsupial carnivores. The extinct Tasmanian wolf does quite a bit better, at around 30 percent of what you would expect from a monkey it's size. A comparably-sized placental wolf would be at around 65%, but the Tasmanian Wolf does beat out quite a few placental carnivores.

Kangaroos and wombats do quite a bit better than the marsupial carnivores. They actually overlap the carnivores fairly substantially. The extinct marsupial lion, which was actually related to kangaroos rather than other Australian marsupial carnivores like the Tasmanian devil, apparently had a brain-size almost indistinguishable from normal carnivores in the same size range.

So what does all of this mean? In terms of land mammals on Earth, the key to a large brain seems to be an omnivorous diet, with fruit as the major component. That holds true mainly in the tropics because of the huge number of species of fruiting trees that a fruit-eating animal has to keep track of, and the high level of competition for the fruit. Get to a big fruiting tree the day after a big troupe of monkeys found it, and you get famine instead of feast. The Malaysian Sun Bear is somewhat convergent on monkeys and apes in that it is small, exclusively tropical, a good tree-climber, and a major fruit-eater. It seems to also be convergent in terms of brain-size.

Marsupials have a somewhat different pattern than 'normal' (placental) mammals in that the largest brain-sizes are seen in big herbivores, possibly because they developed the same kind of thick interconnection between the two hemispheres of the brain that 'normal' mammals did. Opossums and the Australian marsupial carnivores never developed an equivalent interconnection and they may not be able to develop specializations between the hemispheres as easy as other mammals.

There are no marsupial equivalents to the omnivorous/fruit eating monkeys or apes, though sugar gliders and their relatives are in some ways vaguely monkey-like. Sugar gliders are also somehow very alien in a lot of their behavior patterns, based on the one I had as a pet—somehow a different way of being flexible and somewhat intelligent.

What does all of this tell us about growing alien brains? To get really big brains, you need a highly nutritious source of energy that is available in complex and patchy patterns, and that is accessible to a lot of competitors. You need long-lived animals with a lot of investment in a few off-spring. You need a certain minimum level of stability in the environment lest the balance shift toward the cockroach strategy.

Do you need hands or something similar to manipulate the environment? That might help, but initially the boost in brain-size may be from an unintuitive source. It's easier for an animal to have a large brain if it has a short neck.

Think about a human-sized head on an ostrich-type neck. Wouldn't work so well, would it? If you make an ostrich-length neck thick enough to support a human-sized head, you've added a lot

of weight to the animal. In close chase, that extra weight could be fatal. So why can't the neck be shorter? The animal has to eat and drink. That means that either the neck is long enough to reach the ground, or the animal has to find some other way of bringing food and water to the mouth. That means that an animal with some kind of grasping organ like hands, a trunk, or a prehensile tail pays a smaller price for a large brain the one that doesn't have one.

If an animal spends most of its time upright, the large brain costs even less in terms of neck mass, because the neck muscles don't have to work as hard to hold it up. Purely water-living animals get some of the same benefit because the water supports their heads. A water dwelling or upright animal won't automatically have a large brain. It just costs them somewhat less than normal to have one. Ironically, Hollywood's preference for upright aliens has at least a little justification.

Large brains probably cost flying animals more than they do non-flying ones because of the selective pressure to keep weight down, though fruit-eating bats and birds tend to have proportionately large brains. There are upper limits for the size of a flying animal though, and that in turn limits brain-size. A human-sized brain in a body small enough to fly would be quite a trick.

Those of us that came through school a few years ago are often conditioned to think of animal development as a progression. It goes something like: fish, amphibians, reptiles, early mammals, progressive mammals, monkeys, apes, and then us. That's not the way life really works. The reality is that animals of all kinds compete for a variety of niches in a variety of ways. Fruit-eating birds are very formidable competition for apes and monkeys. So are fruit-eating insects. The niche determines many of the characteristics of the animal, though the ancestry determines how an animal exploits that niche. There is no guarantee that monkey and ape type niches will always be occupied by monkeys or apes. For example, in South America most of the niches that leaf-eating monkeys occupy in Asia and Africa are occupied by tree sloths. Tree sloths aren't our type of animal, but they are formidable competitors in their niche.

In an alien environment, don't expect one progression leading to one type of intelligent life, and especially don't expect the progression or progressions to follow the same patterns they did on earth. It's probably better to scrap the analogy of a tree of life and visualize a field of life, where in certain areas a combination of fertile niches and the right ancestry lead to more intelligent animals, and where other areas are less fertile or the ancestry of the current niche occupants keeps them from growing too intelligent.

Is that helpful? Ready to build a brainy alien? I hope so.

I did promise you some data on real-life brain sizes of various mammals. I've put a few excerpts from my spreadsheet below. Fair warning: I explain my methodology in a fair amount of detail, so if you aren't into that sort of thing you might want to skip this part or just cherry-pick the data.

Methodology: A major problem in comparing brain sizes is accounting for body size. Larger animals have to have larger brains to control their larger bodies. In absolute brain size, elephants beat human beings pretty decisively. On the other hand, if you look at the proportion of brain size to body size, a mouse does just as well as a human being. If you look at mammals as a whole, brain size tends to grow about two-thirds as fast as body size. Several authors have calculated some ratio of brain to body growth such as Jerison's 'EQ' to try to separate out the impact of body size on brain size and compare animals of very different body sizes. The problem with that approach is that within closely related animals the growth of brain size is much slower than when you look at mammals as a whole. For example, within the cat family brain size may grow half as fast as body size. That means that within the cats, lions and tigers have very low EQs, while smaller cats have very high EQs. Since there is no reason to believe that a Lion is less intelligent than your average wild cat, EQ probably doesn't necessarily represent intelligence in any meaningful way.

I took a different—brute force--approach. I entered brain and body weights for somewhat over 200 mammals into a spreadsheet and sorted them by body weight. I then divided the data somewhat arbitrarily into groups where the body size didn't vary by

more than 15 to 20 percent. I then looked at each of those size groups for any omnivore/fruit-eating monkeys or apes. If there were any, I added their brain-sizes together and divided by the number of species involved. The resulting average brain size became 1.0, and I then calculated the ratios of the brains of each of the other species in that size group to that average.

There are some problems with that method. Mainly, it assumes that monkeys and apes have approximately the same intelligence across a wide range of body sizes. That is almost certainly not true.

It also fails to capture the fact that if a small animal has a larger than average brain, the excess size can be very small in absolute terms compared to a larger animal with a similar percent of excess size. For example, let's say that a ten pound wild cat has a brain twice the size on an average cat. That might be 30 grams of extra brain weight. A 200 pound mountain lion might have a twenty percent larger than expected brain, but in absolute terms that might be 40 extra grams. Which is more important, the percent or the absolute amount?

The data itself is not perfect. I culled brain and body weight from a variety of sources, each with slightly different methodologies. Also a species can't be represented by one data point. There can be a range of brain and body sizes within a species. If the data on a species happens to be at an extreme edge of brain or body size for a species, that can mess up the numbers.

I didn't enter all of the data I had available to me. I didn't see the point of typing in every species of wild cat and weasel in every study I had available. That may have introduced subconscious bias.

Also, my approach breaks down above and below certain body sizes. There are no elephant sized apes or monkeys and while there are mouse-sized monkeys, they inhabit very different niches than their larger relatives and do not share their tendency to develop larger than average brains. Finally, it isn't universally accepted that brain size, or ratio of brain size to body size really relates to intelligence, or even that intelligence is a meaningful concept in terms of comparing animal species.

With all of those caveats in mind, here is what I came up with for the various mammal families (or in some cases orders) I looked at:

Family or Order	Average Ratio	Ratio Range	Highest in Family	Scientific Name	# of Species
Opossums	0.14	.09 to 0.21		Didelphids-Marsupials	4
Native Cats	0.18	0.14 to 0.21	Tasmanian devil	Dasyurids-	2
Australian Possums	0.19	0.13 to 0.23	Phalanger	Phalangerids/ Petaurids-	4
Rabbits	0.23	0.21 to 0.26		Lagomorphs	2
Mongoose/Civets	0.28	0.20 to 0.35		Viverids	10
Rodents	0.30	0.24 to 0.42		Rodents	5
Kangaroos	0.30	0.24 to 0.36		Macropids	9
Lemurs	0.35	0.28 to 0.40		Lemurids	6
Hyaenas	0.37	0.33 to 0.49		Hyaenids	4
Raccoons	0.46	0.33 to 0.64		Procyonids	5
Otters/Weasels,etc	0.47	0.14 to 0.68		Mustelids	24
Wolves, Foxes, etc	0.50	0.28 to 0.72		Canids	24
Cats	0.53	0.25 to 0.91		Felids	12
Marmosets	0.55	0.50 to 0.59		Ceboids	2
Old World Monkeys-(leaf-eaters)	0.67	0.55 to 0.79		Cercopithecoids	9
Bears	0.79	0.53 to 1.27	Sun Bear	Ursids	5
Old World Monkeys	0.95	0.78 to 1.27		Cercopithecoids	21
Apes	1.02	0.86 to 1.14		Anthropoids	9
New World Monkeys	1.11	1.00 to 1.61		Ceboids	6

Dale Cozort – Yes I usually comment briefly on the last issue of my own zine. First, as often happens I noticed an excessive number of typos and format glitches when I reread the zine, especially in the closing comments. Part of the problem with the closing comments is that I typed them in Scribus (the open source desktop publishing program). The version I have is still in beta and doesn't have a spell-checker yet. That doesn't excuse the lack of proofreading on my part. One of the more embarrassing glitches came in my comments to Robert Lichtman where I say that laser printers are getting downright affordable but that I haven't gotten one yet due to the cost of toner. I was actually intended to say 'color laser printers' rather than just 'laser printers'. I actually own three regular laser printers and I'm looking seriously at getting a color one. Second, it looks like I needed a bit more margin on the inside of the zine pages.

I don't know if I need to apologize for this, but when I reread the zine my response to Bob Silverberg's use of the term 'flyover country' seemed a lot more prickly than I intended for it to when I wrote it. As a Midwesterner I wasn't angered or annoyed by the term. I mildly dislike it because it can tend to be divisive. I wasn't taking offense and I hope I didn't give any.

In spite of the glitches I'm actually pretty happy with the zine. The stories illustrate about where I am talent-wise as a writer, though they are quite a bit less polished than they will be when I try to send them out to publishers.

Eric Leif Davin – Darn. You would have to debunk my favorite ancient Chinese curse. Now I'll have to call it "an ancient Chinese curse made up by some 50's science fiction writer'. Doesn't have the same ring to it. Oh well. Twilight on Olympus was a good read. I kept hoping for some twist that would let your hero survive, but it became increasingly obvious that wasn't going to happen, and your ending was appropriate. If you can't survive, at least die in the most meaningful way you can. Thank you for the reprint of your Fantastic Civil War story. Right down my alley as you suspected.

Gordon Eklund: I wish that my last movie-going experience was as pleasant as yours. A woman two rows in front of us actually answered her cell phone and carried on a fairly lengthy conversation the last time we went out. Of course my kids didn't do much better when they were younger. I remember sitting a couple rows behind my stepdaughter and a group of friends when she was eight or nine. First someone in the group spilled a monster-sized container of pop, which ran down the aisle like a waterfall. Then someone else spilled their popcorn (large container) into that waterfall. Add in the conversation about those events, and it was a tad distracting. Three thousand DVDs is a serious collection. I thought one of my friends was a serious collector with three or four hundred discs. Of course he rips out the copy protection on all of his DVDs, reworks the menus to his liking, and stores the results on one of eleven 350 GB hard drives he has in his main computer. He never downloads anything illegal, and never lets anyone download anything from
He just wants to have access to the material without having to sit through that stupid anti-piracy warning and the previews.

Good point on punk and lack of creativity. Good point also on the succession if both Lincoln and Johnson had been killed. You've almost talked me into trying something from Raymond Chandler—something I've missed out on so far in my life.

Dick Eney: The Star Trek convention sounded a tad depressing. These are the people who should be easiest to convert into science fiction readers, but apparently that just isn't going to happen for most of them. Your Guided Meditation sounded interesting. I'm not sure if I would want to try it due to my rather tenuous connections to reality in normal mode. Several of your comments veer into politics, something that nearly tore POD apart until the editor banned it. I suppose some political discussion is almost unavoidable in an APA,

but I have historically tried to avoid it, partly because what I have to say on most issues gets both sides angry with me.

Consider this a one-shot uncloaking, not to be repeated by me under any circumstances. I'm essentially unclassifiable politically. I think that the leadership and most of elected members of both major political parties have long since sold out their most loyal constituents and will continue to do so until those constituents stop being loyal. Democrats have not actually done much for members of industrial trade unions, for traditional liberals, or for African Americans since the mid-1980s. Republicans have never done anything substantial for social conservatives, and have certainly not done anything for fiscal conservatives or for libertarian conservatives since Reagan's first six years.

Presidents from each party have contributed in a major way to the long-term decline in US power and standard of living. Reagan's high-interest rates and large deficits pushed money away from actually producing things other than weapons and by keeping the dollar artificially high his administration presided over the dismantlement of several key US industries such as machine tools. By the end of his second term, the US consumed considerably more than it produced, and financed that consumption through net remittances from previous investments in the rest of the world. Under Bush Senior, the US started consuming more than those net remittances, in essence going from spending the interest on previous overseas investments to spending some of the principle. That accelerated under Clinton, and by the end of his second term we had not only used up all of our net investment in the rest of the world but now had the flow of interest going the other way. In essence under the Clinton administration we as a country went from having a savings account in relations with the rest of the world to being in debt big-time to the rest of the world and owing yearly interest, but still consuming more than we produced.

Starting with the later Bush Senior administration and continuing through the Clinton administration, the 'real' inflation rate was cloaked to a large extent by cheap imports from China, with the price of US-made goods rising at several times the overall rate of inflation and becoming less and less competitive. The cheap Chinese stuff was cheap partially due to the Chinese artificially holding their currency's value low in relationship with the dollar.

Reagan over-invested in the military. Then both Bush Senior and Clinton arguably under-invested in the military, especially in procurement. The US had huge stocks of Cold War weapons, and neither Bush nor Clinton saw the need to buy much more. As a result, a lot of the companies making weapons and spare parts for the military had essentially no orders for 8 to 10 years. Many of them went out of business or found another line of work. Nobody can afford to keep a workforce or an industrial plant sitting there producing no income for that number of years. As a result, when the Cold War stockpiles ran low in the late 1990s, there was no place to buy a lot of the spare parts or weapons that needed to be replaced. By the end of the Clinton administration, aircraft carriers were meeting each other at sea so that enough parts could be cannibalized from the incoming carriers and their planes to make the outgoing ones operational.

By the time Bush Junior came along, the US was no longer the economic or military powerhouse that it had been even as late as the 1980's. In many ways it was already a shell of what it had been. The stock market was overvalued because of the dot.com boom. The military had been downsized to the point where it was barely capable of handling the occupation of Iraq, much less dealing with a serious enemy. The US had consumed more than it produced or earned for nearly ten years. There was a huge gap between the price of US-made and Chinese-made goods. The US could no longer finance its consumption or its military on its own. Our economy and military power was and is entirely dependent on the willingness of the likes of Japan, China, and the EU to continue lending us money and to hold more and more overvalued dollars.

Given all of that, how has Bush Junior done? Well, the military is in somewhat better shape, but the economy is in far worse shape than it was when he came to office, with US manufacturing getting hammered more and more, and with a huge overhang of unrealized inflation. If China ever decides not to keep subsidizing

manufacturing exports to the US, or if the rest of the world ever decides not to keep subsidizing the US government by buying and holding dollars and government bonds, all of the inflation we would have had through the Bush Senior, Clinton, and first six years of the Bush Junior administrations will hit in a very short time, as the value of the dollar drops to and probably below where it should actually be. Of course the rest of the world would be economically devastated if that happened too because the EU, Japanese, and Chinese central banks hold hundreds of billions of dollars and dollar denominated bonds and companies from all of those countries depend on the US as a market for their goods.

Both political parties are doing things at the behest of corporate contributors and other interest groups that in the long run will be devastating to the US economy. For example, software patents make doing a computer software startup in the US virtually impossible without enough financial backing to hire a team of patent attorneys. Digital Rights Management schemes that cripple the usability of consumer electronics are being promoted by members of both parties. Both parties are allowing the basic idea of copyright laws to be subverted so that corporate contributors don't have to let things become part of the public domain when they should have.

Neither party has done much to deal with the threat of the baby-boomers bankrupting programs for seniors. Both parties have been engaged in massively transferring public funds to friends and contributors in various legal or in some cases illegal ways. Neither side has done much to deal with the oil addiction that is forcing us to spend money and lives in the Middle East. Neither party really deserves the votes of Joe Average citizen, and they don't even claim to. The best they can do is to try to distract voters with sound bites, scandals, and to claim that the other side would be even more disastrous.

Okay. Hopefully that's the only mention of politics that you'll ever see from me in these pages. Hopefully you can see why I tend to get both sides of the political debate mad at me on the rare occasions I do discuss it.

Tom Feller: I had trouble getting past the 'sole descendant' business in the DaVinci Code too. Makes no sense to me. The movie itself was okay, but not spectacular. Your Special Report on the Greece looked very nice. Good layout, nice photos.

Christopher J. Garcia: I enjoyed your 'Claims Department' zine a lot. I read it through and wanted more, which is odd because it isn't the sort of thing I normally like. On Life After Death: of course there is the being on mailing lists and telemarketers 'opportunity-seekers' CDs long after you die. My wife's dad still gets telemarketing calls and junk mail nearly five years after he died. So does my cousin who died around the same time. Okay, it isn't the kind of immortality most people hope for, but it's something I guess. It will be interesting to find out how long they stay on the mailing lists.

On Vespa-borne skinheads: I guess enough tough-looking people on just about anything would be intimidating. Well, maybe not on Segways. That could make for an interesting parody though. A gang of outlaw Segway riders? Back in school one of my friends used to ride to school on a moped wearing a huge menacing 'darth vader'-style black motorcycle helmet that he borrowed from his brother.

I enjoyed the artwork and the layout of both of your zines. Very nice. You mentioned being a Computer Historian. Sometimes I feel like I'm living in a computer museum. In approximate order of age, we have a Kaypro (CP/M-based), several Commodores (Executive 64, C128, Amiga 1000, Amiga 2000, CDTV, PC-40), a Newton, four laptops of various ages, probably half-a-dozen Windows desktop systems, and three Macs. When I somehow end up with unlimited time I hope to triage that mess and get it down to a more manageable three or four computers. Every time I go to my cousin's farm and see the mess he left when he died I push that cleanup higher on my priority list. There's a line from one of my uncompleted novels that goes 'He who dies with the most toys – makes his kids rent the biggest dumpster.'

Arthur D. Hlavaty: I've always thought that copy editing a book or story for someone else would make it impossible to enjoy that book or story. It doesn't work that way for my own stuff, but there I have the pride of seeing something mediocre but with potential turn into something better. Mulligan Stew sounds fun. I've toyed with the idea of characters coming to life and kicking me in the butt for not working harder to get the stories they're in published.

Floyd Patterson. That's a name I haven't heard in a while. I used to love boxing until I started seeing what it did to boxers' brains. I worked out a few times with a kid who went on to get a silver in the Olympics if I recall correctly. Man that guy was in shape. I thought I was too at the time, many years ago, but after three three minute rounds of hitting the heavy bag I couldn't keep my hands above my waist.

Ben Indick: As FAPA's newest member I'm not sure why there's a problem in terms of membership numbers. So far the zines seem enjoyable, the disagreements mostly civil, and the cost moderate.

Fred Lerner: I'm also surprised that Twain took the route he did in terms of Joan of Arc. If someone wrote an alternate history story with a character similar to her as a point of divergence most serious alternate history fans would write the story off as implausible. We live in an improbable time-line, where thugs come from nowhere to take over countries, and peasant girls overthrow empires, which should give us a certain degree of freedom in the imaginary worlds we create.

Robert Lichtman: I used to walk an hour pretty much every day back when we were a foster home for Northern Breed dogs (Sammys and one Siberian Husky). It really did keep me in shape. I dropped 20 pounds and kept it off pretty well until my stepdaughter went away to college and we stopped fostering the dogs. Your response to Silverberg on when you got into fandom. I was three years old in 1958. Makes me feel young, or at least not quite as old as I sometimes feel in the morning. Interesting analysis of the economics of hybrid cars. I wonder how they are doing after the recent gas price drop.

Eric Lindsay: Interesting about the shortage of skilled construction workers after your cyclone. I wonder if manufactured homes could fill some of the gap. My sister was looking into that and she found that kind of home quite affordable and of reasonable quality. We have a problem in the US in that for at least 50 years most of our best and brightest, along with most of the middle class has regarded hands-on types of jobs, even skilled ones, as being beneath them. As a result, even in normal times we often run into shortages of competent electricians, plumbers and the like. Your response to Fred Lerner: I'm glad to hear that someone else misses keyboard capable PDAs. I still have an old one, but I rarely carry it anymore.

Ron Parker: Nice looking zine. Interlineations look a lot like Internet taglines. If I ever think of anything clever enough and short enough I'll try one. Oh wait. How is this (to the tune of Home on the Range)

Home, home at Lagrange
Where earth and moon have equal sway
And seldom is heard a retrorockets surge
Cause if you put something there it will stay.

Is that what you're after? I'm not sure if I just made that up or heard it somewhere. Memory can be a tricky thing sometimes.

On webpages and software. I used to use FrontPage for my web site, and sometimes still do if I want to do something quick and dirty. I've tried the Open Source program Nvu at times, but it sometimes dumps a lot of random garbage into your html code. I know enough html to hand code it and I sometimes do that for quick and dirty jobs also. A lot of people I know swear by a freebie program called FirstPage 2000. You can hand code using it, but it also gives you quite a bit of assistance in the coding process.

On getting shot and not noticing it: I've always wondered if that could really happen. It sounds like you were in some kind of shock. About 30 years ago I fell through a plate glass window. I cut my face open to the tune of over 30 stitches, and broke a cheekbone. I didn't feel hurt at the time. My face just felt a little wet. When the shock wore off they put me on some very powerful pain killers, probably something in the morphine family, so I didn't actually feel much pain until several days later when they took me off of that and put me on something less powerful. Oh did I ever hurt then though.

Robert Micael Sabella: Your comment to Speirs on being older than your parents were at the time of a picture sums up something I've been realizing lately. One of my uncles died of prostate cancer at age 72 about two years ago. At the funeral it hit me that I knew him for years when he was younger than I am now, yet he always seemed so adult, so much a part of another generation. I also remember seeing a picture of one of my aunts who I had only known as a sixty-plus year-old woman. As a woman in her early twenties she had been knock-out gorgeous. Your comments to Fred Lerner: My job, computer support person for some networked PCs didn't exist when I was in college. As a matter of fact PCs as such didn't exist back then, though there were some systems that moved in the PC direction. Your comments to Hlavaty: I agree with all of your joint 'things about you' except 20 and 64. I like to exercise, though I prefer reading and computer stuff. Your comments to Tom Feller: Yes, I've noticed that the fantasy and science fiction part of the APA is sometimes a tad nominal; at least in the two distributions I've seen. Oh well. As long as the writing is entertaining or informative it works for me (not that anyone needs my approval for what they write). I enjoyed your cheat sheet of books to be avoided at all costs. I also enjoyed your humor sections.

A Langley Searles: Interesting bit about William Beckford. That kind of wealth in different hands could have had interesting consequences. If Beckford or one of his descendents had sought political power or sponsored some aspect of the physical sciences…interesting alternate history possibilities there.

Dale Speirs: I enjoyed the essay on the history of envelopes in Opuntia 61; not a big slice of history but a fun one. I also enjoyed the summary of the article that claimed that photosynthesis led to the development of continents, as well as the ones about 40,000+ year old human footprints in Mexico and the economic analysis of the megafauna overkill hypothesis.

I'll have to look up the article on 700,000-year-old human fossils in England. I had assumed that the earliest wave of humans to reach Europe stuck around to eventually become Neanderthals but one recent book on Neanderthals claims that humans were probably pushed out of Europe a couple of times during ice ages, and the continent was then repopulated from warmer climates. The author also claims that Neanderthals pretty much required a forested habitat and that open country was very marginal habitat for them. He says that open country required a lot of mobility and the powerful, bulky Neanderthal bodies wore out too quickly in that habitat and developed crippling arthritis. He claims that modern humans are essentially an adaptation to open country, which had previously been marginal territory for humans. The move to open country required more mobility, which led to less powerful humans more capable of covering greater distances. It also forced modern humans to miniaturize their tools, even though that required a great deal more effort. He says that in places where Neanderthals were forced to adopt a more mobile open country lifestyle they miniaturized their tools, but in less marginal habitats it wasn't worth the bother to them.

I'm somewhat skeptical of the claim that humans were totally pushed out of Europe at any point. Spain and Italy should have provided refuges even during the coldest periods. The Italian mainland would have been connected to Sicily during the ice ages, which would have extended the continent even further south.

Speaking of Italian refuges, apparently someone recently found a Macaque skeleton in the late Pleistocene in Italy. That dates to long after non-human primates were supposed to have become

extinct in Europe. It's possible that the monkey or some of its bones were brought to Europe by humans, but if not there may have been a remnant monkey population in Italy not too long before the Neolithic.

Interesting article summary on the huge Bronze Age eruption of Vesuvius. You mention your farming experiences. I've had a few of my own, including walking down to the creek in subzero weather and howling winds to chip holes in the ice so the cattle could drink. Farming is not something I would want to do for a living, though obviously I'm glad somebody is willing to do it. I've given both my daughter and my stepdaughter some exposure to the farming life through an aunt and uncle who owned a family farm. It's good for them to know where their food ultimately comes from, and hopefully the exposure will make them less susceptible to 'get out of the rat-race' syndrome later on.

Milt Stevens: Good to see that there is another Buffy/Angel fan in the APA. I have complete runs of both also, and I'm also a big fan of Firefly. You might also enjoy Veronica Mars. It isn't as good as Buffy and it has no science fiction or fantasy elements, but at its best it is pretty good.

R-Laurraine Tutihasi: Nice looking zine. Your printer sounds wonderful. It also sounds like it might be out of my price range at the moment, unfortunately. Your response to Speirs. Like you, I struggle with how to deal with both a print and an on-line version of my zine for POD. The ultimate solution would be monitors large enough to comfortably display a whole page of info. Some of the expensive old dedicated word processors from the eighties had screens like that. It probably wouldn't be too hard to do something like that now, or just set up flat screen monitors to easily rotate to 'portrait mode'. PDF is a solution of sorts, but with obvious drawbacks. I hear that Microsoft is planning to spin off some of the display capabilities of Vista to produce a 'PDF-killer'. Microsoft and Adobe have yet to lock horns in a major way but given how aggressive Microsoft is and the profit margins of the Adobe products, I figure that a collision between them is inevitable in the long run.

Art Widner: I enjoyed your extra 5 commandments and your definitions of a gentleman. Being a gentleman has pretty much gone out of fashion these days, as has being a patient wolf, which is a pity. At least playing accordions in public hasn't caught on.

R. Alan Everts, Mike McInerney, Norm Metcalf, Keith A. Walker, Roger Wells : Read, no but comments.

SPECULATION: CLOSING COMMENTS

Well, I'm almost out of room. So far I haven't finished any of the things I started last issue. I'll try to at least finish my thoughts on solar cells from last issue.

As I said last issue, the solar cell industry is expanding fast. It spent a billion dollars expanding capacity in 2005. It has raised at least $1.8 billion in the last 12 months for continued expansion. Industry projections call for the addition of capacity equal to all of world production in 2003 every year between now and 2010--2.5 gigawatts of additional capacity by 2010. Based on the amount of

capital raised and the amount of production already being built, that's probably realistic.

In 2003, a production capacity of 300 megawatts/year would have been more than half of worldwide production. Now the single largest solar cell company, Sharp, produces 400 megawatts/year. Several other companies produce 100 megawatts per year or close to it. A number of companies that are producing 30 megawatts or less per year now will probably be producing 300 megawatts per year by 2010. That's got to stretch every resource, from managerial capacity, to raw materials, to financials.

Darpa recently tossed another wild card into the equation. Most of the cells on the market for terrestrial use are 10 to 20% efficient. Darpa is sponsoring a project that they hope will lead to 50% efficient cells. That kind of efficiency is theoretically possible, and the very expensive cells on satellites are much more efficient than terrestrial cells. The problem is getting the cost down. Darpa is interested because the military is a major user of electronics . Supply lines of batteries and fuel are vulnerable, and the military would like to replace a lot of batteries, generators, and tanker trucks with solar panels.

Now the bad news: even if all of this expansion actually happens, solar cells will still be a minuscule part of the energy equation, producing a fraction of one percent of worldwide energy.

Approaches to Affordable Solar Cells

The fundamental problem: Most solar cells are made of highly purified silicon. This is the same stuff used in computer chips, and is very expensive on a per-square-inch basis. The silicon is grown or cast into cylinder-shaped ingots, usually six inches in diameter, then sawed into thin wafers, wasting a surprisingly high percentage of the silicon. Solar cell based power typically costs around $4.50 to $5 per/watt, around five times as high as power from a coal powered plant.

Other solar cell candidates, such as amorphous silicon, are cheaper to produce, but historically have been much less efficient. That's okay for small-scale applications, but not for roofs or power plants.

Approaches to reducing cost: Increasing cell efficiency: Typical silicon solar cells these days are in the 12 to 16 percent efficient range. Some manufacturers—most prominently SunPower (a subsidiary of Cyprus Semiconductor)—are making progress in getting that up. SunPower recently announced production cells that are more than 22 percent efficient. That's pretty good for cells aimed at terrestrial markets, though exotic solar cells for the space satellites go as high as 28 percent. Raise efficiency from 15 percent to over 22 percent without raising cost of production per cell, and you end up with a major cost reduction.

Decreasing waste of silicon: One major US manufacturer grows their silicon in ribbons, which can then be cut into rectangular wafers with a lot less wastage of the expensive silicon.

Making the silicon less expensive: Solar cells don't need the kind of purity in their silicon that computer chips do. Until recently there hasn't been a large enough market for solar cells to justify building manufacturing plants to produce 'solar grade' silicon—just pure enough for solar cells. With the growth of the market that's changing and several companies are building plants to produce solar-grade silicon. Some companies are also increasing the diameter of the ingots they produce, which lets solar cell manufacturers produce a panel using fewer cells. Typical ingots these days are 6 inches in diameter, but 12-inch ingots are on their way.

Economies of scale: Historically, doubling the amount of production produces an 18% decrease in the cost of producing solar cells. That hasn't been true lately because the very fast growth has led to a shortage of silicon. That should ease as more production comes on line, and hopefully the economies of scale will kick back in.
Using some other material: The leading alternative to silicon is a mixture of materials called CIGS (Copper Indium Gallium

Diselenide). CIGS cells are usually slightly less efficient than silicon, but they are potentially much cheaper. As I mentioned earlier, Nanosolar is building a plant that they claim will produce 430 Megawatts of CIGS solar cells per year within a couple of years. They also claim that those cells will be cost-competitive with traditional power sources. They have $100 million in financing to try to prove they can do that. Durability has been a concern with CIGS cells, but Nanosolar claims to have solved that problem. They also claim that they can build their 430 Megawatts of production capacity for about one-tenth of what it would cost a traditional manufacturer. If both claims are true, solar power could see a take-off that will make the current growth look puny. Based on past history, ramping up manufacturing will almost certainly take longer and be more expensive than they predict, but we'll have to see.

But Will It Save Us From Peak Oil ?

A recent article in Scientific American summed up solar cells as "Growing fast but still a sliver." All of the solar cells produced through 2005 generated roughly .02% of the world's electricity. If production increases at the high end of industry predictions, annual production would amount to between .015% and .02% by 2010.

Could production be ramped up faster? Maybe, but not easily. The industry is expanding as fast as it can reasonably be expected to right now. Part of the problem is money. For current production processes, 500 Megawatts of additional capacity would mean an investment of $1 billion. Using current production methods, adding even one-tenth of one percent of world electrical capacity per year would take roughly $32 billion in investment for the manufacturing plants alone, and it would not even keep pace with the rise in electrical demand.

If Nanosolar can do what they say they can do, then fast expansion gets a lot more feasible, but that has yet to be proven. Even if the money was there for that kind of growth, I doubt that the rest of the infrastructure would be. Could the plants making solar cell production machinery produce fast enough to make that growth possible? Would there be enough trained production technicians and quality assurance people for the solar cell industry? Enough people to actually install them? Production is already limited by a shortage of silicon feedstock, and even if all of the planned expansion in silicon production actually happens production of silicon cells would be limited to about 8 gigawatts by 2010. That would make a substantial industry but it would still be a sliver of world energy needs.