Affiliation of Christian Engineers *and* Scientists in Technology (CEST) Newsletter

Spring 2015 Issue 34 **American Scientific Affiliation/Canadian Scientific & Christian Affiliation**

IN THIS ISSUE

From the Editor

In last Fall's newsletter I wrote these comments:

> "What is to be the future of CEST? By the end of this year I will have turned 75 and will have completed 50 years in the ASA. I do not plan to prepare CEST newsletters beyond the time of the ASA 2015 annual meeting at Oral Roberts University.
>
> "I would be glad to publish your comments about whether CEST should continue, what it should do, and your interest in helping in some way."

If you are interested in the future of CEST perhaps you would like to volunteer or nominate someone else to serve as president, secretary-treasurer, or newsletter editor. Please send me your comments.

This newsletter is intended to facilitate camaraderie and exchange of information among CEST members. Reader responses and other inputs are welcomed. Please send me **your** input for this newsletter.

- Send an account of a project you worked on.
- Send a note about something you've seen in the news that you think others would be interested in.
- Send a response to one of our math, physics, engineering, etc. challenges.
- Send a challenge question of your own.
- Send an article about something you've been thinking about.
- Send a photo you took.
- Send a comment on something you read here.

My thanks to those who contributed to this issue, i. e., Dennis Feucht, Dave Kramer, and Bruce Nelson.

We'd be glad to get your input!

BY ■

The Spider and the Fly II

This problem, which was posed in the last two issues of this newsletter, has been solved by a reader. Here is the problem:

Consider a room that is a cube. A fly is caught in the spider's web in the center of the ceiling. From a certain area on the floor there are 12 different straight-line paths to the fly. Describe that area. Use a sketch if you like. Please send your answer to lwyoder@ieee.org. We'll acknowledge correct answers in the next newsletter.*

**straight-line in the sense that if the room is "unfolded," spider paths across floor-wall, wall-wall, and wall-ceiling joints will be straight lines.*

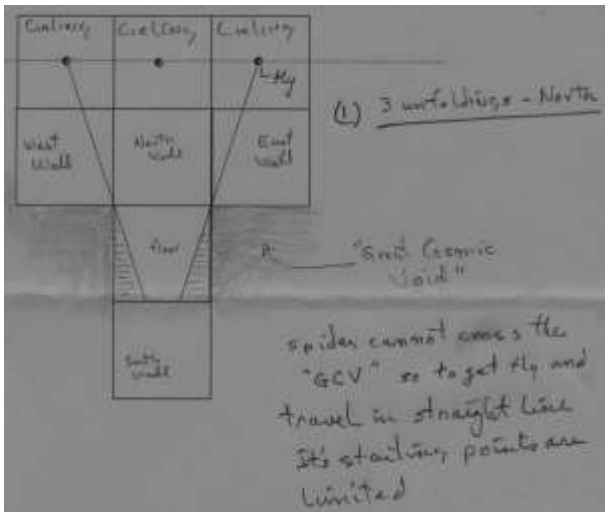
Bruce Nelson (Abiquiu, NM) sent the following solution:

Hi,

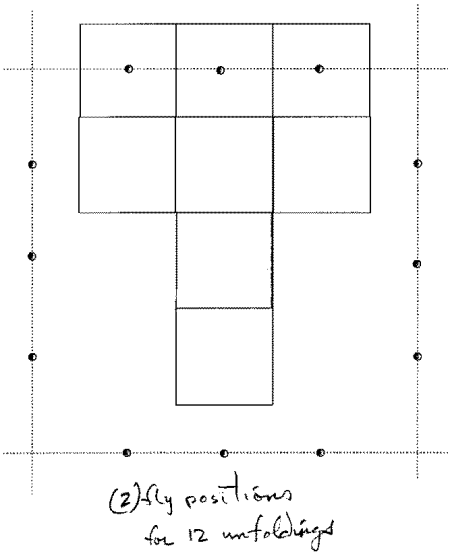
I don't know if Spider-fly II was easy or hard. When I first read it, I got nowhere and went after S-F I (and didn't get far with that either). Then I was off doing other stuff - feeding birds, shoveling out 2 snow storms - a total of 6 or 8 inches. Got your email and after a few days, doodled a diagram and the answer jumped up and bopped me in the nose!

Here are 3 figures that show the spider's 12-Fold Way.

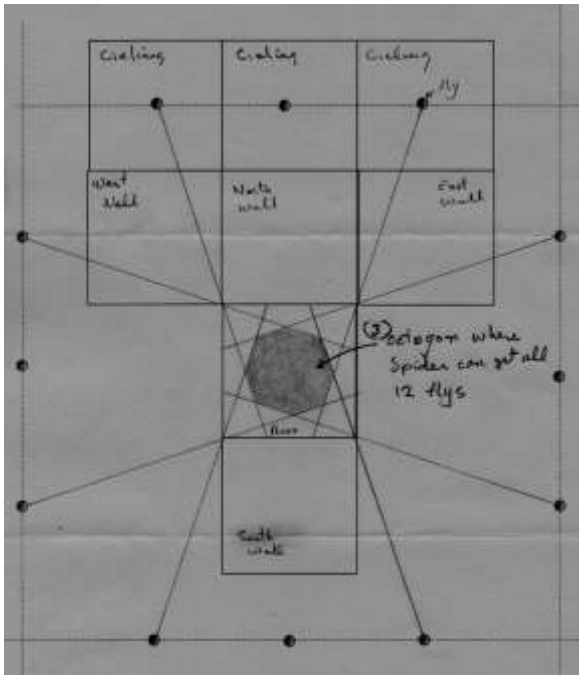
The first figure shows 3 unfoldings of the cube to the North side. The fly is the dot in the center of each ceiling instance. The spider can't get to the fly in a straight line in the left or the right unfolding from certain floor positions. (Spider doesn't know about the worm hole through the Great Cosmic Void.)



The second figure shows the fly positions when one does unfolding as in figure 1 but to the East, to the South and to the West as well.



The third figure shows the octagon centered on the floor where the spider can get to the fly via any of the 12 straight line paths.



QED

Thank you Bruce!

BY ■

New Challenge:
When is Cheryl's birthday?

Dave Kramer (Chelmsford, MA) submitted this challenge problem which he found in the New York Times Science section.

Apparently the problem came from a math olympiad test for math-savvy high school-age students in Singapore.

How would you fare in a room full of adolescent math competitors in Singapore?

The problem:

Albert and Bernard just met Cheryl. "When's your birthday?" Albert asked Cheryl.

Cheryl thought a second and said, "I'm not going to tell you, but I'll give you some clues." She wrote down a list of 10 dates:

May 15, May 16, May 19

June 17, June 18

July 14, July 16

August 14, August 15, August 17

"My birthday is one of these," she said.

Then Cheryl whispered in Albert's ear the month — and only the month — of her birthday. To Bernard, she whispered the day, and only the day.

"Can you figure it out now?" she asked Albert.

Albert: I don't know when your birthday is, but I know Bernard doesn't know, either.

Bernard: I didn't know originally, but now I do.

Albert: Well, now I know, too!

When is Cheryl's birthday?

If you figure it out, send me the answer and I will acknowledge you in the next issue. If your kids in high school can answer it, send their names, too! Send to lwyoder@ieee.org.

BY ■

***Technology in the news*:**
Graphene for efficient photovoltaics

For the past dozen years researchers have been studying grapheme and considering potential uses for it. Here is a paragraph from Wikipedia.org's article on graphene:

"As of 2015, graphene is not used in commercial applications. However, many uses for graphene have been proposed or are under development, in areas including electronics, biological engineering, filtration, lightweight/strong composite materials, photovoltaics and energy storage. Graphene is often produced as a powder and as a dispersion in a polymer matrix. This dispersion is supposedly suitable for advanced composites, paints and coatings, lubricants, oils and functional fluids, capacitors and batteries, thermal management applications, display materials and packaging, inks and 3D-printers' materials, and barriers and films."

A recent IEEE Spectrum news note, "*Proven: Graphene Makes Multiple Electrons From Light"* at http://spectrum.ieee.org/nanoclast/green-tech/solar/graphene-gets-another-boost-in-high-conversion-efficiency-photovoltaics says in its first and last paragraphs, respectively,

"Researchers at École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland have for the first time observed and measured graphene converting a single photon into multiple electrons in a photovoltaic device. This work should buoy hopes that graphene can serve as a material for photovoltaics with very high energy-conversion efficiencies.

"But if multiple electron generation can—as some hope—boost conversion efficiency to 60 percent from what was thought to be a 32 percent limit, then proving that the event indeed occurs is well worth it."

BY ■

***Technology in the news*:**
New approach to fusion energy: the Dynomak

An IEEE Spectrum article at http://spectrum.ieee.org/energy/nuclear/inside-the-dynomak-a-fusion-technology-cheaper-than-coal discusses a new type of fusion energy machine called a dynomak. Here is a paragraph from the article:

"The University of Washington's dynomak is a refinement of a subtype of tokamak called a spheromak. The most important difference is that the spheromak does away with most of the tokamak's expensive superconducting magnetic coils. Instead, a spheromak uses the electric currents flowing though the plasma itself to generate the magnetic fields needed to both stabilize and confine the plasma."

According to their projections the cost to build a 1 gigawatt dynomak fusion power plant could be slightly cheaper than that of a 1 gigawatt coal power plant!

BY ■

Technology in the news: Desalination in China

An article in the April 13, 2015 issue of Bloomberg Business week posted at http://www.bloomberg.com/news/articles/2015-04-09/china-embraces-desalination-to-ease-water-shortages reviews China's plans to produce 800 million gallons per day of purified seawater by 2020. The projected cost for the water will be about 7 yuan per cubic meter (about $4.31 per thousand gallons).

BY ■

Misguided Directions for Engineering Part 1

Most of us engineers concern ourselves with detailed technical problems, and a few also reflect on the long-range effects of technology on society - in particular, about whether technology in the larger, long-term picture is not causing as much trouble as it ameliorates.

Most of the earth's human population is weighed down by a constrained life, seeking its necessities. People in the developing world often do not go through what Americans call *adolescence* but must do what must be done - which is what *can* be done. At age 12 or 13, they take on adult-like responsibilities of carrying out farming tasks, for instance. Otherwise, they will have insufficient food; it's that simple. In contrast, we in the developed world have had the luxury of growing up leisurely, of benefiting from extensive education while being supported in what at the time is a parasitical existence upon others. We have the luxury of time to think, although that luxury is disappearing. Yet it is underappreciated because it has been so abundant. The consequence is that too many people are not thinking much about where not only their own lives but the larger human setting in which they function is headed.

I see two ways in which the developmental direction of technology can become misguided. The first is from overtly evil intentions. If humanity were redeemed, swords would be beaten into plows and institutions having the purpose of killing and destroying would have no place in society and would not be supported by technology. The argument can be made that in a morally fallen world, militaries are a necessity, to thwart evil. Just-War-leaning Christians accept, though with varying degrees of reluctance, the need for weapons, war, and weeping over the situation, while those from more of an Anabaptist viewpoint see in a closer look at history that there are no *just* wars, there are just *wars*. (I will leave aside the exceptional case where Yahweh involves, though with reluctance, humans in his own wars, such as in the conquest by his covenant people, the Israelites, of Canaan.) The case of evil intentions driving humanly-originated wars can certainly be made with some force for each of the wars in the history of the government on the Potomac - and especially so nowadays.

The many sophisticated methods for fooling people into accepting false beliefs, such as justifications for aggressive action by those in power, is itself a form of social engineering in which the entire enterprise is borne of foul intent. For this article, we will stay within the scope of engineering involving improvements over what we are given in the form of nature, not society. This first kind of technological misdirection has a major impact on the natural-engineering world, for many projects and resources are directed to the development of technology to be used for what in the end are destructive purposes, whether justified or not. It is not only military technology but also methods that give those in power undue surveillance and control over others. This category of technology has as its ultimate purpose to either enslave or keep from being enslaved, to empower or disable stealing, killing, and various other manifestations of breaking the Law of Yahweh. It is, in short, technology that exists because of the moral deficiency of humanity, used to either express or inhibit it.

The second way technology can leave the narrow path of life is not from evil intent but from human inability to see the larger consequences of the many incremental developments and what their end is. For this, we return to that vast horde of engineers working on detailed problems - a faster, more linear amplifier, a more efficient pump, a wing with less drag, a cheaper chemical process, an examination of a failure mode. And in all of this ordinary engineering work - in project after project all over the globe - clever minds are finding ways of incrementally improving technology, of optimizing performance, of doing it simpler and better for the next generation of products, and applying the occasional breakthrough. Opportunity draws the creative engineer to seek new paths leading from the paved road of established engineering to the gravel roads needing improvement and with potholes of ignorance needing refinement, and on further to the dirt paths of research where few tread, leading into the wilderness where only sci-fi (which is usually tech-fi) lurks.

We now stand back and ask whether the many incremental motions forward have placed the road of technology along the best course. Has technology developed in the only way it could have? Probably not. Although the physical and biological laws of nature constrain possible solutions to engineering problems, within those constraints are multiple alternatives which the engineer is free to choose. Comparison of technology in relatively isolated societies such as Euroamerica and the Iron Curtain countries during the Cold War or Japan during the shoguns, shows that the path of technological development is not deterministic; human will is involved. Cultural orientation affects it.

If the course of technology is not deterministic, then is there for technology an analogous "hidden hand" that Adam Smith postulated, a hand that guides the dynamics of free markets? The minds of engineers proverbially plan the way forward, but the Lord directs the steps. It is the sum of all of human technical decision-making that has resulted in the present state of technology. While God will use the historical development for larger purposes than we might conceive, yet even engineering is tainted with human imperfection in knowledge and wisdom. The purpose of my article in the previous *CEST Newsletter* was to draw attention to engineering in a larger context, suggesting that not all of the important criteria have been taken into account - namely, the *sustainability* of technology in the ecosphere. In this article, I want to draw attention to another often overlooked criterion for technology. Perhaps it could be called *robustness*, but it is more clearly expressed in the negative, as *vulnerability*.

Human life for much of the global population is no longer merely aided by technology but *depends* on it. Urban life

is exceedingly vulnerable to mishap because of this extreme dependence. A group at Cornell U. recently did a study of what would happen in America if there were a major virus epidemic. The study concluded that the best response to survive would be to "head for the hills" - or more exactly, to the northern Rocky Mountains - but that this would be inadequate and the prospect for survival, they concluded, was grim.

Another example is the vulnerability of urbanized populations to an EMP event such as an electromagnetic-pulse atomic bomb or a strong solar flare. One such bomb detonated over the center of the American land mass at a 100 mile altitude would produce a quick neutron flux followed by a flux of current with a high charge density capable of destroying the electric power utility grid and unshielded solid-state electronics. This would result, in a matter of minutes, in a regression of the technological state-of-affairs to that of the early 1800s, yet with a population dependent upon electricity to supply them life's essentials. Without electric power, pumps do not move water or sewage or crude oil, gasoline or natural gas. Refrigerators do not preserve food, buildings are not heated, industry shuts down, communications and transportation ceases, medical equipment stops working, electric tools become useless, and pencils used by older engineers must again be sharpened with a pocket-knife. Advanced society would cease, and with the discontinuity, social stability would dissolve. In the end, millions would die. Studies of this scenario predict that most of the American population would die within three months. All of this would occur simply because the course of technology did not factor in the *vulnerability* being created by such dependence upon it.

An EMP event is not a distant possibility, but other causes for technological collapse also exist short of an all-out nuclear war. As technology "advances" to greater amounts of vulnerability with the IoT (Internet of Things), an Internet cyber-attack could equally collapse the technological infrastructure. The Stuxnet computer virus was used by the U.S. to not only disable but damage centrifuges used for uranium isotope separation in a secure facility in Iran. Recently, a sniper shot to failure a transformer in a power distribution station in the Silicon Valley area. Although the scale of destruction was not widespread, the event brought briefly to the attention of the public the vulnerability of the infrastructure. With suitcase-sized nuclear bombs and Internet access, the balance of power has shifted back from large, powerful central states to small groups or individuals, and the states of the world are defenseless against such technology.

Centralized security is now more vulnerable too. The large, organized security infrastructure of police, military, and intelligence operations are designed to successfully deter large-scale armies or criminals lacking the firepower of the police. Organized gangs such as drug cartels or groups projected as hostile in the Middle East are not supposed to have the intelligence capabilities of the large states. Yet the Internet has placed the largest library in human history into the hands of nearly everyone. Secrets by large states and their political operatives are now much harder to keep. What is done in secret is shouted on the "rooftops" of alt-net news and covert leak sites. The intelligence capabilities of large central governments are now being acquired by small groups.

The emergence of terrorism as a central feature of today's world is a result of the inability of large states to defend against small groups. Washington is leading the way in response to this social shift caused by technology with desperate behavior, building a militarized security state. Technology has been developed for recognizing individuals by their faces. Other similar technology that emerged from work on robotics and artificial intelligence from past decades is now being applied to empower the state against the individual. Cameras are everywhere in urban areas. Drones and airborne platforms are looking down on cities. Surveillance is expanding to deterrence as robot policemen are put on the streets, an early version of *Robocop*. Sci-fi is hardly lacking in developing this theme.

As engineers, we know this advanced technology is not refined and hardly foolproof (as illustrated dramatically by sci-fi movies: *Minority Report*, *Eagle Eye*, *Eschalon*, *Elysium*, no less the *Terminator* series), and when it is used by the state to make decisions that are in essence judgements on individuals carried out by the police power of the state, then the result is rule by machine, or automated justice. This would not have been possible without the course of technological development that occurred last century.

While some events, such as devastating solar flares, exceed human powers to counteract, what is within the will of humans to effect is ours to contemplate as engineers. Could technology have taken a different course that could have avoided much of its ill effects today? And can such a course still be taken? This line of inquiry is to be continued in Part 2 of this article.

Dennis L. Feucht, MAR 2015

Misguided Directions for Engineering Part 2

Could technology have taken a different course that could have avoided much of its ill effects today? And can such a course still be taken? An alternative course for technology is developing in parallel with the technology of centralized control and vulnerability. Technology is related to the social structure itself. The trend in social organization during the industrial age has been the consolidation of power and control, the centralization and standardization of decision-making, and the reduction of diversity in favor of large-scale and uniform repeatability. This course is reaching its apocalyptic end as technology which empowers the individual emerges.

One major example of a reversal of this trend is off-grid electricity. Solar panels have finally developed in scale to be cost-competitive with the centralized electric power grid. The Internet, though centralized in some ways (URLs and website name assignments) is a distributed network with a routing protocol that is not dependent on centralized decision-making. By hindsight, this could also have been applied to radio and TV station bandwidth use, eliminating the need for a centralized government agency (the FCC) to assign operating frequencies to stations and issue licenses with state-imposed conditions attached. Although the feasibility of this distributed control alternative might be inconceivable to Americans, it is this way in Italy. The result is not the expected massive interference on the radio bands. Other self-regulating social principles come into play - some other kind of

"hidden hand" - that result in radio spectrum use not unlike the USA, but without an FCC to centrally control and manipulate it.

Yet another example is the control of traffic in large urban areas. It is centralized in the USA, with street lights at every downtown intersection and a central control room staffed by traffic engineers. To the mind conditioned for centralized control, it is infeasible to consider simplification of the system by abandoning street lights. The imagined result is confusion on the streets, chaos, and frequent accidents; it just would not work. Yet it does. I counted only three traffic lights in a city of over a million people elsewhere in the world. Were cars colliding everywhere? No. The traffic in Panama City operates in a different manner than North Americans are accustomed to, and the end result - that of effective transportation in a high traffic-density environment - is equally well achieved with a simpler system. Horns are used more but traffic lights cost far more than horns. Drivers develop localized decision-making skills.

A continuing trend in technology toward centralized control is the control of products after they have been bought. Manufacturers expect you to buy their products without telling you what they are. They want to retain control over the technical knowledge of the product so that you are dependent upon them in their after-market racket of expensive and controlled-access repair. This is driven by a desire to keep the technical details out of the hands of competitors, though any competitor who really wants such information can reverse-engineer the product. So can customers who are engineers, but at the expense of much time and effort. The open-source and repair-ware movements are responses to this centralized technical control.

Engineering is driven more by political fashion than it might at first appear. The organization of the social order is not isolated from engineering trends. In the last century, the social order in the developed world has developed significantly toward collective, centralized control, or what is popularly called *socialism*, characterized by large central governments that micromanage every aspect of life. Technology has been following this same path. Decentralized decision-making and control reverses this trend, turning it in the opposite direction toward something like *libertarianism*, in which localized responsibility, decision-making, and control is exercised. This opposing trend in technology is empowering individuals, and this clashes with the power of the centralized state.

Which is biblical, centralized or distributed control? Put simplistically, which form of government, centrism or libertarianism, is given in the Bible? Despite the popular notion in the churches that God leaves it to us humans to choose our own form of government, the prominent theme of scripture is the human-divine relationship as expressed in the form of a suzerainty covenant. The kingdom of God, as constituted in the covenant, not only establishes the supreme authority of Yahweh (rather than "We the People") yet at the same time, is highly distributed in its operations: structurally authoritarian and operationally libertarian.

Yahweh is the superior party and his people are organized under him to act freely within covenantal law. The authority originates with Yahweh while decision-making is distributed in the form of adjudicating the human obligations of the covenant - the law - by his people, who are not given the authority to make up their own law, of legislating. Yet legislatures are a common institution in governments today, in defiance of God's repeated prohibition against adding to or subtracting from his law (Deuteronomy 3:2, 12:32) which is given and unchanging, yet remains to be interpreted and applied using human ability. Most Christians of today do not think twice to involve themselves in the sin of Adam, in support of legislative activity, all the while ignoring much of what is explicitly given us to obey. The deeper consequences of the law of God remains to be further explored in the context of how we apply our abilities in engineering, in choosing which problems to solve that will contribute to social advancement in the spirit of and direction supported by God's law.

The kingdom of Yahweh does not fit the post-Enlighenment political categories (no less pejorative language lacking much definitive content such as *conservative* and *liberal* or *right* and *left*) but is grounded in what is more basic: truth and justice (righteousness), which is defined by God's covenant. We are not empowered by God to decide for ourselves what is true or good though the covenant empowers us to apply the insight the law gives us in the doing of good. For engineers, this is the solving of problems that overcome real disabilities and that free society to a greater pursuit of what is good and true. It is not hard to find examples of engineering efforts motivated by the fickle desires of an affluent market, or by doing what can be done merely because it is possible or appeals to the baser instincts of a sufficient size of market. In the 1960s, one of the "prophets" of top-40 radio, Paul Simon, wrote a song, *Big Bright Green Pleasure Machine* (Simon & Garfunkel), that was critical of engineering gone awry to please the idolatrous desires of the buying public.

Consequently, to the extent that the course of technology has parallels with the course of human social organization and dynamics, and that its normative form is that proscribed by God under the covenant, engineers who recognize the authority of the law of God will also be influenced by it in a parallel way in our engineering activities. We will seek to make technical contributions of a kind that are directed by the "hidden hand" of God that do not lead to the collapse of what is true and right in civilization but enhance it instead.

ASA/CEST Newsletter Distribution

The primary distribution of this newsletter is via email to ASA/CEST members as indicated in the ASA's online directory. Members are expected to keep their email address up to date there. No paper copies are mailed. Recent past issues are located at ***http://www.asa3.org/ASA/cest*** *. All issues are archived at the YahooGroup asa_cest@yahoogroups.com web site, where they are accessible to group members. To join the group, go to groups.yahoo.com/group/asa_cest/join and follow the instructions.*

Bill Yoder, ed. ■

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