Christian Engineers and Scientists in Technology Newsletter

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IN THIS ISSUE

From the Editor

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., Dave Kramer, and Dennis Feucht.

We'd be glad to hear from you!

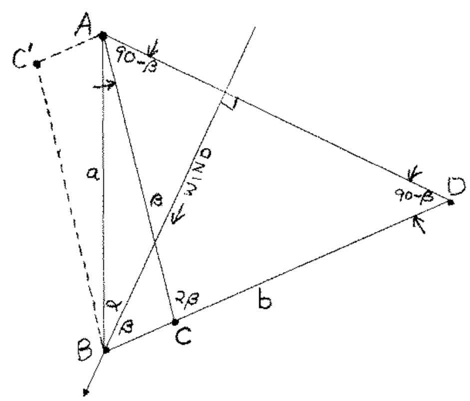
BY ■

Solution to *Winter 2014 Challenge #1* *Sailing Problem*

The problem as submitted by Dave Kramer, Chelmsford, MA (Adapted from MIT's Technology Review magazine):

A sailor wants to sail to an island, but the wind is coming from a direction just 20 degrees from a direct line to the island. He figures he'd have to tack. What path should he take in order to minimize his time en route? Assume his speed is proportional to the wind speed and sin|β| where β is the angle between the boat's direction of progress and the wind direction. [Note that I've made it explicit that the boat speed is symmetrical around zero. Surely all readers assumed that.]

Since I didn't receive any solutions, I decided to publish my own solution. Here is the picture:



The wind is blowing in the direction of the arrow. The sailor wants to sail from B to A (a distance of a) and decides that he will have to tack so he is not sailing so hard into the wind. So he will sail from B to C then to A (or from B to C' then to A). Thus he will sail β degrees on one side of the wind, then β degrees on the other side till he reaches A. A quick inspection of the drawing shows that A-C-D is an isosceles triangle so the line segment C-A is equal to C-D. Thus the total distance to travel is B-D (= b), which, divided by the speed, will yield the time of transit. This is to be minimized by properly choosing the angle β.

We need to write an expression for b in terms of a, α, and β, then divide it by the boat's speed to determine time. Finally, we'll determine what value of β minimizes the time. We can use the law of sines to write

$$\frac{a}{\sin(90-\beta)} = \frac{b}{\sin(90-\beta}$$

$$b = a\frac{\sin(90-\alpha)}{\sin(90-\beta)} = a\frac{\cos\alpha}{\cos\beta}$$

Now, dividing by the speed, k sin β,

$$time = \frac{a\cos\alpha}{k\cos\beta\sin\beta}$$

$$= \frac{a\cos\alpha}{k\left(\frac{1}{2}\right)\sin 2\beta}$$

Clearly, time will be minimized when 2β is 90 degrees or β is 45 degrees [and this will hold not just for α = 20 degrees, but for any α up to 45 degrees].

BY ■

Responses to *Winter 2014 Challenge #2* *Square Bottle Uses Less Plastic?*

The question as submitted by Dave Kramer, Chelmsford, MA:

"I recently purchased a new bottle of hydrogen peroxide and noted that the container had a square rather than round cross-section. Then I noticed a statement on the bottle saying that a square bottle uses less plastic than a round bottle. Puzzled, I calculated the volume to area ratio of the two containers, and as I suspected, for a fixed surface area a round bottle encloses a larger volume than a square bottle. What do you think about the manufacturer's claim? Does the square bottle allow for a thinner plastic? The square bottle certainly saves shelf space."

Can you explain the manufacturer's claim that a square bottle uses less plastic?

Receiving no responses from readers, I looked online and found responses to essentially the same question at http://www.reddit.com/r/math/comments/1lbc6a/can_someone_explain_how_a_square_bottle_uses_less/

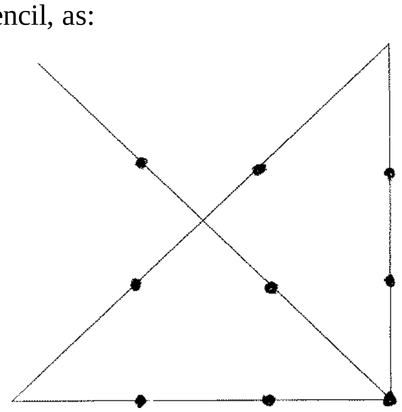
Here are several of them:

- *You have to consider packing and shelf space. Square bottles can be packed perfectly together, leaving no airspace.*
- *Maybe round bottles have to be made with thicker plastic, so that you don't squish the bottle when trying to pick it up, whereas square ones keep their shape pretty well even if the plastic is flimsier?*
- *When the containers are rectangular they can be packed together tightly, and fit precisely inside a cardboard box. This time when the lateral forces come each container will be hemmed in by other containers and the box, so you can afford to use thinner walls on the containers.*
- *This is more of a material science problem than a surface area problem. Square plastic bottles can be made of a thinner material because corners are so rigid.*
- *I think they meant "Because the gaps between square bottles is smaller you can ship more volume using the same amount of plastic" which is another way of saying "You can ship the same amount of volume using less plastic."*
- *This is usually the reasoning behind this. I remember reading about Costco and how they changed their plastic jar that the cashews and mixed nuts come in. They went from round to square profile and ended up fitting more nuts in the same "footprint" and since the product on the pallet was denser they ended up shipping ~200 fewer trailers of the same quantity the following year.*

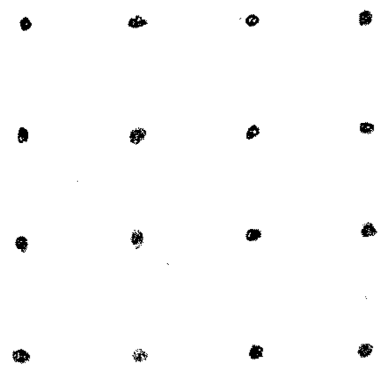
BY ■

Spring Challenge: Connect the Dots

You probably know that one can connect a matrix of 9 dots with 4 straight lines drawn without lifting the pencil, as:



Now, what is the fewest number of such lines required to connect this matrix of 16 dots?



Please send me your answer. lwyoder@ieee.org

BY ■

Technology news: Ethanol from Carbon Monoxide?

A brief and sketchy article at foxnews.com refers to research being done to develop a method to produce ethanol from carbon monoxide. See http://www.foxnews.com/science/2014/04/10/scientists-can-make-ethanol-without-corn/. It refers to an article in *Nature* by authors Christina W. Li and Matthew W. Kanan at the Department of Chemistry, Stanford University, and Jim Ciston at the National Center for Electron Microscopy, Lawrence Berkeley National Laboratory.

Here's a quote from the article preview at http://www.nature.com/nature/journal/v508/n7497/full/nature13249.html:

> "Here we show that nanocrystalline Cu prepared from Cu_2O ('oxide-derived Cu') produces multi-carbon oxygenates (ethanol, acetate and *n*-propanol) with up to 57% Faraday efficiency at modest potentials (–0.25 volts to –0.5 volts versus the reversible hydrogen electrode) in CO-saturated alkaline H_2O."

A review of this proposed method at http://www.technologyreview.com/news/526456/a-less-resource-intensive-way-to-make-ethanol/ suggests "One could image, for example, having a rooftop solar panel produce liquid fuel stored in a tank the size of a water heater."

BY ■

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Technology news: Solar Cell with 42.5% Efficiency!

From an article in *The Economist*, February 22, 2014:

Dr. John Rogers of the University of Illinois has devised cells that are being manufactured for pilot projects that convert 42.5% of the sunlight energy into electricity. His cells are 4-layered, with each layer designed with a different band gap so that each layer collects energy from a different section of the sunlight's spectrum.

Only a small fraction of the panel's surface is taken up by the cells; the rest is covered by lenses used to focus the sunlight onto the cells. This saves costs because the cells themselves are made of expensive materials.

Although the article doesn't say so, it would appear that the panels will have to be steered to keep the light focused on the cells.

BY ■

Engineering in a Collapsing Civilization An Inventory of Ways Engineers Contribute to Dysfunctionality and What to Do About It

An article by Dennis Feucht

At social gatherings, I observe behavior and have formed an *electric-panel model* of human interaction. Envision a large rectangular panel of pushbuttons, most of which are black in color. The buttons represent topics in the human mind. Dispersed among them are some red buttons. These are the *hot-buttons* which represent topics of particular interest to a person. As people mingle, they try out various buttons on each other's panels. For strangers, the colors of the buttons are unknown at first until they are pushed. Occasionally, a hot-button is pushed and lively conversation ensues. Friendships form. Disputes break out. The encounters progress.

Among engineers with a biblical outlook, not all of the hot-buttons pertain to engineering topics. Some of them are outside this subgroup within the electrical panel yet are related to it because engineering is related to the wider issues of life. Persons who relate to God also have a wider dispersion of hot-buttons on their panels and some of these also relate to society generally. Except for narrow topics of a highly technical nature, engineering in one way or another applies to the satisfaction of genuine human needs. It is, in essence, the refinement of the ability to build and use tools.

The benefit of engineering relates to social concerns because physical constraints apply to social and spiritual beings. In our highly developed and now affluent civilization, basic human needs have been satisfied to the point where the desire to solve them has in itself diminished. Problems remain, though the main challenges have been met to the point where the comforts and conveniences of an affluent lifestyle have dulled the motivation to press forth to new frontiers. Engineering success has led to decadence. The irony in this is that the prerequisites in human character required to solve human problems eventually results in the destruction of the character needed to solve them. With physical needs met, it should be possible to concentrate on social and spiritual needs, though what we observe is that the hot-buttons for these too have been replaced by black buttons, and the social milieu is in purposeless disarray. Apostasy has now had three or four generations to sink in to a deep level in the Euroamerican world, beyond the hope of substantial recovery. This has continued since at least the popular prophets of Top-Forty radio in the 1960s warned about the "sounds of silence" (Paul Simon) and that "you don't believe we're on the eve of destruction" (Bob Dylan), and more recently by hip-hop artist DMX. In contrast, emerging civilizations confronted by significant physical challenges also engage significant social and spiritual challenges. Civilization is an all-or-nothing affair.

Because of the important role of technology, we engineers are caught in this maelstrom of social dynamism. While we are both regarded and sometimes regard ourselves as being like the monks of the Middle Ages, cloistered in our laboratories, pushing buttons that most people do not have on their panels, the fact is that we are leading contributors to whatever technology is being used for nowadays. We are unattachedly involved.

When Roman society was in decay, the Roman prophets of their time and culture - writers such as the satirist Juvenal - did what the prophets of Israel did; they called the culture to task for no longer being true to their greater calling. In contrast to the other great Roman satirist, Horatio, Juvenal's style of denouncing the sins of Rome was more biting and leaves an astringent after-effect on the mind. In addressing fellow Christians who are also colleagues in engineering, I need not engage in such (or much) satire (though it is common among Christians nowadays who banter about the state of the world) but instead try to exemplify the early Christians and OT prophets, who had a sober outlook and a simple, matter-of-fact, non-presumptuous, and observation-oriented logic to their thinking. Their mind-set engenders what I call T^3: The Two Things:

1. dig (investigate, observe)
2. think (reason)

These Two Things are familiar to us though it is noteworthy how often they are *not* applied when they could be, even by engineers (including myself!). T^3 is one of the best remedies (along with godly prayer and biblical meditation) for overcoming the endless stream of tampering with our attitudes, outlooks, viewpoints, worldview, and orientation that confronts us in an information-overloaded and dysinforming world. With a cleared but not empty mind, we now venture to inventory some of the dysfunctional uses of technology in our time, including the institutionalization of its dysfunctionality. The list is long and has been growing. Three are listed in this article.

The ongoing fragmentation and dissolution of a once-great civilization is seen in the decay of its institutions. First inventory item: Hospitals and health care were instituted to save the physical lives of people and aid them in returning to health. Now they aid the enrichment of insurance companies and lawyers while killing human life (abortion, euthanasia) and poisoning people (overdrugged patients, heavy-metal tooth fillings and adjuvants in vaccines). Public health, while attempting to reduce water-borne disease also chronically poisons the users of the public water supply with halogen compounds of chlorine and fluorine. (Fluorine is a neurotoxin and calcifies the pineal gland.) Health research is tainted by the money of pharmaceutical and other interests who desire outcomes favorable to their businesses, and effective non-patented or inexpensive cures are lost, replaced by information and supply of drug samples to doctors. Low-cost methods of treatment are eclipsed by expensive diagnostic and therapeutic equipment. Health care has been reduced to a machine-like status of procedures and methods, all in the name of "science", and is a major contributor to what I refer to as *Establishment pseudoscience*, a modern mythology that has grown up around science.

How does this relate to engineers? I have participated in the design of surgical Nd-YAG lasers, ophthalmic ultrasonic imaging machines, and phacomachines (for cataract surgery). They could be designed and sold far more cheaply than they are. American doctors are willing to pay for luxurious design. For instance, the displays on the front-panel could be light-emitting diodes (LEDs) instead of vacuum-fluorescent or plasma dot-matrix displays, which cost a decade more and are only slightly more beneficial. Connectors need not be of the high-quality but expensive Swiss Lemo brand, but could be a sufficiently reliable, lower-cost type. Medically-approved power supplies are slightly more expensive to design for added safety but are sold for much more than ordinary supplies. The list goes on. A worthy pursuit for Christian and other electronics and biomedical engineers would be to design some low-cost medical equipment for the developing world where these health-care dysfunctionalities are not prominent and whose doctors cannot afford American equipment.

Item number two: Agriculture once provided nutritional food in abundance but now, commercial wheat has mutated to a less nutritional form that produces higher growth yields. Hybrid seeds and genetically-modified (GM) crops place control of crop food and clothing (cotton) supply in the hands of a few big transnational corporations. Leading them is Monsanto, a company that qualifies and is regarded by many as the most evil corporation in the world. Not only has nutritional value decreased, crop food has even become toxic. GM crops with built-in production of *Bacillus thurengiensis* (Bt) toxin, which naturally occurs in soil at a much-reduced (3 decades lower) concentration, kills the corn borer worm by perforating its stomach. Bt corn has its own built-in pesticide, a seemingly good engineering idea. Because it is produced within the corn genetically, it is not removable when the corn is consumed by humans. The marked rise in intestinal health problems in America correlates with the introduction of Bt corn into the food supply.

Another seemingly good engineering idea is to make crops genetically resistant to herbicides and pesticides so that greater differentiation between crop and weeds is effected. GM corn based on resistance to glyphosate, a herbicide which is also toxic to humans (a chemical variant of Agent Orange, a defoliant used in the Viet Nam war) allows more of it to be used on crops without killing them. Consequently, this kind of GM corn encourages greater use of a toxin that is being found everywhere in the environment.

Bioengineering, like artificial intelligence in the 1960s, is touted as having great beneficial potential, yet it is in a state of development where electronics was in the 1920s. Life is not sufficiently understood for large-scale experimentation with the ecosphere. It is a Pandora's Box situation. Once naturally-occurring (or non-GM) varieties of crops interbreed with GM crops (which can, and despite "scientific" assurances to the contrary, does happen), then the resulting genome is not reversible with the current state of bioengineering. GM crop engineering is a symptom of a larger problem: large-scale chemically-based farming has come to an impasse. Weeds and insects have mutated to resist the older methods of crop protection. An emphasis on increased yields has led to less-nutritious products.

Meanwhile, non-GM or "organic" methods of farming are continuing to develop with increasing crop yields. The main difference is that organic farming of smaller plots with higher yields requires more work and greater vigilance. Neither appeal to farmers with air-conditioned tractors and who have the same fix-it mentality of some medical patients who do not want to be bothered with a change in how they live; they just want a pill that fixes the problem. This is another opportunity for engineers to make real contributions to agriculture, in developing organic or other alternative methods for growing food crops that do not have the harmful side-effects of the present GM crops. We had (until recently) a creative mechanical engineer in Belize who was successfully finding ways of solving the usual agricultural problems. These solutions often must be optimized for the particulars of the growing environment. This is unsurprising to engineers yet shows a failure to apply T^3 to agriculture more generally. Few are thinking outside the "box" of existing solutions to problems.

Perhaps one alternative is to wean the world off of grains and onto tree leaves. Here in Belize, what is becoming a staple in our diet grows in abundance (like a weed) in our yard and is not carbohydrate-intensive like grains: chaya bushes and moringa trees. Both produce highly nutritious leaves that not only taste good but can be included in soups, enchiladas, casseroles, and with mixed vegetables. Leaf production of chaya is prolific and seems to lack the pest problems of traditional grain crops. One of my chaya bushes fell over from having shallow roots, so I broke off the branches and stuck them into the ground in an adjacent field. I now have by default become a chaya farmer, though I have essentially no work to do in enhancing chaya growth. (This should appeal to the modern American farmer.) Moringa leaves are small and more delicate than chaya leaves but are also prolific, and moringa trees are also easy to grow. Unlike chaya, which must be cooked, moringa leaves can be eaten uncooked in salads or soups.

Engineers are involved in the ag-related food-processing industry; item three. Food has become processed to where too much of it is not nutritional and some is even toxic. The artificial sweetener, aspartame, was once banned by the FDA until the former CEO of the company that originated aspartame became head of the FDA. Aspartame breaks down into methanol and is neurotoxic. It is also somewhat addictive. Its chronic use is correlated with fatal heart attacks in people without prior symptoms and in MS-like symptoms. Toxological and medical research studies have adequately demonstrated its toxicity and information on its health effects and is readily available on the Internet. Anecdotally, my wife and I know at least three people who were developing MS symptoms and who were diet beverage drinkers. When they stopped ingesting aspartame, the symptoms disappeared. At least one friend in his mid-50s, who drank diet Coke for years and also exercised (tennis), died suddenly of a heart attack without prior symptoms.

One of the more recent fads in food design is to use high-fructose corn syrup instead of sugar (sucrose). Both are known to contribute to health problems though unprocessed cane sugar (like the original intent of Coca-Cola as a health drink) is loaded with minerals and is even medicinal. In cane-producing areas of Latin America, cane juice is boiled down (like maple syrup) to a solid form called *panela*. It is a nutritional sweet substitute for white or brown sugar yet is absent from American grocery stores. This solution is more of a marketing than an engineering task, yet "food designers" must know of it to include it in processed foods.

The inventory list can be greatly expanded and I hope to do so in sequels to this article. Three examples, however, should suffice to stir your thinking about right and wrong ways to apply engineering efforts. Do you have any more items to add to this list?

Dennis L. Feucht, MAR2014 ■

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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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