THE CONSULTANT

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Chairman's Corner – Jerry Brown, Essex Systems

Have We Given Up on Progress?

The science mine is nearly played out. The "big" opportunities for discovering world-changing technologies are exhausted. I only recently became aware that these are prevalent attitudes. Listen carefully to the current debates about offshoring, the deficit, social security and healthcare and you will find that no one is talking about scientific innovation as the answer. There will be token references to improving education and reeducating the workforce for higher-skilled jobs. But, politicians and media pundits seem to assume we can't have another revolutionary technological development like the microprocessor. It's as though people's imaginations have become fatigued by past successes and their optimism poisoned by environmental concerns.

The most recent reminder of this pessimistic view came to me from one of our own. In Bill DeAgro's discussion of offshoring in the "Chairs Message" of the March IEEE Section Newsletter, he said,

> "*Now, due to technological saturation (i.e. reaching or nearing the limitations of physics more and more as time goes on) attempts by the technologically advanced country to maintain technological superiority by improving its own technology would not suffice. Other actions are needed.*"

Bill goes on to suggest that the answer is to find ways of stopping offshoring. I disagree. There is certainly nothing wrong with negotiating the best deals we can to keep jobs at home for as long as possible and our government should fight to make international competition as fair as possible. In the end, though, we have to accept the fact that lots of jobs are going to go to the lowest bidder. If we raise barriers to moving jobs, then the companies themselves will move. So, what do we do? I think the answer is that we need to change the attitudes expressed at the beginning of this article.

Magazines like "Science", published weekly by the American Association for the Advancement of Science, have article after article about breakthroughs in many fields.

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Meetings

March 2008

Topic: "Using Google AdWords To Promote Your Website"

Speaker: David Pinkowitz, DCP Marketing Services

April 2008

Topic: "What to Expect When Working on Projects Involving Manufacturing in China"

Speaker: John Weiss, Weiss Instruments

7:00 PM, Wednesday, April 2

Briarcliffe College, 1055 Stewart Avenue, Bethpage, NY.

Admission is free (no charge). No pre-registration is required. For information, contact John Dunn at (516) 378-2149 or e-mail ambertec@ieee.org. Guests are welcome. Light refreshments will be served.

Directions: See our website www.consult-li.com.

May 7, 2008

LabView Instrumentation Software

June 4, 2008

Sensor Technology

Other Meetings

Consult the Events Calendars on the Section website: www.ieee.li and the LICN site: www.consult-li.com

Remember to inform the members about seminars and other items that might be of interest. E-mail them at members@consult-li.com.

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Take just one example - organic electronic materials. All of our electronic devices to date have been based on inorganic crystalline semiconductors, like silicon and germanium. Organic semiconductor technology is only in its infancy and has developed slowly because charge transfer in organic molecules is much harder to analyze than in inorganics. The electrons involved in conduction are shared between dissimilar atoms in complex structures rather than between identical atoms in a neat crystal lattice. This makes the application of quantum theory more difficult by orders of magnitude. The February 22 issue of "Science" contained an excellent overview of this subject. It indicates they are finally making progress with quantum theoretical modeling of these structures. The potential for organics is much larger than inorganics because the thing that makes them so difficult to analyze - the complexity and quantity of molecular combinations compared to single-element crystal lattices - expands the range of applications. Just a few of the more obvious possibilities are:

- Large arrays of electronic switching devices deposited onto flexible substrates in roll-to-roll printing processes.
- Light emitting diodes with areas of several square feet.
- Reduced cost to convert sunlight to electrical power.

If history is any guide, there will be many more applications that become apparent only as existing paradigms shift.

There are many other fields of opportunity that I have neither time nor space to discuss here, such as electronic devices based on particle spin and quantum entanglement. One thing they all have in common is the application of quantum theory to materials at increasingly larger scales – molecules and aggregates of molecules in the form of organic semiconductors, nanoparticles and micromechanisms.

This will require a new generation of engineers who will have to add quantum theory to the arsenal of tools we had to master. But, that's a solvable problem.

Special care will be needed to insure that the waste generated in the manufacture and use of 21st century innovations doesn't create new environmental problems. But, that too is a solvable problem.

So, we are nowhere near technological saturation and I would rather bet my children's future on innovation than maintenance of the status quo. We have an open society that encourages and rewards individual performance. Everything possible ought to be done to reinforce that advantage so that America continues to be the best place in the world for smart people to create new technologies that keep us a step ahead of everyone else. If we're successful we can even "onshore" brains. This can become the destination of choice for the world's best scientists, engineers and entrepreneurs. While older products move off our shores to the lowest bidder, we can be skimming the cream from the latest new thing. Solutions to the rest of our problems will flow from the resulting prosperity.

Solar-Powered Evaporator Rafts – ***Dr. Richard LaRosa, sealevelcontrol.com***

PURPOSE

There is a surplus of salty water in the ocean while many land areas are suffering drought. Solar energy can be used to evaporate fresh water from the ocean, leaving the salt behind. In the usual solar distillation apparatus the evaporated water condenses on a sloping transparent cover, clings to the underside of the cover, and slides down to a collection trough. In the present application there is no cover and the evaporated water, in the form of a vapor, is carried away by the prevailing wind. We hope to put the evaporator rafts in near-shore locations where the wind will carry the vapor up over a coastal mountain range. When this moist air rises, the reduction in pressure will allow it to expand and cool. If it cools below its dew point, the moisture will condense on whatever nucleation centers (dust, salt crystals, soot, aerosols, etc.) are present. If these droplets are able to coalesce to form drops that are large enough to fall instead of re-evaporating, we will have precipitation. It is called orographic rainfall because it is caused by air flowing over the topography of the area.

LOCATION

There are many factors which are necessary for success. First, we need a near-shore location where the wind will carry this expensive water vapor up over a mountain range often enough to provide useful precipitation. Suitable locations might be those where nature has been doing this for many years, attracting agriculture and urban populations. Now, for some reason, the air does not have enough humidity.

We will examine many mountain areas in North and South America and other continents, but will focus first on Australia, which has a central desert that heats up during the day in the Spring, Summer, and Fall seasons. At 9 AM the winds along the coast are chaotic, but by 3 PM air comes in from the sea along the entire coast to replace the air that rises from the central desert. The southeast corner has a coastal mountain range that has provided orographic rainfall in the past, enabling the establishment of cities such as Sydney and Melbourne, and agriculture in the basin of the Murray and Darling Rivers. But now they are facing drought. One might assume that the conditions are almost right, but the incoming air is not humid enough to yield rainfall when the air expands and cools going over the mountains. If this is the case, and it must be checked out, it may not require much additional moisture to correct the present condition. I have tried to contact the Australian Bureau of Meteorology without receiving a reply.

EVAPORATION RATE

I did some sample calculations using wind, temperature, humidity, and solar insolation data for Sydney in January, which is the austral summer. For a solar input to a horizontal surface of 830 Wm^{-2} and an air temperature of 27 °C, the evaporator plate temperature turned out to be 40 °C, the heat loss due to evaporation is 408 Wm^{-2}, the radiation loss is 85 Wm^{-2}, and the air convection loss is 306 Wm^{-2}. These heat losses add up to 799 Wm^{-2}, which is close enough to 830, considering the approximate nature of the calculations. The small value for radiation loss indicates that attempting to make a selective coating for the evaporator (high emissivity in the visible band and low emissivity in the long-wave infrared band) will not make a worthwhile improvement in the performance.

The evaporation heat loss is equivalent to the evaporation of 1.3 kg m^{-2} of water in a two-hour period, which would lower the water level by 1.3 mm over the active area of the evaporator plate. I used a formula that was developed for evaporation from a large lake surface to calculate the rate of evaporation from the solar-heated evaporation plate. The rate depends mainly on the difference between the water vapor partial pressure at the plate temperature and the vapor pressure at the dew point of the overlying air. The dew point is the wet bulb temperature of the air. I simply assumed that a water molecule will depart from a thin film on a hot plate just as well as it will leave the surface of a deep lake. I think I remember reading that the salinity has no effect on the evaporation rate, and this needs to be checked along with everything else that went into this calculation.

WILL IT RAIN?

I don't yet know the answer to that question, so I'll dance around it instead. One thing we can say for sure is that the water will evaporate faster from a solar-heated plate that is thermally insulated from the ocean than it will evaporate from the ocean surface itself. This is primarily due to the solar energy being entirely absorbed by the thin plate and water film, instead of being distributed throughout the illuminated depth of the ocean water. This assumes that the plate stays wet while it is being tossed around in the ocean. I have thought up some solutions to this problem, such as small pockets in the plate to hold water when it tips, a photovoltaic array to drive small pump motors to collect water from the lowest edge of the plate and spray it on the upper end. A rectangular plate would require four pumps, three of which would be running dry a good part of the time, and (hopefully) not drawing much current. I don't have a clue yet as to how to control the make-up water supply. Mooring these things in deep water and not having them pile on top of each other in storms will undoubtedly be a challenge.

It may be comforting to know that the ocean underneath the evaporator plates will not absorb any solar radiation. This is seen to be an insignificant benefit when compared to the vast unshaded ocean area. The real sticker shock will hit when we are able to figure out how many square kilometers of evaporator plates we need to make enough rain to grow crops and flush toilets. This reminds me of how our kids used to ask "Are we there yet?" on a long car trip. This particular quest could be a long trip because I don't even have a map of how to get there. There will be some wrong turns, but I am determined to enjoy the drive and help answer Jerry's call for innovation.