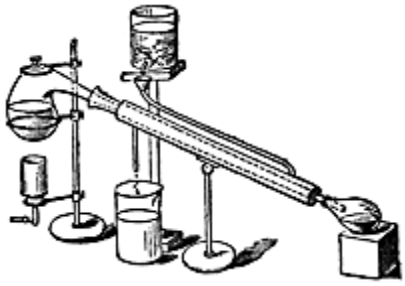
SOUTHWEST RETORT



SIXTY-FOURTH YEAR **November 2011**

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FIFTY YEARS AGO IN *THE SOUTHWEST RETORT*

Dr. Raymond C. Sangster of Texas Instruments is the November ACS tour speaker for Louisiana and Arkansas. He has three different lecture topics: "Thermoelectricity Today;" "A Chemist's View of Semiconductors;" and "Model Studies of Crystal Growth in the Zinc Blend Lattice." The November tour speaker for Texas is **Dr. George H. Cady** of the University of Washington. His topics are "Chemistry of Compounds Containing the –O-F Bond" and "Fluorides and Oxyfluorides of Sulfur."

New Orleans will host a combined Southwest and Southeast Regional ACS Meeting Dec. 7-9. There will be 169 contributed papers and 56 invited symposium papers. The symposia will be in the areas of organic, inorganic, analytical, and physical chemistry, biochemistry, and chemical education.

At the University of Texas (*now UT-Austin*), a number of faculty have received research grants. They were **Drs. R. J. Williams** (Tobacco Industry Research Committee, **P. S. Bailey** (NIH), **Norman Hackerman** (Office of Naval Research), **D. M. Ziegler** (NIH), **L. F. Hatch** (Dow), and **W. C. Gardner** (NSF).

New chemistry faculty at East Texas State College (*now Texas A&M-Commerce*) are **Dr. Stephen L. Razniak** (Assistant Professor), **Mr. David Flinn**, and **Mr. George Nixon** (Instructors). At North Texas State College (now *UNT*) **Dr. William H. Glaze** joined the faculty as Assistant Professor. **Drs. Price Truitt** and **R. J. Thompson** attended the Chicago ACS meeting. At TCU **Dr. John Spessard** joined as a new Assistant Professor, coming from Convair. **Drs. J. E. Hodgkins** and **W. J. Watson** were awarded a supplementary $24000 grant from the Welch Foundation. The grant was used to purchase a Varian A-60 NMR Spectrometer and also in their current research activities. **Mrs. Joy Terry**, Assistant Professor of Chemistry at Tarleton State College (*now Tarleton State University*), attended the Gulf Coast Spectroscopic Group Meeting in Beaumont. **Miss Betty Lou Campbell** has joined the Tarleton staff as Instructor of Freshman Chemistry.

Texas Instruments announced that Professor **Frank A. Cotton** of MIT is the winner of the ACS Award in Organic Chemistry sponsored by TI.

Dr. James L. McAtee of Baylor presented a paper at the National Clay Minerals Conference in Austin Oct. 16-18. **Dr. T. C. Franklin** presented a paper at the Electrochemical Society meeting held in Detroit Oct. 1-5.

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NATIONAL CHEMISTRY WEEK IN THE DFW SECTION ROCKED!

In 2008 the United Nations declared 2011 ***International Year of Chemistry.*** Through-out 2011, advancements in chemistry and its life changing power have been displayed throughout the world. The theme to IYC is ***Chemistry? Our life, our future***; a key component is to attract young people into the field and increase awareness of chemistry's contributions to the general public. With this in mind, and in celebration of National Chemistry Week, the Texas Christian University's Chemistry Club teamed up with the Fort Worth Museum of Science and History to organize ***Chemistry Connection*** at FWMSH during National Chemistry Week Oct 18-22, 2011.

Sandi Dang, TCU Chemistry Club President, initiated the organization of this week and the TCU Chemistry Club spent over 100+ hours of preparation and work on National Chemistry Week both on the TCU campus and at the Fort Worth Museum of Science and History. Sandi's vision for this week led to the incorporation of 8 DFW Universities (TCU, Southern Methodist University, University of North Texas, University of Texas Dallas, University of Dallas, Dallas Baptist University, Texas Wesleyan University, and Texas Women's University). The universities collectively recruited 120 volunteers to organize activities throughout the week, especially on Saturday. Well over 3,000 individuals from the community came through the museum and experienced hands-on chemistry demonstrations and activities at the museum. Throughout the week, many local schools participated in field trips to the museum and on Tuesday a special home school day was organized during the week.

The local DFW section participated in the event by providing professional chatters Saturday to help children see the wide spectrum of chemistry careers, ranging from academia to industry to patent law. A special thanks goes out to **DFW ACS and ZS Pharma** for sponsoring the events throughout the week. A huge round of applause goes to **Sandi Dang and Kayla Green**, Assistant Professor of Chemistry at TCU and TCU Chemistry Club sponsor, for all their hard work!!

MORE PHOTOS ON THE NEXT PAGE!!

National Chemistry Week with the Fort Worth Museum of Science and History.

Periodic Table of Cupcakes

National Chemistry Week with the Fort Worth Museum of Science and History.

NON-NEWTONIAN FLUID

THANK YOU Sponsors: ZS Pharma and ACS! Friends of CHEMISTRY!!

Around-the-Area

Dr. Mary Teasdale, long-time managing editor of the RETORT**,** has resigned as her professional comittments prevent her continued participation. We appreciate her dedication and wish her well.

UTD **Steven Nielsen and Jung-Mo Ahn** were promoted to the rank of Associate Professor and awarded tenure. Professor **John Sibert** was named a UT Regents' Outstanding Teacher. The School of NS&M welcomes a new Dean, **Bruce Novak**, former head of the Department of Chemistry at North Carolina State University. Professor **Dean Sherry** was elected as a Fellow of the International Society for Magnetic Resonance in Medicine.

UTA Recent retirees **Martin Pomerantz** and **Zoltan Schelly** were recently named Professors Emeriti, a title reserved for faculty members with outstanding achievements. Both are Doherty award winners and researchers of note.
Undergraduate biochemistry student **Pinaki Bose** recently traveled to Washington, D.C., where he met with the NIH Board, the Director of the EPA, and John Holdren, the President's "Science Czar." He was accompanying his younger sister Shree, who was the grand prize winner of the Google Global Science Fair.
Dr. Brad Pierce recently gave seminars at Texas A&M, SMU, Colorado State, the University of Wyoming, and Trinity University on "Single-Turnover of Substrate-Bound Ferric Cysteine Dioxygenase with Superoxide Anion: Enzymatic Reactivations, Product Formation, and a Transient Intermediate."

DFW Section:
ACS Fellows Named

The following members of the DFW section have been named Fellows of the American Chemical Society:

Kenneth Balkus (UTD)
Robert Larsen (Alcon)
Diana Mason (UNT)
James Marshall (UNT)
Patricia Smith (TriQuint)

Call for Nominations for Doherty and Schulz Awards

Nominations are invited for the 2011 Wilfred T. Doherty and Werner Schulz Awards. Nomination forms are available online at **acsdfw.org.**
This year's chair is **Dr. Claire Bambrough,** Brookhaven College (972)-860-4214 cbambrough@dcccd.edu. Nominations are due by April 15. Seconding letters may accompany nominations. Each nomination should contain a cover letter carefully highlighting the nominee's ccomplishments. Nominations remain active for five years but should be updated annually.

The Doherty Award is given for excellence in chemical research or chemistry teaching, meritorious service to ACS, establishment of a new chemical industry, solution of pollution problems, and advances in curative or Preventive chemotherapy. The impact of these accomplishments may be either of local or national significance. Nominees may come from industry, academia, government, or small business. The nominee should be a resident member in the area served of the DFW Section, and the work on which the award is based should have been done here. The honorarium for the Doherty Award is $1500 and an engraved plaque. A photo of the Doherty Award winner will be displayed permanently in the Gallery of Doherty Award winners, Berkner Hall, UT-Dallas.

The Schulz Award is given to high school chemistry teachers like the late Dr. Werner Schulz, who bring that something extra to the teaching of chemistry. The nominee or nominator need not be ACS members. Nominees should show excellence in chemistry teaching as demonstrated by testimonials from students and fellow teachers, results in student competitions, and diligence in updating and expanding scientific/ teaching credentials. A photo of the Schulz Award winner will be displayed for one month at the Science Place 1 in Dallas, and then the photo will be displayed permanently in the Gallery of Schulz Award winners, Science Bldg., Tarleton State University. A traveling plaque stays at the winner's high school for the year of the award.

Winners will normally receive their awards and give their lectures at fall meetings of the section. **A continual flow of high quality nominations is needed in order to maintain the quality of these awards; please keep those nominations coming in.**

Upcoming Grant Application Deadline: Innovative Project Grant

The Local Section Innovation Projects Grants are available for up to $3,000 per calendar year to fund new local section projects. The Local Section deadline for applications is June 30. For more information contact **lsac@acs.org.**

Starter Grants Available for ACS Student Chapters at Two-year Colleges

ACS student chapters at two-year colleges provide students with opportunities for leadership, project management, networking, and collaboration, thus enhancing the college experience. ACS is offering starter grants of up to $500 to two-year colleges starting or reactivating an ACS student chapter. For more information, please visit **www.acs.org/2YColleges.**

Younger Chemist Leadership Development Award

Each year, the YCC organizes a Leadership Development Workshop that is geared toward younger chemists; the workshop is designed to help young chemists develop into highly skilled leaders in the Society and in their chosen profession.

The YCC grants 15 Younger Chemist Leadership Development Awards support

to travel to and participate in the annual ACS Leadership Institute and the Leadership Development Workshop. For more information go to:
http://ycc.sites.acs.org/ldw.htm

Local Sections and Membership Retention

***Bridging the Gap* Nano Grant: Sponsored by the ACS Committee on Local Section Activities (LSAC).** This $250 nano-grant seeks to encourage ACS Local Sections to communicate the value of ACS membership to its current members, especially those having recently joined the society. ACS Local Sections are encouraged to sponsor an event/project/ display with newer members in mind and to promote the value of remaining an engaged ACS member. Local sections may also use the grant funds towards innovative marketing of existing programs.
The deadline for applications is March 12, 2012. The focus, guidelines and application can be found online. Please contact lsac@acs.org with any questions.

Ana-Lab Corp. in Kilgore is recipient of the nationwide 2011-2012 ACIL (American Council of Independent Laboratories) Seal of Excellence Award. The award was announced in New Orleans at the ACIL annual meeting. The Kilgore-based organization is among 21 laboratories across the nation to receive such recognition and Ana-Lab is the only Texas laboratory among the 21. To become a Seal of Excellence participant, testing laboratories must distribute satisfaction surveys to customers and maintain proof of an annual

ethics training program and an early detection system for questionable analytical practices, and submit a signed code of ethics.

"It is significant that we are the only laboratory in Texas to be recognized for the award," said Bill Peery, executive vice president of Ana-Lab. "It is also significant that only 21 laboratories nationwide are recipients of the Seal of Excellence."

Contributors wanted!

The RETORT seeks articles on technical topics, scientific and opinion papers, as well as news items and announcements. Submit to retort@acsdfw.org

The RETORT is seeking a COPY EDITOR
Experience in newsletter construction and Word preferred

Email retort@acsdfw.org

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Email notices are sent separately for the monthly meetings, so that you are informed in a timely fashion.

DFW ACS
NOVEMBER MEETING
SCHULZ AWARD LECTURE

Monday, November 14
Deadline for RSVP Nov.8

The Highlands School
1451 E. Northgate Drive
Irving, TX 75062
(972) 554-1980

Michael E. Trulson, PhD

"A Paradigm Shift for Overcoming
NOVEMBER MEETING NOTICE
Limits to Progress in Education"

Reception: 6:00-6:30pm **Dinner**: 6:30-7:30pm **Lecture**: 7:30-8:30pm

Menu: Pesto Chicken w/ Scalloped Potatoes and Vegetable Medley; Dessert and Tea/Water/Coffee

Dinner Cost: $25 (Payment by cash or check will be accepted at the door. Please note that registrants are financially responsible for reservations made but not used. It is not necessary to attend the dinner in order to attend the lecture.)

RSVP for Dinner and/or Lecture: ***Tuesday, November 8th***
to VMTrulson@gmail.com or 972-231-5350

Directions: From Highway 183 exit Carl Road – Drive North to T-intersection at Northgate Drive – Turn Right onto Northgate – Drive approximately ¼ mile – Turn Left into The Highlands School gated entrance – Students and Signs will guide you from the parking lot to the Assembly Room.

January 2012

DFW ACS Meeting

acsdfw.org

Meet DFW's New Young Investigators

Learn about exciting research in the DFW Section

Saturday, January 28, 2012, 9 A.M. to 2:00 P.M.
Sid Richardson Building, Texas Christian University, Fort Worth, Texas

Updates and details on registration, directions, and parking will be posted at
http://faculty.smu.edu/pwisian/Jan2012.htm

Speakers (as of 11-5-11)

Frank W. Foss, UTA
Peter Kroll, UTA
Roshan Perera, UTA
Rob Petros, UNT
Youngha Ryu, TCU
Mihaela C. Stefan, UTD
Justin Youngblood, UNT
Jie Zheng, UTD

Invitation to all POSTDOCTORAL RESEARCH ASSOCIATES

in the ACS-DFW Local Section

All postdocs from the DFW section are invited to present a poster on their current research from **noon to 2:00 pm**. This is an excellent opportunity to network in the local section, meet local academic and industry leaders, and or develop collaborative research projects.
Please send your name, email address, a descriptive title, authors, and affiliation to Patty Wisian-Neilson at pwisian@smu.edu by **Wednesday, January 25, 2012**. Posters will be pinned to 2 x 6 foot poster boards.

METROPLEX SEMINAR SCHEDULE

Seminars are occasionally postponed or cancelled. Check departmental websites or call the department before attending.

UTA

November 4. **Professor Paul F. Fitzpatrick,** UT Health Science Center, San Antonio, Department of Biochemistry
Title: "*Catalysis and regulation of the aromatic amino acid hydroxylases*"
Host: Dr. Brad S. Pierce, **bspierce@uta.edu**

November 11. **Professor Paul Bagus,** University of North Texas, Department of Chemistry
Title: *"Interpretation of Satellites and Multiplets in Photoemission Spectra: Implications for Materials Properties"*
Host: Dr. E. Tom Strom, **tomstrom@juno.com**

November 18. **Professor Uttam Tambar,** UT Southwestern Medical Center
Title: *"Asymmetric Molecular Rearrangements in Chemical Synthesis"*
Host: Dr. Carl J. Lovely, **lovely@uta.edu**

December 2. Professor Nicolay Tsarevsky, Southern Methodist University, Department of Chemistry
Title: *"Controlling Molecular Architecture and Placement of Functional Groups in Polymer Synthesis: From Synthesis to Applications"*
Host: Dr. Brad S. Pierce **bspierce@uta.edu**

December 9. **Professor Sung-Kun Kim,** Baylor University, Department of Chemistry and Biochemistry
Title: "Novel Inhibitors of Metalloenzymes from Antibiotic Resistant Bacteria and ssDNA Aptamers against Anthrax Protective Antigen"
Host: Dr. Roshan Perera, **perera@uta.edu**

Editors Note: Due to the copy errors in the previous issue, we are reprinting part 1 of John's article, as well as part 2

Analyses of Alternative Energy Strategies, Wind, Solar, Tide

By

John E. Spessard, PE

This paper discusses the feasibility of obtaining electricity from wind, solar and tidal energy. The feasibility is on the basis of the technologies functioning profitably without government subsidies and tax breaks. The technology is required to provide significant portions of our electricity needs and pay normal local, state and federal taxes and fees.

Implementing New Technology is a Challenge

A friend who is a fine engineer expressed it this way:

You can take any plant or process and reduce it to some number of squares on a flow sheet. Each square represents a major process step or piece of equipment. If every square is proven technology, with proven meaning it has been done before on this scale and in this country, you will have an easy startup. One square of problems, you will have problems but they can be handled. Two squares of unproven technology, the first Plant Manager will be fired. I have checked it through the years and it works.

Startup is defined as being the period between the startup of the plant and the time when you are consistently producing specification product at the design production rate. A change of scale changes surface to volume ratios. This leads to complications involving pumps, valves, piping, fittings, etc. TXI licensed German technology to build a new cement plant like the ones operating successfully in Germany. The kiln is hot enough that the coal fuel melts. BUT the liquid characteristics of German and American coal were different enough to cause problems. These problems were resolved. The plant in Beulah, North Dakota that makes synthetic natural gas from coal was enough aware of the potential problems that they sent a boatload of North Dakota lignite to South Africa to be tested in the Salsol gasifiers. This was a very well managed project, completed on time and on budget. (That it was an economic disaster is a story for another day.)

DuPont, which has a well-deserved reputation for technical excellence, built a plant to make titanium dioxide pigments by reacting titanium dioxide ore with chlorine. The plant produced titanium tetrachloride which was reoxidized to provide pigment grade titanium dioxide. The plant dealt with the very corrosive environment of titanium dioxide (fine abrasive powder), titanium tetrachloride, ferric chloride, chlorine and oxygen, all at high temperature. This plant had a three year startup. DuPont built a **second** plant using mostly the same technology. It had a nine month startup.

How Much is Two Plus Two?

There is a joke where various professions are asked "How much is two plus two? The accountant's answer was "What do you want it to be?" This very much applies to innovative technology cost estimates. When coming from advocates of a technology, these estimates are optimistic to the point of absurdity. This is particularly true for yet-to-

be implemented technology. Also, which set of books are you looking at? General Electric provided one financial statement to their stockholders that showed GE making a profit. GE provided a financial statement to the IRS that showed they had lost money and did not have to pay taxes. This is routine. A big factor in how you run a business is to reduce taxes. This may not be optimum efficiency but it makes business sense. Certainly, tax breaks go a long way toward making alternate energy technologies feasible.

Cost estimates from governmental bodies are often ludicrous. One example is the Trinity Tollway in Dallas. The City Father Advocates were less than candid about the Corps of Engineers' statement that the project was feasible. A bond issue of $243 million was voted for the project. The most recent estimate is that an additional **one billion** will be required. In 1987, when the Superconducting Collider construction began, the cost estimate presented to Congress was four billion. In 1993 when the project was cancelled, the new estimate was $12 billion. (It was by no means certain that this was the end of the cost escalation.) Defense systems contracts always greatly exceed the initial estimates. One reason is that to win in the competitive bidding process, the vendor needs to be optimistic. A second reason is that the customer demands a lot of innovative never-been-done before technology. To make it even worse, additional innovative technology is demanded over the course of the project.

Therefore the only cost estimates for innovative technology implementation that I have any faith in are historical costs. That is, it has actually been done for this price. A popular ploy is to ask for more money late in the construction process. The rationale is we have gone this far, we only need a little more money and it would be a shame to abandon it now.

The One Dollar Black Box

Suppose you have a black box that costs one dollar and each year, it produces five cents worth of product. Say no more! It is not economically feasible. Ignoring raw materials, labor and utilities, the costs of depreciation, the dollar of capital tied up in the box, maintenance, taxes and insurance renders any hope of profitability impossible. Presently, except for a few favorable circumstances and government subsidies and tax credits, these technologies are uneconomical. The operating facilities using these technologies are located only in the locations most favorable to these technologies. Eventual profitability requires technological advances that will reduce capital costs.

Once a too-high capital cost facility has been built, the capital investment can no longer be returned. It is now better (or less bad) to operate the facility to recover what you can. This is what happened in the North Dakota plant to obtain synthetic natural gas from coal. This plant was built on the expectation of nine dollar per thousand cubic feet gas.

Blowing in the Wind

Electricity from wind is the most developed of the three technologies. Independent investors are putting their own money into wind generators. Wind generates about 20% of the electricity in Denmark, 7% of the electricity in Germany and 1.5% of the electricity in the United States. However governmental subsidies are necessary to make wind power economically feasible in these most favorable

locations. In the United States, there is (1) a production tax credit of 1.8 cents per kilowatt hour, (2) the investor can depreciate the equipment over a six year period and (3) utilities are required to buy the wind-generated electricity through green energy requirements. Even Advocates accept that parts of the United States, including the entire Southeast, do not have strong enough winds to make wind electricity feasible. Thus, at best wind is only a partial solution. The existing facilities are located only in the most favorable locations.

The 1.8 cents comes directly off the Federal taxes. As a comparison in Virginia it costs between 3.5 to 4 cents per kilowatt hour to generate electricity from a conventional power plant. The cost of wind-generated electricity is about 6 to 6.5 cents a kilowatt hour. Utilities will buy the electricity to satisfy regulatory requirements for obtaining electricity from renewable energy sources. A six year depreciation schedule using the double declining balance allows the investor to recover 55.5% of the investment in six years. (The expected tax lifetime for regular utilities is 20 years.) In Germany the generator receives 9 eurocents per kilowatt hour. That is 13 American cents per kilowatt hour paid to the generator. As a comparison, I pay TU Electric 13.5 cents per kilowatt hour for electricity delivered to my home. In the United Kingdom, land-based wind generation costs are estimated at 3 pence (4.9 cents) per kilowatt hour. (This estimate comes from advocates and should be considered optimistic.)

In Europe wind turbines are frequently located offshore in the North and Baltic Seas. These are at sea level at lower temperatures (look at the latitude compared to Amarillo.). In America, wind turbines are frequently at altitude (Lubbock is at 3241 feet above sea level and Amarillo is at 3676 feet (Rand McNally) and higher temperatures. The Texas winds will be less dense and carry less kinetic energy than the European counterparts.

Estimated construction costs of wind-generated electricity range between one and two million dollars per megawatt. (This is from Advocates.) As a comparison Tampa Electric Company built five 60 megawatt natural gas fired peaking units at a cost of $237 million or 0.79 million dollars per megawatt (This is a real number). Peaking units have to be on line within ten minutes after startup and this makes them more expensive than other conventional power plants. Regular power plants run hot and will need a day or more to both startup and shutdown to avoid damaging the equipment.

The availability factor for a wind generator is about 30%. This raises the capital cost for electricity actually produced. The capacity factor is a measure of how much electricity is generated versus the theoretical maximum. The wind does not blow all of the time or at the optimum speed. Turbines begin to generate at wind speeds of 8 mph, reach full power at 30 mph and need to shut down at 55

mph to protect the equipment. As a comparison, nuclear plants have a 90 percent capacity factor, and main line coal and natural gas plants an 80 percent capacity factor. (These plants will schedule shutdowns for maintenance in the spring and fall when the demand for electricity is at a minimum.)

Failure of the turbines due to vibration is a major problem. Bearing failures are a problem. Turbines have grown from 50 kilowatts capacity to over three megawatts. (See my discussion on the problems created by different sizes.) The industry has made significant efforts to increase equipment reliability. The propeller blades have gotten larger to where some have diameters of over 100 meters. The industry has settled on the planetary gear box for turbine design.

One source identified the worst possible case for vibration problems:
*Variable speed and load
*Difficult and limited accessibility
*Complex gear boxes with planetary gear boxes being the worst
*Very low speed shafts

If you have a 300 foot diameter blade, the turbine must be at least 300 feet above the ground to (1) catch the optimum winds and (2) provide clearance for the blades. When there is a problem with a turbine, the technician will have to climb 300 feet up and 300 feet down to diagnose the problem. Then there will be at least one more climb and decent to fix the problem. This is expensive and potentially hazardous maintenance labor. The combination of larger turbines and propeller blades exacerbates the vibration problems. Diameters have been reported up to 100 meters.

The new problems associated with wind power being a major source of electricity have been addressed. Is there enough available capacity on electric transmission lines to handle a major new electricity source? If not, new transmission lines will cost about a million dollars a mile and securing a right of way could be a political adventure. If we rely on electricity as a major source, what happens when the wind doesn't blow, there is no electricity and we need it? The policy of building peaking units such as the ones built by Tampa Electric to serve as backups has been mentioned. Having built the peaking units, where do you find the crew to run it? In a small country like Denmark getting a crew to the site quickly may not be a problem. What happens if an operating crew is needed at Springfield, Colorado, on short notice? The expensive answer is that the on-site crew has to be able to operate and maintain BOTH units.

In Denmark, wind energy provides 20% of the electricity. The propeller blades are made of carbon fibers and are not recyclable. Denmark has found that failed propeller blades are consuming undesirable amounts of landfill space. Carbon fibers have the advantage of light weight and high strength. But they still fail and disposal is a problem. The Denmark experience indicates that the blades do not have the projected 20 year life.

To summarize, wind power does not have the potential to become reliable major electricity source. Equipment reliability issues with the turbines and blades are a problem. Wind is not always there when you always need it. (The entire Southeast does not have enough wind to make wind farms feasible.). Assuming that transmission line capacity is always available,

wind is probably limited to producing about 20% of our needs, based on experience with wind farms in Germany and Denmark.

The Sun Shines Bright On My Old Arizona Home

The problem with solar electricity is best summed up by the uneconomic black box that costs one dollar and produces five cents worth of product per year. Capital costs are too high. Advocates confidently predict breakthroughs that will greatly lower the capital investments.

Solar electricity has practical applications. One we see every day is the solar panels that provide power for the School Zone Lights. The solar panel is cheaper than running wiring from the light to a power source. Another application is providing power to a remote location where (1) the utility is required to provide electricity and (2) it is a long way – and expensive-to the nearest electric wires. Another application is off-shore drilling platforms. In the last two instances a backup generator or power supply is necessary for the sun does not shine at night. The offshore platforms operate 24-7.Solar panels have also been used to power space probes.

Solar energy panels have been used to heat water to (1) heat a home and (2) provide hot water. Advocates estimate that the costs will be recovered in 8 to 12 years. (How many people can make a binding commitment to stay in a home that many years?)

The largest operating solar plant in the world is in the American Mojave Desert and is rated at 354 megawatts. Most plants are smaller than 100 megawatts. Again, all existing plants are sited in optimum locations. A typical fossil fuel power plant is rated at 600 megawatts. Hence, the technology is at the advanced pilot plant stage. First Solar has received government-guaranteed funding to build two 550 megawatt generating facilities in Southern California, another optimum location. (We lived four years on the Mojave Desert. I wonder how the solar panels will stand up under the annual spring sandstorms.) The

loans are for 1.88 and 1.93 billion dollars (3.4 million dollars a megawatt.) Will that be enough? See the 0.79 million dollars a megawatt as the REAL cost of a natural gas-powered peaking unit. The technology advocates have adopted the position that the technology is in its infancy and that while solar electricity is not yet economic, yet-to-be realized breakthroughs are inevitable and will make the technology economic. Advocates accept that for the foreseeable future tax subsidies will be required. I found no advocate that believed that subsidies were economically unnecessary.

George Frisvold, William P. Patton and Stan Reynolds of the University of Arizona presented a paper at the Arizona Solar Energy and Economics Summit in January 2009. I classify them as advocates. They do conclude that Arizona is a most favorable location for solar energy and governmental subsidies are

required to make the technology viable. Arizona has (1) lots of sunshine, (2) relatively few clouds and (3) lots of available land. This land may be required to be fairly flat and undeveloped. (Have you ever gone through Arizona on I-10?).Other locations with less sunlight have less attractive economics. With subsidies, they project a cost of electricity per kilowatt hour delivered to homes: 17.1 cents in Albuquerque, 17.7 cents in Phoenix, 20.2 cents in Fort Worth and 33.0 cents in Fairbanks, Alaska.

To summarize, wind power is closer to economic than solar power. Even the advocates concede that subsidies are needed to make solar power possible. The advocates admit that technological breakthroughs are needed. I have not seen such breakthroughs reported in C&EN or other publications that I read. Even when breakthroughs take place at the laboratory level, there is a long and uncertain road to economic implementation.

Roll, Tide, Roll

People have been aware of the potential for tidal energy for centuries. The largest tidal electricity in the world is the Rance plant in France, completed in 1966 and with a 240 megawatt capacity. There are other plants with capacities of 20 megawatts and smaller. These plants obviously are experimental. It is significant that no second large capacity has been built since the Rance plant. Like solar power, it is the one dollar black box that produces five cents worth of power per year or the capital cost is too high to be practical

The Rance Tidal Electric Plant has continually operated since 1966. It cost 650 million francs to build or 94.5 million euros or 142 million dollars. That is 0.59 million dollars a megawatt. Inflation has a way of bailing out bad financial decisions. In 2011 dollars, the cost would have been 852 million dollars or 3.5 million dollars a megawatt. Compare this with the 0.79 million dollars per megawatt for a gas-fired peaking unit.

There are environmental issues. The Rance ecosystem has silted up. Sand-eels and plaice (a type of flatfish) have disappeared, although sea bass and cuttlefish have returned to the river. There are reasons why another tidal plant has not been built since 1966.

Obviously tidal power generation is restricted to coastal areas. Also tides have to be unusually high. One advocate source estimated that to be practical, the tide has to be at least 7 meters high. The Bay of Fundy in Nova Scotia and near Inchon in South Korea has been considered for locating tidal electricity stations since they have unusually high tides. Tidal power can only be generated when the tide is going out or coming in or for about 12 hours a day. The technology is to dam the estuary. Either the water can be run through turbines similar to those on wind farms or the water at high tide can be captured and run through a

hydroelectric generator. Vibration of the turbines would be much less of a problem than the wind turbines but salt water is corrosive. The hydroelectric power of which I am aware uses fresh water where corrosion is not such a problem.

A Ray of Light

Having spread large helpings of negativity, I now turn positive. If I were running the energy research effort, I would concentrate on developing a reliable, economic energy storage system.

This would allow the use of wind power when the wind is not blowing, solar power at night and very importantly, the ability to run conventional power plants at full capacity when the demand for electricity is low. This would reduce the need for electric generators that operate only at peak demand times. Electric plants could operate full out at night when pollution is less of a problem. (At night, the Los Angeles smog is driven out to sea and is less of a problem.)

We are already looking for such an energy storage system in electric car batteries. Electric cars receive large subsidies but are not selling that well, although governmental action may force people to buy them. We are probably closer to success in developing better and less expensive batteries than practical wind, solar and tidal electric plants.
I am by no means an eminent authority, yet I have seen it written that great breakthroughs occur only after an eminent authority in the field says that it is **impossible!**

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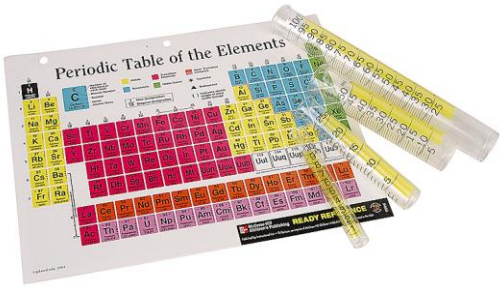
From the editor:

While preparing this issue of the RETORT, I suddenly realized that I get to write this editorial every month! After a while, it might get old, but right now, I'm excited. Some of the things you're going to see in our new RETORT are clip art, cartoons and links to ***YouTube***. Now that we're electronic, we can add inserts in color and hyperlinks without extra cost in printing. If you have favorite chemistry jokes, chemistry clip art, favorite chemical trivia, or if your hobby is cartooning, you can send that in, as well as the serious articles and the news notes.

As the great Oscar Wilde said, "Life is far too important to be taken seriously." This sentiment was certainly endorsed by Tom Lehrer, American singer-songwriter, satirist, pianist, and mathematician, known for the humorous songs that he recorded in the 1950s and 1960s. In his song, ***The Elements***, he sets the names of the chemical elements to a Gilbert and Sullivan tune. He retired from public performances in the early 1970's to devote his time to teaching mathematics and music theatre at UC Santa Cruz. In 2001, Lehrer's last lecture in a mathematics class was on the topic of infinity, and was said to go on forever (see, now Oscar Wilde would have liked that joke), after which he retired from academia. He is still to be found hanging out around UC Santa Cruz. Here is a link to YouTube with a performance by Lehrer himself singing ***The Elements***, plus visuals:



http://www.youtube.com/watch?v=DYW50F42ss8 Turn your computer volume on high and watch the ***Tom Lehrer*** Elements song!

What ***was*** the point of all that? I suppose it is to be aware of the little things….crystals, bubbles, puns, chemical trivia….things that perhaps look frivolous but in reality are at the basis of our love for what we do. As examples, look at the National Chemistry Week at the Dallas-Fort Worth Science Museum (p. 6). Flubber! Elephant Toothpaste! Periodic Table of Cupcakes! Of course, you say, you have to have these sorts of frivolous things to attract kids' interest, to get them interested in chemistry. Well, what got **you** interested in chemistry? For me, it was watching silver chloride crystals, falling lazily out of an invisible interface of silver nitrate and sodium chloride solutions, as I held a test tube up to the window, one fall day in inorganic qual lab. Send your stories to the RETORT, too, as well as your articles.