EEVC NEWSLETTER

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Club Address: P.O. Box 134, Valley Forge, PA 19481-0134 **NOVEMBER, 2010**
email: easternev@aol.com. Web site: www.eevc.info
President: Oliver Perry, 5 Old Stagecoach Turn
Shamong, NJ 08088, (609) 268-0944

Now affiliated with EAA

THE CAR THAT COULD, REVISITED
Oliver Perry

Quote from Henry Ford:

"If there is any one secret of success, it lies in the ability to get the other person's point view and see things from that person's angle as well as from your own."

I feel that the "Car That Could" does a good job of helping you and I to do just that. The book helps us to understand better why a production EV may not be as easy as some think.

The Car That Could is a book detailing the amazing and compelling story of GM's adventure with the EV-1, written by Michael Shnayerson. Many people may not be aware that GM allowed writer Michael Shnayerson inside its Tech Center gates daily in 1992 to visit the Impact (later to become the EV-1) project with few restrictions. He tells the story as he gathered the information directly from those involved. With GM's permission Shnayerson was allowed to interview and observe the engineers and managers working on the EV-1 project as it was taking place. Shnayerson was the only journalist at that time allowed to sit in on nearly 300 staff meetings and share a highly guarded secret that even many within GM were not aware of. His book offers readers a real inside glimpse into the automaker's world and provides us with factual information regarding the design and construction of one of the greatest electric cars the world has ever driven. Much of the story we have either forgotten or never learned.

Before the EV-1existed, There was the Impact .

And the Impact was reduced to a symbolic effort before it was turned back on under the EV-1 banner.

Scenes from "The Car that Could," the Impact stage.

In 1990 and 91 GM was struggling to stop huge losses in their North American operations. GM had invested in solar and electric car adventures back in the 80ties and on and off had been experimenting with electric cars.

Back in the 80s

The highly publicized GM Sun Raycer, built by a California company by the name of AeroVironment, outside of the auto industry , won the solar race in Australia from Darwin to Adelaide in record time. "The solar car lent a sheen of technology daring to a carmaker widely viewed as stodgy. It (the solar car) toured hundreds of schools before finding a permanent place in the Smithsonian Institute." (page 18)

Intro the Impact

A bright young engineer working on the Sun Raycer project by the name of Alec Brooks, having successfully accomplished an engineering marvel in record time, wondered if he could now convince GM to advance from the Sun

Raycer to building a real electric car. The components used in Sun Raycer Brooks felt could be upgraded and placed in a car that could really make eyes roll. "What Brooks had in mind was a sporty two seater built from the ground up to be lighter and more nimble than any electric vehicle of the past." (page 18) "Brooks, for one, had no doubts about his ultimate goal: to prove that EVs of the future could not only be cleaner than gas cars but in most respects better; even, some day, cheaper." (page 19) When Brooks was provided an opportunity to discuss his dream with selected GM managers, his comment that he could design an electric car that could go from 0-60 mph in 8 seconds caused some eyes to light up.

Brooks was then introduced to GM's Ken Baker who had been the director of the ill-fated GM Electrovette. Baker showed genuine interest in Brooks's idea. He told Brooks why the proposed two-seater should have front wheel drive and a battery tunnel down the center rather than have the batteries concentrated in the back. Baker also agreed it was a right decision to use lead acid batteries. All of the experiments with newer types to that date had ultimately failed to hold up in real driving conditions. Lead acid technology in theory could cause an electric car to go very fast indeed, and for a reasonable price.

Bob Bish, the battery expert from Delco Remy (owned by GM), later flew out to California to meet with Brooks and his team. He explained that watering systems for lead acid batteries were nothing but trouble and advised against using one. For the average consumer electric car batteries must be maintenance-free. Bish advised Brooks that if he was serious in developing a proof of concept EV car, he might try a new and untried electric car battery using gas recombinant technology. These were what we would today call AGMs. Instead of using flooded acid around the plates a sponge like glass and fiber mat was inserted to soak up the electrolyte. This battery no longer needed a space above the plates for gases to collect and reform. One could pack more lead into the box and have a denser battery. Brooks needed 900 pounds of batteries to give his concept car the acceleration and range he wanted. Bish did a calculation and told Brooks that his plans only had allocated 843 pounds of space even by using special build high-density lead acid batteries.

Green Light From GM

In 1988 Brooks and a representative from Hughes Aerospace, recently purchased by GM, traveled to Detroit to pitch their concept car, referred to as Project Santana, to the top executives. Chairman Roger Smith suggested that the Sun Raycer had given GM all the publicity they needed and he voted no to funding another "one of a kind" car. Several executives around him, Robert Stempel included, continued to pressure Smith to change his mind in the weeks that followed. Eventually Roger Smith agreed to fund the project with 3 million dollars with a 15 month deadline. The project was to be completed in California miles away from the rust belt mentality of Detroit, and kept a secret. It became known as Project Santana.

Alan Cocconi, from Cal Tech, who had proven himself by building the inverter in the Sun Raycer project, was assigned the similar electronics in Project Santana. Delco-Remy would handle batteries and GM's Advanced Concepts Center in Newbury, California would design the body. (In time AeroVironment became disgusted with the GM body designs and began making covert designs of its own. When GM management learned of the squabble they laid down the order that they would not support two cars.) Brooks's demands that the aerodynamic drag coefficient be similar to that of a F-16 fighter jet eventually forced both sides to accept a teardrop shape with a belly pan.

In the battery department Bish, at Delco Remy, began building the denser battery that he had previously suggested. The tighter the space between electrodes the more lead one can pack into a battery. One of the tricks Bish and his workers used to accomplish that feat was to freeze all of the battery components before they put them together. After the plates were put in place, with ultra narrow spaces between them, the frozen mats containing the electrolyte were slipped into these narrow spaces. The cold temperatures slowed the chemical reactions down enabling the mats to be fully inserted before chemical reactions caused them to swell. This technique enabled tighter spaces than normal to be used between the plates and led to the

more dense battery that the body design required.

The pages that Shnayerson writes describing the helter skelter rush to build the unique proof of concept EV on schedule are of great interest to read. The engineers and builders faced all kinds of unexpected problems. They fell behind schedule. Eventually Brooks asked for five more months time to complete the car. Then suddenly out of the blue he was faced with board chairman Roger Smith. Smith, who at first had been reluctant to fund the project, had become so excited about the reports he had been reading regarding their work that he wanted to have the concept car ready to reveal to the world at the upcoming LA car show in January. This was not a popular decision among many in GM. There were fears that showing California a car that could meet their mandate could place all of them in bondage, especially if the car didn't live up to expectations.

At that point in time it was only a proof of concept car with many bugs to be worked out. Engineers feared revealing their electronic trade secrets. Shnayerson writes that Smith cheerfully waved away these fears. "Most engineers would be still working on the 1971 Chevrolet if someone hadn't grabbed it away from them. It's time to get this thing out of the chute."

Crunch time had unexpectedly arrived. Night after night everyone scrambled. In frustration Brooks even accepted fixed windows which would not roll down. At 1:00 AM November 28, 1989, a doorless shell flew around the parking lot demonstrating the power train worked. As show time came closer the car passed initial tests at the GM proving grounds in Mesa, Arizona. It jumped from 0-60mph in 7.9 seconds. It went 124 miles at 55 mph. It simulated urban traffic and performed up to accepted driving standards. The controller limited the top speed to 75 mph, which did not seem to pose a problem for anyone.

Proof of Concept EV Made an Impact!

Although the suspension and handling were terrible, and the car lacked any amenities including air bags, several weeks of sanding and repainting presented an exciting image to the public. As the engineers made the final preparations for the unveiling of the car to the GM PR people, someone added a license plate that read, "The Future is Electric." The PR man in charge of the video crew required that the plate be removed because it made too strong of a statement. That did not go over well with the team that built the car.

The name of the proof of concept car had been Santana until GM lawyers discovered that the name Santana was registered to a VW model in Europe. Either Chuck Jordan, the GM vice president of design, or Don Runkle an executive at the Tech Center in Michigan, came up with the new name, Impact, supposedly for the impact it would have on the world. Few working on Project Santana liked the name and were dismayed that their replacement name selections had been overridden.

GM chairman Roger Smith, after presiding over another tough year of dwindling market share, seemed almost intoxicated over the great fanfare and buzz that the car generated when he personally introduced it to the public in January of 1990. For the moment the Impact team reveled in glory. Roger Smith had hired an outside R&D firm to build a visionary concept electric car that shocked the socks off of its drivers. The Impact created an uproar of public approval at the car show. Soon against the pleas of his advisors, Smith would declare to Washington Press Club (at an Earth Day event) that GM was going to actually produce the vehicle.

To some, amongst all the hype and fanfare, there was cause for concern. The video linked to the display at the car show did not give any credit to AeroVironment, the company responsible for making the car. The GM engineers seen at the Tech Center in white coats were actors. MacCready, head of AeroVironment, taking the long view at that point didn't care who got credit for the car. In his mind the Impact hastened the development of electric cars by five years.

From Concept Car to Production

Meanwhile, back in Michigan, GM executives set about to find someone to head up the team needed to bring the Impact to production. How GM could actually make the Impact a production car would become Ken

Bakers next career challenge. Baker felt flattered that he had been offered the opportunity. But looking back over the Electrovette experience he wondered whether or not he was once again being set up for failure. When the oil prices had dropped the Electrovette died a quiet death at the demo stage.

In accepting the position of being the one responsible for bringing the Impact to production Baker hoped he would help write a page in automotive history. He hoped that this time GM would follow through on proving electric vehicles could work after all. Making the Impact a production car would not be an easy task. Its handling was awful and although it proved the concept, many changes were needed in order for such a vehicle to turn a profit in production. The first step would be to produce a working prototype in a way that manufacturing could effectively reproduce. It meant starting all over from scratch examining every aspect of the "show-stopper" Impact.

Due to the change in fortune of GM profits in the early 90ties Baker's budget and time frame to produce the working production prototype were both very tight. Many feared it was only a matter of time before top management would be forced by the board to shut the Impact program down, especially if the effort proved to be costly and failed to turn a profit in a reasonable time.

As the final design stages neared the deadline for the first production model testing, the GM Impact engineering teams began to feel all sorts of pressure. The parts engineers were eventually split into nine groups called PDTs. (PDT stood for production deliver team.) In the case of the builders of the GM Impact the PDT teams were eventually transferred to a church near the test center because it had enough common space for the teams to work jointly in problem solving. The Impact program had been assigned limited space and funding.

The PDT job was to design and engineer the manufacturing procedures needed to assemble the various parts of the Impact: to decide whether to use nuts and bolts or rivets and glue as well as to determine the best assembly procedure that would provide the shortest assembly time. At this stage it was too late for them to change basic designs without stalling the whole project. They were now held hostage to the strict standards they had set for themselves earlier in the over-all design of performance and range stages.

The structure team was one of the first teams to feel that they were finished. They resisted making changes to accommodate modified parts more suitable for production procedures. Trade offs between departments became harder to implement as the production deadline approached. Every 22 kg of mass (about 45 pounds) was defined as a mile of range. So were every six counts of aerodynamic drag, and every 34 watts of power.

But Shanayerson describes the biggest frustration for the engineers, as the deadline for production testing approached, was the failure of the battery team to finalize the number of batteries it would include in the final proof of production Impact. The size of the battery pack seemed to grow daily, requiring changes in the structure of the car. If structure changed then the parts connected to the structure would have to change.

Basically as time went on it seemed as if the mass and cost of assembly targets could not easily be met. Every part had to be strong, functional, reproducible, light and reasonable in cost. It was not always easy to take the mass out of a part without either raising the cost or lowering the strength. Each part department wanted somebody else's part department to reduce weight and leave them alone.

Eventually it became clear that the lead acid battery stood in the way of meeting the range and performance standards that the engineers had set for the production Impact. It began to look too difficult to accomplish their goals even for the believers in the electric car concept.

Furthermore many arguments continued regarding the price range the car should sell for. Price affected production design. Although engineers continued to improve the parts, reduce their weight and the space they consumed, the first production ready Impact was not in sight.

Collective Battery Research Begins

As GM quietly began to ready its Impact for production, so too were Ford and

Chrysler working on EV projects of their own that would could be used down the road if and when the California Mandate was enforced. As he supervised the Impact project, Ken Baker had begun secret meetings with EV counterparts in Ford and Chrysler. Although the three auto giants were competitors they sometimes found reasons to do joint research.

At the same time a gentleman by the name of Michael Davis, a new assistant secretary of the DOE, observed that although the DOE was handing out 20 million dollars a year in small amounts to federal and university labs all around the country for battery research not much of any value was resulting from this research. (Because of the California Mandate the big three auto companies were pouring some money of their own into battery research in case they needed EVs.) Why not, Davis reasoned, put all of the DOE funds into one big basket and give it to a consortium made up of the major auto companies? These same companies could be required to add the funds which they were already devoting to their company battery research. Davis observed that the Big Three would automatically get a return of six dollars for every dollar they spent. So what if all three companies ended up using the same advanced battery? They could still compete against each other with the rest of the car. Pooling their resources the Big Three stood a greater chance of meeting the California Mandate by jointly developing a battery than by trying to develop a battery on their own.

As the idea was pushed forward the big question occurred as to who would be responsible for managing the collective effort that would eventually become the United States Advanced Battery Consortium (USABC).* For several months the big three engaged in very tense meetings in the attempt to work out an agreeable plan.

Although each company would have loved to abolish the others, each knew that their best chance of creating an advanced battery lie in working together. Soon the directors of the Ford Eco-star, Chrysler TEVan, and the GM Impact vehicles were sharing information and working together… or were they?

Ford pushed their sodium sulfur battery, Chrysler the nickel cadmium, and GM a lithium polymer. Over time the three companies smoothed out the last wrinkles in the newly formed consortium. The government would allow USABC to own patents, reasoning that if the research produced anything of value the government's money would be well spent. The big three worked out requests for proposals for battery developers and a fair way for the resulting technology and profits to be shared. Congress was convinced by the White House Office of Management and Budget to see the USABC as a money-saving venture, resulting in more funding as the DOE had requested.

In the fall of 1991 the DOE provided 130 million dollars to the battery research fund while the Big Three and Utilities matched that amount to give the USABC 260 million dollars for battery research. Since the USABC had become a shining example of how government and industry could work together the White House called for a Rose Garden ceremony to give it an official launch. President Bush the first offered a short speech. Parked off to the side sat a converted Chrysler mini-van, a Ford Ecostar van, and the original Impact show car. The choice of car to demonstrate was predetermined by a drawn lot. President Bush waved to photographers as he climbed into the Chrysler van and pressed the accelerator. The van didn't move. The panicked mechanics corrected the electrical connections in several minutes and the president was able to drive the van a few hundred feet for the press.

It wasn't long before the USABC received an application and awarded an 18.5 million dollar DOE grant to go to a small unheard of company in Troy, Michigan, ECD (Energy Conversion Devices). An independent lab picked the ECD nickel metal hybrid battery as a winner. It had an 80 watt-hrs per kilogram output compared to the lead acid battery of about 35 watt-hrs per kilogram. The consortium hoped that the winning technology would be able to reach their mid-term goal of 100 watt-hrs per kilogram. Stan Ovshinsky, who had developed the nickel metal hydride battery and owned ECD was thrilled to pieces when he received the grant. As most of our readers know, the nickel metal hybrid battery would eventually become a game changer.

Meanwhile efforts on Impact continue

As GM's profits seemed to keep sliding Baker worried that his team was falling further and further behind in creating a feasible model of a production Impact, that is, moving the Impact from Concept Initiation to Concept Approval. The poor financial climate forced Baker to delay the project another six months. He worried that management might decide it was best to kill the whole program at any moment.

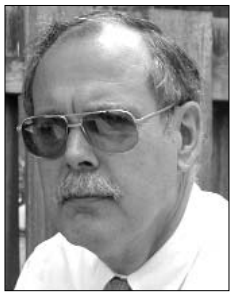
To Be continued…

*The US Advanced Battery Consortium (USABC) was formed in January of 1991.

The mission statement on the USABC web page states that USABC's purpose is to develop electrochemical energy storage technologies which support commercialization of fuel cell, hybrid, and electric vehicles.

USABC is currently one of the research units under the direction of the Energy Storage Technical Leadership Council, which presently is a basic research unit of the United States Council for Automotive Research (USCAR) formed in 1992. The USCAR has its roots in the1984 Cooperative Research Act in which congress provided opportunities for a wide range of research and development collaborations involving industrial competitors. The USCAR is a management group that serves as a coordinating research hub for automotive related needs.

WINNERS AND LOSERS
By California Pete



The Bay Area is still basking in the glow of the Giants' victory in the World Series; It did feel a bit odd to root fervently for the Phillies in the playoffs and then switch allegiance to the Giants, but I'll take the win (this from an ex-Dodger fan who stopped watching baseball for 30 years following the Great Betrayal — and that came after a Series win as well). But as I said, I'll take it.

Perhaps the biggest news outside baseball was the election results. While the Democrats swept all the major California elective offices (S.F. really, really likes Nancy Pelosi, and Jerry Brown gets to be governor again), the results of the various ballot propositions weren't quite so far to the left.

Proposition 19, which would have legalized the possession and production of marijuana for recreational purposes (as if all the toking going on already wasn't just for fun in the first place) was defeated. San Francisco, as expected, backed the measure, but other areas, perhaps having heard that the measure would have allowed people (including school bus drivers) to show up for work stoned, and perhaps having been reminded by the U.S. Attorney General that pot was still against federal law, helped to vote it down. Oddly enough, the pot-growing "Emerald Triangle" of Mendocino, Humboldt and Trinity counties voted against it. Apparently while some growers felt they could turn their pot farms into boutique affairs like the fancy wineries in Napa, others worried that commercial production would hurt prices.

More good news from Tesla

Tesla Motors has had some more good news. First off, the company officially moved into the NUMMI plant, and put its name on the building. And on November 3 Panasonic announced that it was investing $30 million in Tesla, acquiring about a 2 percent stake in the company. Panasonic and Tesla will jointly market and sell battery packs for EVs.

Local grants for EVs

On October 27 regional and local officials gathered at City Hall in San Jose to unveil a plan to introduce electric vehicles into several Bay Area market sectors with the help of the Metropolitan Transportation Commission's Climate Initiatives Grants. Nearly $14 million of the $33 million in climate grants announced will go to four major electric vehicle projects in the Bay Area:

• $7 million for an electric taxi demonstration program based in S.F. and San Jose that will provide 61 EV taxis with switchable batteries (to cut down on time lost to recharging); with matching funds, the total cost is $20 million;

• $2.8 million for a local government EV fleet program that will involve the purchase of 90 electric vehicles (including 79 Nissan Leaf sedans) for use in eight jurisdictions' fleets.

With added local match funds, this two-year, $5 million national demonstration will showcase electric vehicles in government fleets;

• $1.7 million for incorporating electric vehicles into car-sharing programs ($2.4 million total with matching funds); and

• $2.4 million for Bay Area electric vehicle infrastructure and readiness programs, such as installing charging stations.

More on grants

Speaking of grants, CNN Money reported on Tuesday that buyers of the new Nissan Leaf may have to pay only about $17,000 — if they live in the right place. The car sells for $32,500, but the federal government offers a $7500 tax credit, the state of California gives a $5000 rebate, and local governments in the San Joaquin Valley offer another $3000.

But would you move to Fresno for $3000?

Is Coda Automotive for real?

Back in March of 2009 we learned of the formation of Coda Automotive under the leadership of low-speed EV entrepreneur Miles Rubin. The plan was to build a full-size, highway speed EV in China and import it into the U.S.

In October of this year the *San Francisco Chronicle* reported that the company, headquartered in Santa Monica, might begin assembling the car in the Bay Area town of Benicia. The CEO, Kevin Czinger, touted the car as better than other EVs. Things were looking up.

Then in November Czinger abruptly left the company. While an interim CEO has been put in place, things look pretty shaky.

NEWS UPDATE

SAP, Siemens are getting into EV chargers

On October 21 *greentechgrid* reported that two German companies — software maker SAP and Siemens — are teaming up "to integrate the entire process of people charging their EVs, no matter where, and ultimately generating an invoice at the 'home' utility."

How exactly this would work, and how practical it might be, are still to be determined, said the report.

What will EVs do to engine makers?

An article by Hiroko Tabuchi in *The New York Times* for November 2 reported that owners of companies in Hahamatsu that supply parts to the Japanese car companies — exhaust pipes, spark plugs and so on — are worried that as EVs take more of the market they may be driven out of business. In response, the part makers are working hard to figure out what parts they can make for EVs. Chinese companies present potential competition, says the report, but businessmen in the region feel that they will be able to adapt.

Li-ion battery prices going down

An October 18 Bloomberg story reports that lithium-ion battery maker Sanyo plans to reduce manufacturing costs by half over the next five years. The company is gearing up for increased production, and "may add a manufacturing line at the plant to make large-capacity cells for plug-in hybrid and all-electric cars by March 2011, raising its output ability to as high as 1.5 million units a month."

Mitsubishi plans larger i-MiEV

A November 1 article by Hans Greimel of *Automotive News* reports that Mitsubishi Motors Corp. plans to unveil a wide-bodied version of its i-MiEV at the Los Angeles auto show. The larger size — larger than the Japanese and European version, the story says — will be "both to meet U.S. crash standards and cater to American tastes." Predicted retail price is less than $30,000.

EV training program

For those readers who make it to the West Coast, Electro Automotive is pleased to announce the launch of the Electric Vehicle Tech Training Program™, in collaboration with the Electronic Transportation Development Center, Breathe California, Silicon Valley Clean Cities Coalition, and Autotrend Diagnostics, and partially funded by the Bay Area Air Quality Management District. The EVTT Program™ will provide training on the technology of electric vehicles, with the goal of developing a trained workforce for the emerging job sector of green transportation as well as educating potential electric vehicle buyers and users, such as fleet managers.

The first training event will be a three day

seminar scheduled for Jan. 14 -16, 2011. The seminar will be held at the San Jose office of Breathe California, Silicon Valley Clean Cities Coalition and the Electronic Transportation Development Center (ETDC) at 1469 Park Avenue, San Jose. Material covered will include performance, cost, environmental, and energy aspects of electric vehicles; AC vs. DC systems; components of the vehicles; conversion of internal combustion vehicles to electric power; driving, charging, and maintenance; troubleshooting; and more. Vehicle components and a running vehicle will be on hand. For details, see www.electroauto.com/3Day-Seminar.shtml.

PV industry to grow 902% in 2010 - Report

Global solar photovoltaics (PV) panel production will eclipse 15 GW this year, according to GTM Research's latest report, "PV Technology, Production and Cost Outlook: 2010–2015." While subsidy cuts in key markets will lead to slower growth in 2011 and beyond, panel production will still exceed 25 gigawatts by 2013. At the same time, increasing competition between suppliers will lead to panel prices of less than $1/watt by 2012 for select technologies.

For more information on the report go to www.gtmresearch.com/report/pv-technology-production-and-cost-outlook-2010-2015.

2011 Green Car of the Year finalists revealed

On October 21 *Green Car Journal* announced its five finalists for the 2011 Green Car of the Year®, including the 2011 Chevrolet Volt, 2011 Ford Fiesta, 2011 Hyundai Sonata Hybrid, 2011 Lincoln MKZ Hybrid and the 2011 Nissan LEAF. For the sixth consecutive year, this increasingly important award will be announced during a press conference at the LA Auto Show Press Days on Nov. 18.

The Green Car of the Year award is a program that honors environmental leadership in the automobile field and recognizes vehicles that become available to consumers during the award year. For the first time, the finalists include two primarily electric-drive vehicles in addition to two hybrids and a high mile-per-gallon, gasoline internal combustion engine.

While four of the five nominees do incorporate electric drive, the Ford Fiesta nominee underscores that internal combustion continues to evolve in important ways. This hatchback achieves up to 40 EPA estimated highway fuel economy, running on conventional gasoline. Along with vehicles incorporating electric drive, a new generation of internal combustion gasoline and clean diesel models are expected to push efficiencies ever higher in the coming years.

COMING EVENTS

The New England EV Car Show
November 14, Middletown, CT, For info go to www.ecedra.com.

World Energy Engineering Congress
Dec 8-10, Washington, DC. Go to www.energycongress.com

Green Truck Summit
March 7-10, 2011, Indianapolis, IN. Contact Susan Romeo, sromeo@calstart.org, 626-744-5600

EVs in Macungie
April 30, Macungie Memorial Park. Contact jisaacs@buckscountyrenewables.com.

Solar 2011
May 16-21, Raleigh, NC. For info go to www.ases.org/index.php?option=com_content&view=article&id=18&Itemid=147

11th Challenge Bibendum
May 18-22, 2011, Berlin, Germany. Go to www.challengebibendum/en

MEETING SCHEDULE

Meetings are held in Room 49, Plymouth-Whitemarsh High School, 201 East Germantown Pike in Plymouth Meeting, PA, and begin at 7:00 p.m.

Dec 8

Jan 12

Feb 9

Mar 9

Apr 13