January minutes not available

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (1 February 2017)

President Jim Serene called the meeting to order at 6:45 p.m. Gordon DeJong announced the death of our former club president, Rex Warland. No treasurer's report. Art reminded the members that there will be a meeting of Region 2, to which we are all invited, in Millersville, PA, on Saturday, 1 April, and briefly spoke about a buffet option, which would cost each diner $5 more than what we pay for a fixed meal. Dave Mudgett introduced his wife, Judy. Jim introduced his guest, Lee Grenci, a retired professor of meteorology who served for twenty years on "Weather World." Ed Buss asked members to vote on John Golbeck, who was elected unanimously to membership in the club.

Dave Mudgett, applied mathematician, electrical engineer, musician, and lecturer in the College of Information Sciences and Technology, spoke on "Systems Science—Data and Information; Mathematical Modeling, Causality, and Sense-Making; Prediction, Decision-Making, and Control," or "Adventures in Information Science outside its Natural Habitat." His interest is in applied mathematics, applying feedback-control theory to a model-controlled system. He provided an equation for a controlled system. One simplifies the problem by linearizing and applying transfer analysis. Mathematics provides easily evaluated insight into how a system behaves. Frequency response analysis helps to guide design. He showed a generalized feedback control model as a diagram, a deliberately simplified control model of the system (plant) that one is trying to control. Feedback is needed to stabilize an uncontrolled system, or to remedy poor performance. Control actions can make systems worse. How well does the model predict how people behave? Humans aren't usually in the loop. The natural habitat of Classic System/Control Theory. It may be hard to apply this model to other kinds of control systems. Jay Forrester and Dennis Meadows tried to apply this analysis to large human systems. Although their books are Interesting and accessible, they don't tell how to design something. It is hard to predict the future because so many random variables exist, yet one must make forecasts, e.g. manufacturing or sales. Time series analysis uses past data to predict the future, but projections will always lag behind behavior. stock market projections show us that past isn't prologue. Econometric analysis, an alternative, is an art as well as a science for humans are in the loop. People tend to be conservative, we underestimate how long they take to make decisions, corrective measures change the system's dynamics, causing counterintuitive behavior, overreacting to a problem, and individual and organizational goals diverge.

The Forrester ("Bullwhip") effect states that production exceeds real demand, huge inventories become capital sinks, and may destroy a firm, illustrated by the relationship between sales and inventory in the Norwegian pulp industry, Procter & Gamble's output of Pampers, and his own work experience in the 1970s at Chrysler, with its large inventories. He studied lead time, inventory management, and control mechanisms. The studies took time, as did making reports and persuading anyone to act on his report. Boom times lead to pressure to overproduce, regardless of long-term consequences. The firm was biased against cutting production. Even during the 1978-79 economic slowdown, Chrysler still had to maintain high production. Forrester's *Industrial Dynamics* advised management to cut inventory, but it didn't understand mathematics, and the economists were right. The second oil crisis put Chrysler in dire straits. In the1974 crisis it had cut half its engineering staff and more than half of its production workforce, but lost to its competition, for its Volare, Aspen, and Cordoba models failed, yet it raised production, against economists' advice. They repeated these mistakes in 1979: badly made cars filled their inventory. A $1 billion federal bailout in June 1980 saved Chrysler, but it repeated this mistake in December 2005. This recurs, because managers fear if they cut production they will be fired. Overreaction causes excessive production cuts. Manufacturing firms could solve these problems using systems analysis, making mathematical models to predict behavior, based on the economy's performance. However, human behavior is rarely rational, individuals don't act in the firm's interest, and it is hard to extract useful information and prove causality. "Not everything that can be counted counts, and not everything that counts can be counted" wrote William Bruce Cameron. Mathematics isn't just about numbers, e.g. set theory. In his dissertation Dave tried to use mathematics to apply "fuzzy reasoning/control" or adaptive control theory to these problems. Neural learning systems can aid pattern recognition. Network science is used to predict stock market, based on statistical physics. Dave lost interest in control systems in the 1990s, choosing instead to play music and teach mathematics. Many questions followed.

The meeting was adjourned at 8:05 PM.

Next meeting, on 8 March, has Al Turgeon comparing Scottish and American golf courses.

Respectfully submitted, Art Goldschmidt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (8 March 2017)

President Jim Serene called the meeting to order at 6:40 pm. Art announced that our April talk will be given by Walt Ebaugh and urged that future March meetings be scheduled in a week other than during Penn State's spring break, to which the 15 members present agreed. There was no treasurer's report. Al Turgeon introduced his guest, Lou Persic.

Jim introduced tonight's speaker, Al Turgeon, speaking on a "Comparison of Scottish and American Approaches to Golf Turf Management." Educated at Rutgers and Michigan State, Al taught at Illinois and Texas A & M before coming to Penn State in 1986 as head of the Agronomy Department and Professor of Turfgrass Management. Having visited golf courses in various parts of the world, Al has long noted the contrast between American and European approaches to golf turf management. The origin of golf is claimed by many countries, including the Netherlands, France, and even China, but it most likely began on Scotland's eastern coast between Peterhead and Edinburgh. "The Links" is a strip of land between the beach and inland farms, its soil being fine washed sand 40-70 cm deep, covered in drier, higher areas by fescues and in wetter, lower parts by browntop bentgrass. Unlike US greens, which are mostly flat, Scottish greens are undulating, with the fescue dominating on the drier mounds and bentgrass in the wetter depressions, reflecting their differential environmental adaptation. Scottish links comprise scattered dunes and intervening greenways where sheep graze, "mowing" and "fertilizing" the grass. In depressions at one end of the greenways, runoff water and nutrients promote denser growth, attracting rabbits, which graze more closely forming the green. The rabbits even create the holes. Thus, a golf course is formed with virtually with no human intervention. Links golf, called the "long game," was played by wealthy farmers during winter when there was more time for leisure. Some of the less wealthy townspeople played "town golf", principally in churchyards, a hazard to passers-by. King James II banned it (along with soccer) in 1457 for the games interfered with archery practice. Al also explained the origin of sand traps, which were hollowed out by sheep for protection against wind and blowing rain. Sheep, as well as scythes, served as "mowers" for many centuries, the first mechanical lawnmower was invented in 1830 by Edwin Budding, a textile engineer. The first role of a greenkeeper was to cut a proper hole, using a knife. These holes varied in diameter and depth. A hole-cutter was invented in 1829, setting the standard diameter at 4.25 inches, and the depth at between 4 and 6 inches.

Ole Tom Morris, the greenkeeper at St Andrew's GC, introduced the practice of sand topdressing, to manage thatch and produce a firm but resilient playing surface on the greens. In an attempt to fertilize the grass more uniformly, sheep manure was dried and pulverized, and mixed with sand, for uniform spreading on the greens by shovel. Spreaders were invented later to ensure a more precise application. With heavy golf traffic on the greens, the turf can eventually deteriorate, requiring replacement of the sod. A greenkeeper can lift the turf and apply sod from another site to replace worn sites. So, the first golf courses were natural ecosystems, requiring few cultural inputs. Eastern Scotland has a temperate, oceanic climate, with light rainfall that varies little from month to month and monthly temps ranging from 36˚ in January to 66˚F in July, ideal for sustaining healthy golf turf. Only a few areas of northwestern Europe and the US Pacific coast possess this type of climate; East Europe, Russia, and most of the US Northeast have temperate continental climates. The first US golf course still in existence is in Yonkers, which has a warm temperate continental climate. Climate stresses here exceed those in Scotland, so US golf courses incur more diseases and thus need more maintenance. Walter Travis, a golf journalist, stated in 1901: *"The climate in this country can hardly be said to lend itself to the growth or development of natural greens of the first rank. The extreme heat and cold are not favorable allies."* To combat the problems encountered in golf turf management in the US, requests were made to the US Department of Agriculture for help. Forage agronomists had to consider how to promote healthier verdure (the grass remaining after mowing) not yield in this new approach t grassland research. Dr. Charles Piper, a USDA agrostologist, was asked to address these challenges. He and his associates initiated turf research at Beltsville, and later developed the Arlington Turf Garden in 1920. (The Garden was destroyed in 1941 to provide land for constructing the Pentagon). In Pennsylvania, Mr. Joseph Valentine, superintendent at the Merion Golf and Cricket Club, asked Penn State President Hetzel in 1928 to start a program of turfgrass research and training for golf course managers. Bert Musser, a red clover breeder, created PSU's turfgrass management program from scratch, authored *Turf Management* (1950), and developed Penncross creeping bentgrass for golf courses. European golf course managers maintain as natural a system as possible, whereas Americans use improved turfgrasses, irrigation, nutrients, improved soil aeration, and pest control. They seek playability even if the grass gets brown in the summer; Americans try to balance golf course playability with appearance. Al showed slides showing a Scottish course that favors tradition and tolerates weeds compared with an American one that is beautiful, straight, and manicured. We also differ in how we make the rules for playing golf. Which way is better? Don't be judgmental. Questions from the floor: how do Scottish golfers perform in international competition; divots; control of weeds, e.g. wild strawberries;, applying fertilizer and controlling its runoff; comparative number of UK and US golf courses; maintenance costs; declining number of players and GC members; golf as a barometer of economic conditions in the US, China, Korea, Australia, and the Gulf States; usage of the Stimpmeter on the US greens in order to create a faster green; effect of our turf management methods on how golf is played; the emergence of skilled Korean golfers, notably women; the effect of high costs on skiing and golf participation; and advantages of reel vs. power lawnmowers.

The meeting adjourned at 7:45 pm. Our next meeting will be on 12 April.

Respectfully submitted, Art Goldschmidt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (12 April 2017)

Jim Serene called the meeting to order at 6:35 pm. and reported his attendance, with Louise and Art Goldschmidt, at the Region II Meeting held in Millersville, PA, on 1 April. Lee Stout said that the treasury is fine. Art announced that the IATC Convention will take place in Kalamazoo, MI, on 18-21 June. He urged someone else to represent our Club there as he and Louise may not be able to attend. Jim and Louise described the regional meeting, IATC's expectations of a healthy club, Steve Toy's advice on writing an article for the *Torch*, such topics as membership recruitment, outside speakers, websites, and the IATC leadership issue. Ed Buss introduced his guest, Jim Rosenberger, statistician, Penn State faculty member, and Borough Councilor. Lee proposed Lou Persic for membership, who was approved unanimously.

Walt Ebaugh gave his paper: "We are not Downstream from Anywhere." When he came as a child to State College, it had 7,000 inhabitants and an equal number of Penn State students. Its population now exceeds 100,000 and at this rate of growth State College could have 1,000,000 in 70 years. Where will we get the water? We are downstream from no river or stream. We used to get surface water from Tussey Gap, in our case Shingletown Gap. As our population redoubled, the Borough Water Authority drilled wells to get more water. Now our supply comes mainly from the aquifer on the valley floor between Tussey and Bald Eagle Ridges. He showed a slide portraying how water cycles between the atmosphere, precipitation, and groundwater; then a map of North America, then focusing in on our local ridges and gaps. Our water equation: precipitation = runoff + evapotransporation + recharge. What enters the aquifer equals what leaves it via seeps and springs along the valleys. He explained how Spring Creek excelled for trout fishing, but we now pump 10 million gallons per day from that aquifer, one tenth of its natural flux. The Spring Creek aquifer land area is 175 sq mi.; he showed its geologic profile of folded rocks. The surface watershed is 143 sq. mi. He showed a topographic map of the water table surface and a model of the water recharge system, a map of its spring locations and of the municipal supply wells and their capacity. Having earned an MS in hydrogeology and built up a consultancy in that field, he enabled the Borough Water Authority to double its capacity. He now serves on our sewer authority. He noted how our water use has caused streams, such as Slab Cabin Run, to dry up. The Spring Creek Aquifer consists of the upper 400 feet of saturated rock. He showed slides of Spring Creek, also of Bellefonte's Big Spring (now covered), and Spring Creek at its confluence with Bald Eagle Creek. The latter's drainage depends on the amount of rainfall. Spring Creek's flow varies little due to its aquifer, and it is a high-quality cold-water fishery. We are using too much of it, decreasing the flow of headwater tributaries and warming the stream at the sewer plant outfall. Our sewage effluent is too warm for fish. By using micro filtration and reverse osmosis, sewage is converted to drinking water quality, and we should aim toward recycling that water. He provided statistics on how pure recycled water is. We now discharge from the sewer plant 5 million gallons per day; 6 million are permitted, but our system has an actual capacity of 9 million. Ways we now use recycled waste water, including washing uniforms and vehicles, making concrete, heating or cooling buildings, and watering fairways. If we use water wisely, we can avert the desiccation of Slab Cabin Run. We are all in one bathtub: The Spring Creek Aquifer.

Discussion: Gary Petersen noted that water use has declined in the last ten years even as population has grown. Walt noted many economies, such as repair of leaking pipes. Are the benefits of water reuse being researched? Penn State's research projects would not be permitted by PaDEP. Lee recalled how water problems were supposed to limit Penn State's growth. We have raised enrollments at the cost of the fish. Could we pump water from Bellefonte's Big Spring? It discharges is 19 million gallons per day. Water saving shower heads and toilets help limit water use, but this decline won't go on forever. Scott Flipse asked if water supply affects the Toll Brothers' development project. Walt said that it is not a problem. Gary argued that the Toll Brothers' plan safeguarding water supply is the best he has ever seen. Too bad, Walt quipped, that the Susquehanna doesn't run through State College! He cited the saying: dilution is the solution to pollution.

The meeting adjourned at 7:51 pm. Our next meeting, on 10 May, will feature Lee Stout: "History of Beaver Stadium and its Predecessors."

Respectfully submitted, Art Goldschmdt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (10 May 2017)

Jim Serene called the meeting to order at 7 pm. Asking for comments on Walt Ebaugh's talk, he asked when Penn State or State College will find that the demand for water exceeds its supply and make a decision. Walt answered that we have three water sources and one sewer system. Representatives met for the first time yesterday. Art was instructed to send out info about the IATC candidate's qualifications and policies. Roy Hammerstedt will preside at the June meeting. Mick McKay has agreed to be our Club's VP next year. Lee introduced his wife Dee, who is a spousal member who hasn't been able to come regularly. Jim reported eight members joined in 2016-2017 and he will photograph them afterwards. Roy notes that our club has acquired two thirds of its present membership since 2010. He wants the officers to examine its bylaws and procedures, hoping to recruit many more members. Other clubs are quite different from ours.

Lee Stout spoke about his and Harry West's new book, *Lair of the Lion: A History of Beaver Stadium.* Harry, an engineer, taught a Gen Ed course on the history of structures. For this course he prepared a slide lecture on the history of Beaver Stadium as one example. Lee and Harry met and agreed to write this book: Harry writing on the site and structure; Lee on the spectators and their experience. Penn State's original Beaver Field was behind where Osmond Lab is now. Gov.'r Beaver got an appropriation for the first grandstand, seating 500. Built in 1893, it had a locker room with showers under the stands. Later, Charles Lowry developed Penn State's first campus plan. Athletics were moved away from the campus center to the northwest periphery. By 1908 the college got an appropriation to grade the ground from Hort Woods to the area of what is now Rec Hall and moved the grandstand there. As Penn State played football against larger colleges, it was gradually enlarged to a capacity of 11K, plus temporary bleachers adding 9K. Wooden grandstands are hard to maintain, so steel replaced wood section by section in 1934-39. President Hetzel's "Grand Experiment" led to 9-10 losing seasons in the 1930s, but the team improved during and after World War II. Penn State went to the Cotton Bowl. Rising demand for seating led to adding a section to each end of the stands, also a north end stand that made it a horseshoe. New Beaver Stadium could expand no farther in its location. President Walker, in his strategic plan, decided to relocate it eastward, starting in 1959. The existing structure could be reshaped for easy transfer, but first they built high stands in their new location, fitting in the stepped steel stands below (seating capacity about 40K). In 1977 the stadium was lifted by jacking the stands section by section and enlarging the south stands (new. capacity 76K), all done after the 1977 season and before 1978 season, adding forty rows of concrete stands to form a bowl.

The next major addition in 1999-2001 enclosed the south end and added two decks, new locker and press rooms, the All Sports Museum, Mt. Nittany Club, and suites for the president, legislators and top visitors. Current capacity is. 106,572. Many books cover games and players, but this one treats the spectators' experience. Management of college athletics from 1890s to the 1920s passed from students to alumni. A student manager had huge responsibilities at first, but a "graduate manager" (an alumnus) took over. The coach's role expanded. Faculty's role was to set eligibility rules, and players were often paid by alumni and abused the system in other ways. The president and trustees provided facility but had little control. As Penn State played against stronger teams, many were reluctant to play in State College; larger stadiums were more lucrative. The earliest fans were students and faculty, later alumni and other fans, coming by trains, then cars. Extracurricular activities were evolving. Newspaper coverage began. The lion mascot, marching band and cheerleaders were added. The concept of what it meant to attend a game changed. In the 1930s Penn State experimented with stopping athletic scholarships, recruiting players, scouting opponents, athletes' dorm and training table. No other college followed its lead. Attendance fell and the season was shortened. Revival after WW II. As fans arrived by car, tailgate picnics began. Students no longer dress up for games, but now are more apt to wear school colors. Games are noisier. ESPN says Penn State provides the greatest experience in college football. Penn State, like many other colleges, need athletics to make themselves known, attract student applications, and make up for parsimonious appropriations. Plans exist to expand the stadium. It would now cost a billion dollars to build a new one. Possible renovations: enclose completely, expand outward, change luxury seats, enlarge concession stands, and improve restrooms. May have to reduce seating capacity to widen aisles. Book copies are available from publisher at discount. Discussion ensued about sneaking into Stadium, restricted access now, were anyone's ashes scattered in the stadium, snow crises, early use of radio communication, uncomfortable seating, and nighttime security.

Meeting adjourned at 8:21 pm.

Next meeting 14 June will feature-Scott Flipse: “High Performance Building.”

Respectfully submitted, Art Goldschmidt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (14 June 2017)

Roy Hammerstedt called the meeting to order at 6:57 and asked the group to give Jim Serene a round of applause for his service as President. There was no secretary's report. Treasurer Lee Stout announced that our treasury has about $2,500, nearly the same as last year. Lee Stout introduced Carl Sillman; Gordon DeJong introduced Caroline; and Scott Flipse introduced guests including Rachel Flipse, Brian Healy, and Louis Glantz. Jim Rosenberger said he will actually join in September. John Golbeck announced that he will be on sabbatical leave. Roy has reviewed at the behest of the Executive Council the recent impact of many new members, and notes that our members want and expect a crisp Torch evening. Therefore, he proposes that we follow these procedural guidelines–that have evolved: Gathering about 5:30 for general talk and mixing; meal from 6 to 7; Club business/announcements conducted in an informal manner just before the speaker starts his talk at 7; speaker finishes about 7:30; which allows up to 30 minutes for discussion. We should aim to adjourn at or before 8 pm. He then introduced Scott Flipse, who spoke on High-Performance Building of houses.

High-performance houses may vary in size or style, but they must be energy efficient, healthful, comfortable, durable, and resilient. Scott has built houses in Williamsport and Punxsutawney, and two in State College, and plans another to start in 2018. They are similar in construction and vary in size, but all "nearly" high performance. Their cost of heating & cooling is $35-45/month. HERS raters, using software called REScheck and on-site testing, will assign a house a HERS rating, a number from 100 to 0. (HERS is Home Energy Rating Services) "0" means the house will produce as much energy, typically with photovoltaics, as it uses over a year. These are "Net-Zero" houses. A house that scores well enough (HERS 50 or less) that it <u>could</u> reach net-0 with added PV is considered to be "Net-Zero-Ready". How a house actually performs in use can be measured in Energy Use Intensity, i.e. BTU/sf-year. An EUI of 15,000 BTU/sf-yr is also considered to be "Net-Zero-Ready." Scott identified six critical elements of design & construction. The "Envelope" is the assembly that encloses the entire house and consists of 1) a thermal barrier (insulation), 2) an air barrier, 3) a water-resistant barrier (WRB), and 4) a system for managing moisture. "Mechanicals" include 5) a heat pump and 6) a controlled ventilation system. Basics of heat and insulation include the Second Law of Thermodynamics (heat flows from warmer to cooler), thermal resistivity (R value), and thermal transmittance (U value). R values are additive; U is 1/R with units of BTU/hr-sf-deg F. A small area with a low R will dramatically reduce overall effectiveness.

The builder should design the whole envelope as a unit, but doors and windows cause heat loss and one should incorporate those that have highest resistivity. Continuous rigid external insulation (CREI) is essential to boost R, eliminate bridging through framing, and prevent condensation. He showed a house profile with continuously insulated walls, roof, and basement floors using extruded polystyrene foam panels. After external insulation and installation of wires and pipes, one adds cavity insulation in the walls. The air barrier too must be continuous. Sheathing panels must be taped at joints, edges, corner, and penetrations. Air barrier prevents the stack effect (air infiltrating at the base and exfiltrating at the apex), thermal bypass, condensation by moisture-laden air flowing through walls, and indoor air quality (IAQ) degradation by air infiltrating through wall cavities, attics, crawl spaces. He explained how the air barrier is tested and reported in air changes per hour (ACH-50). The WRB prevents leaks into the structure and includes a drainage plane or rainscreen. The moisture control strategy includes prevention of leaks and condensation as above and is enhanced by control of indoor humidity levels via ventilation and dehumidification, and by allowing drying to the interior by avoiding a low-perm vapor barrier (no plastic). The key is to build the envelope right. Then a simple heat source within the envelope, a means for heat distribution, and a ventilation system are all that are needed. A heat pump is the best fit for sizing and efficiency. A distributed, balanced, whole-house, heat-recovery ventilation system will provide fresh air, humidity control, and heat distribution. These measures will result in a high-performance house: energy efficient due to conservation and heat pump technology; healthy and comfortable due to controlled humidity, ventilation, even temperatures, good lighting and quiet, solid construction; durable due to moisture-damage prevention, value to owners prompting maintenance, and "reversibility" allowing updates to prevent obsolescence; resilient due to "passive survivability," remaining habitable even with prolonged loss of power. Few houses are built to HP standards due to costs, real and perceived, industry resistance to change, low recognition of value by appraisers, banks, and consumers, and low energy costs. Questions: Cost of HPB? (8-10 % at most) Does the lack of air exchange increase incidence of illness? (yes, hence ventilation) Benefits of geothermal heating? (works well for higher loads) Is a double studded wall useful? (yes, but more complex than CREI) How big are his studs? (2x6). How can one reduce radon buildup in tightly insulated houses? (air sealing and sub-slab ventilation through roof).

The meeting adjourned at 7:59 pm.

Respectfully submitted, Art Goldschmidt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (13 September 2017)

President Roy Hammerstedt called the meeting to order at 7 p.m. Treasurer Lee Stout reported that the treasury is constant and reminded everyone to pay annual dues, by a check made out to Central Pennsylvania Torch Club. There is a spousal rate, if a member has a wife or husband who wants to join. Jim Ultman introduced his wife, Deena. Roy distributed his report about our club, its accomplishments and opportunities. Of all age cohorts, the one growing fastest in Centre County is 65 and over; we should encourage retention of present members and invite retirees who have newly arrived. He introduced Ed Klevans, a retired professor of nuclear engineering.

Ed's topic was the current status of controlled fusion to produce power, which is difficult, may take 50 years to produce, and will cost billions to achieve. Advantages: lower radioactivity than fission; less risk of accidents; fuel taken from a type of water (deuterium), but to it must be added tritium, to be produced using lithium, an abundant salt, hence an inexhaustible fuel supply; advantageous environmentally, but not sure we can produce economically; no need to import resources, but we don't do that now. Possible benefits: will it meet people's needs, will it cost more and will it produce less waste than nuclear fission, will it be timely, considering how long it takes to build nuclear plants, how will it impact the environment relative to coal and natural gas, will the power produced be compatible with the existing grid, a problem in underdeveloped countries, will it allow diverse generation methods? Best fusion reaction we know now is combines deuterium and tritium. If they collide with enough energy, they produce helium and a neutron that carries away most of the energy, producing steam to drive a turbine that drives the generator. He discussed some alternative fusion fuels. One criterion is reactivity: how much heat is needed to cause the reaction? If Helium3 is needed, it is rare on earth, but ample on the moon. Mining and transporting would be costly, and the needed temperature is 10^{21} C, usually expressed as Kev where 1 ev is equivalent to approximately 10,000 K. Fusion power requires hot plasma that is fully ionized (fourth state of matter). The neutron escapes from the reaction chamber into a blanket, where it slows down until it can be absorbed by lithium, causing a reaction that produces tritium, the other fuel component. Since tritium is radioactive with a 12 year half-life it isn't found in nature. Ed spoke in terms of particles per cubic meter, compared atmosphere to higher vacuums or to high density. Ionized gases or plasmas exist in all stars, including our sun, and are held together by gravity.

Problem to confine hot plasma at high temperatures: gravitational confinement can't be used on earth, so we need either magnetic confinement, or inertial confinement produced, for example, by multiple laser beams hitting a small fuel pellet. This generates very high density for a billionth of a second. If you can reach fusion temperatures in the compressed pellet it will burn up with fusion reactions before it blows apart. This is because the speed of burning exceeds the speed of disassembly. For magnetic confinement the main concept is the Tokamak Device ("large current"): the creation of a twisting magnetic field, creating higher temperatures and longer confinement, a device developed by a Russian scientist, Artsimovich**.** The US built a better device with computers whose results could be processed. Further improvements were made by the Europeans, Chinese, and then South Koreans. Magnetic coils surround the electric current. Neutrons exit device and enter a lithium-containing blanket, from which is pumped out tritium that can be injected back into the device, mixed with deuterium and shot at high temperature, it collides with the material inside, replenishing the supply of plasma that has leaked out and heating the gas as well. Only Canada now extracts D_2, from sea water. Requirements for a Magnetic Fusion Power Plant? Extreme temperatures are easy to get but hard to confine. John D. Lawson set criteria for energy confinement times plasma density. This parameter for fusion with the high temperature required has not been reached so far. Magnetic confinement (β), the ratio of particle pressure to confining magnetic pressure, so typically been around 5% but must try for 40% for economic fusion power. What methods can heat this deuterium-tritium fuel? Compress fuel, run internal electric current, beam neutral particles into the device, use microwaves to heat the electrons, and lasers. Energy taken out almost equals energy put in (Q=1), but we need ignition, and we're still working on this. The International Thermonuclear Experimental Reactor (ITER), being built by seven countries in Cadarache, France, aims at Q=10. Original estimated cost was $5 bn, but it is now estimated at $15 bn, and may go as high as $20-25 bn; completion date was 2018, now 2027. Problems: coordination, design changes, and possible US dropout due to rising cost. Goal: 500 megawatts output or fusion of 50 megawatts input (Q=10). Pulse length run 500 seconds. To get to 500 seconds will take a very large power supply. Expect high costs of operating and maintaining ITER, a tall (60 m) device with huge superconducting coils. ITER is an expensive experiment to learn how to hold plasma, maintain stability, dissipate heat load (using big divertor), handle radiation generated, cool the walls, and gain experience with alpha particles. Scientists must run the device for 15-20 years to learn how to handle fusion. At least 50 years of physics and engineering studies will be needed for effective nuclear fusion power, not 20 as originally expected.

Will we ever produce power economically using fusion? We are developing a smaller, spherical Tokamak, making efficient use of the magnetic fields, hoping to achieve a higher β level, using simpler divertors. No time to speak on inertial confinement. Questions: The difference between controlled fusion and uncontrolled fusion, which Klevans said are really hydrogen bombs; which countries are paying for ITER – EU, as the host country, about 40%, Canada, US, Russia, S. Korea Japan have a much smaller share; was "cold fusion" a hoax? Although it isn't easy to reproduce the original experiments, it is now called LENR (Low Energy Nuclear Reactions) since it clearly wasn't fusion. It is still an active field of research with promising results; Will sponsoring countries limit diffusion of findings? The answer is no, for publishing is still the lifeblood of research and development. However, when commercial companies get involved, they are highly proprietary, so final commercialization may be much more restricted in information out. It was noted that a campus plaque regarding discovery of deuterium is near Whitmore Lab. This is because Professor Brickwedde of the physics department was one of the co-discoverers of deuterium, but he came to Penn State after that discovery.

The meeting adjourned at 8:03 p.m.

Respectfully submitted, Art Goldschmidt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (11 October 2017)

President Roy Hammerstedt called the meeting to order at 6:52 p.m. Al Turgeon announced that a series of discussions on the Vietnam War will take place at Military Museum on Sundays from 2 to 4 p.m. Ming Tien introduced his guest, Petra, a budding tennis star, and Lou Persic introduced his wife, Freddie. Roy reported on the recent officers' meeting. Members who say they are coming and don't show up must pay. We need to run our meetings closer to a schedule. John Vincenti has prepared the club website; members may address suggestions or additions to the president. We have made significant gains in membership and hope to continue to do so. There were no reports from the treasurer or the secretary.

Roy introduced Jim Serene, a retired orthopedic surgeon, who spoke on common problems of the foot and ankle. He was educated at Wake Forest, did his residency in Atlanta, and in addition to his practice also served on the faculty of Hershey Medical Center. He did many hip and knee replacements but had a special interest in feet and ankles. The human foot is unique in that it acts on a hard surface, bears weight, propels, and balances us. It consists of 26 major bones, 14 phalanges, and 33 joints. Two parts actually hit ground: the heel and the ball of the foot. The plantar fascia acts like the string of the longbow, maintaining the arch of the foot. The subtalar joint allows heel to go in and out. Ligaments check the tendency of the foot to spread apart; if the first and second metatarsals spread too far, a bunion may form. Pain on bottom of the foot, such as a corn, usually occurs under the second metatarsal bone. Sesamoid bones are small bones within a tendon, that serve as a fulcrum. Primates have a similar bone structure to humans. The extrinsic muscles are the strongest ones located in the calf. The foot has muscles but aren't so strong. Toenails help protect the toe. The big toenail is the slowest growing nail. Under the nail is the ungula, which helps create its shape. Injury to the Achilles tendon, which extends from the calf to the ankle joint, is extremely disabling. Tendonosis is an inflammatory process. Heel bursitis occurs just above the heel, some-times due to rubbing against a shoe, creating a bump. Treatment can involve removing a portion of the bone. An Achilles tear, a common athletic injury, is a rupture of fibers. The living cells in the tendon live on body fluid; they have no blood vessels.

A man over 35 playing basketball or tennis may get fatigued, make a quick step, and become unable to run or walk well due to Achilles Rupture. A noncompetitive athlete may wear a cast for a time (fibers may reconnect), but generally surgical treatment is indicated. Most ankle sprains are inversion. Some involve fracture, but usually not. Most sprains heal without operative care. Early motion and bracing help; the hard cast formerly used was ineffective. A question was asked about "high ankle sprains." the fibula and the tibia have a ligament connection, but enough twisting and turning may cause them to separate. This may require an operation. Heel spur syndrome, caused by tears in the plantar fascia, really hurts, especially upon first up but pain decreases as one walks. It is treated by stretching exercises. Heel cups and orthotics help somewhat. Are they the same as fallen arches or flat feet? Adult flat feet result from degeneration of the posterior tibial tendon. Shoes may help. If surgery is performed, recovery period is prolonged. Exercises are prescribed to keep posterior tibial tendon strong. Stress fractures are often just tiny cracks and don't show up in an x-ray. Common in marathon runners, long distance runners. Morton's neuroma is a pain shooting out from the bottom of foot toward the third and fourth toes, due to irritation of the digital nerve. Can be treated by shoes. The nerve may form a lump that can be removed surgically. Pain in the ball of the foot is usually due to cushion's wearing down due to age. It may be treated by padding. A callus, usually under the second toe, can be treated by surgery. Hammer toe (often the second toe) can be strapped, stretched, or surgically treated. Bunions occur when the first metatarsal head sticks out, and the big toe angles toward the little toe. Is wearing high heeled shoes harmful to women's feet? Possibly may lead to a bunion. There are over a hundred bunion operations written. Monofilament nylon stitches are advisable for skin closure. Gout is caused by uric acid crystals in the joints and can be treated by steroids. Ingrown toenails may get infected; they may be caused by skin growing around the nail's edge and apt to recur. Portion of the nail can be removed but incision must extend to the nail bed, or problem will recur. Fungal infections in toenails can't really be cured. Drugs cause liver problems. Melanoma can occur under the toenail, especially in blacks. Mosaic plantar warts occur in teenagers, not older people. Does a history of sprains or fractures cause problems for an aging person. If athletes have frequent sprains, surgery is indicated. Stress fractures, once healed, strengthen the affected area. Injury to the big toe causes many problems. Are foot injuries more common in women than men? Women get more bunions, possibly due to shoes, possibly hormonal, but little difference between the sexes regarding other foot and ankle problems. Should podiatrists do what orthopedic surgeons do? Latter have six years' more training. Medical licensing is political in some states. Can a patient with plantar fasciitis resume his normal life? Yes, they can, and it rarely recurs

Meeting adjourned 7:57 p.m. 20 people attended.

Jim Ultman will talk on "The Six Million Dollar Man" next month.

Respectfully submitted, Art Goldschmidt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (8 November 2017)

President Roy Hammerstedt called the meeting to order at 6:45 p.m. Art announced the next IATC convention, to be held 21-23 June 2018 in the Menger Hotel, San Antonio. Lee Stout introduced his guest, Carl Sillman, who was unanimously approved for membership. Roy reported Ed Buss's absence due to illness and introduced Jim Ultman, retired professor of biomedical engineering, who spoke on the "Six Million Dollar Man." In this television serial produced in the 1970's, Steve Austin, a badly injured test pilot was made whole again (and "stronger, faster") by the implantation of bionic devices. The idea of such devices precedes the television series by at least 250 years when Robert Hooke, an eminent scientist, wrote in his book, *Micrographia*. that "The next care to be taken, in respect of the Senses, is … the adding of artificial Organs to the natural; …one of them has been of late years accomplished with prodigious benefit …by the invention of Optical Glasses." The purpose of this talk was to review some of the history and the current development of such devices.

Jim first discussed devices that aid in Locomotion and Work. The exoskeleton is a device, akin to the external skeleton of insects, that surrounds the body and provides power and control that allows the global movement required in tasks such as walking and lifting. The earliest known device resembling an exoskeleton was Yagn's running aid, patented in 1890 but never built. It was a simple bow/leaf spring operating parallel to the legs and was intended to augment running and jumping. In the late 1960s, General Electric working with Cornell University constructed a full body powered exoskeleton prototype the "Hardiman," a 1500 lb, hydraulically powered machine that included components for drastically amplifying the strength of the wearer's arms (including hands but without wrists) and legs. Exoskeletons were developed at Belgrade's Mihailo Pupin Institute in the 1970s: the "partial active exoskeleton," which used pneumatic actuators for flexion/extension of hip, knee, and ankle, as well as an actuated abduction/adduction joint at the hip. With many refinements since then, commercially available exoskeletons have aided patients who have lost motor functions of their lower limbs to walk again.

The need to replace limbs lost in accidents or by amputation has long been addressed by man-made prostheses. The world's earliest functional prosthetic body parts were artificial toes produced in Ancient Egypt. Only in the mid-20th century were major advancements made in the design of artificial limbs. In 1945 the National Academy of Sciences established the Artificial Limb Program to improve the quality of life of World War II veterans who had lost limbs in combat. Most recently, a revolutionary prosthetic hand controlled by a person's brain allows paralyzed volunteers to "feel" physical sensations from lost limbs. Skin sensors placed over motor axons on the shoulder or remaining portion of the person's arm carries electrical signals from touch sensors on the prosthetic fingers directly to the user's brain.

Sensing the Outside World was the second topic he addressed. Vision is perhaps the most important way that we sense our environment. As noted by Robert Hooke, eyeglasses (first produced in the 14th century) were perhaps the first cybernetic device. Current cutting-edge technology has enabled us to progress far beyond eyeglasses. For example, the Argus II Retinal Prosthesis, a device developed by a team of physicians and engineers from around the country, aids adults who have lost their eyesight due to retinitis pigmentosa (RP), age-related macular degeneration or other eye diseases that destroy the retina's light-sensitive photoreceptors. In April 2013, the FDA approved what it called "this first bionic eye for the blind." The heart of the device is a tiny yet computer chip that, when implanted in the retina, sends electrical signals directly to the optic nerve, thereby sidestepping the damaged photoreceptors in the retina and tricking the eye into seeing.

Hearing is another important way in which we sense our environment. Sir Francis Bacon, a champion of modern science, studied hard-of-hearing people. In his book, *Sylva Sylvarum: A Natural History* (1627), Bacon proposed the first hearing aid. He writes: "Let it be tried, for the help of hearing (and I conceive it likely to succeed), to make an instrument like a tunnel; the narrow part whereof may be the bigness of the hole of the ear; and the broader end much larger, like a bell at the skirts; and the length half a foot or more." This ear trumpet, like a contemporary hearing aid, amplifies sound waves to more greatly stimulate the inner ear's cochlear hairs. Some patients have such severe dysfunction of the cochlear hairs that amplified sound cannot stimulate them. Similar to the bionic eye, the cochlear implant is a modern, commercially available device that bypasses the damaged cochlear hairs with a computer chip that directly stimulates the auditory nerve.

The final bionic devices that he described were those used for Nutrient & Waste Processing, normally performed by internal organs. As an example, the discussion was focused on the removal of metabolic waste products that normally occur by the natural kidney. Currently, kidney failure is only fully treated with a kidney transplants, but thousands of patients die each year due to the scarcity of donors. Peritoneal dialysis is an established method of replacing kidney function, temporarily at least. The peritoneum is a thin, shin, richly perfused membrane that covers the whole abdominal cavity. During peritoneal dialysis, a special fluid – the dialysis solution – is introduced at regular intervals to the abdominal cavity through a catheter. This fluid surrounds the peritoneum and allows metabolic waste products to pass from tiny blood vessels through the peritoneal membrane into the dialysis fluid. The dialysis solution carrying these substances is then removed several hours later and replaced by fresh solution. Between 1924 and 1938, medical teams in the US and Germany performed the first regularly repeated – or intermittent – peritoneal dialysis treatments and proved that the procedure can replace for the kidneys' natural function temporarily. Today, commercially available, automated machines can perform Continuous Ambulant Peritoneal Dialysis (CAPD) while a person sleeps.

The most common treatment of kidney failure uses an extracorporeal artificial organ—the hemodialyzer. Instead of separating blood and dialysate solution through the peritoneal membrane, this device uses an artificial membrane outside of the body to which those fluids are continuously routed. Hemodialysis treatments under medical supervision requires some three sessions per week, for three to five hours per session. The father of dialysis is Dr. Willem Kolff, a young Dutch physician who created the first dialyzer (artificial kidney) in 1943. Working in a remote Dutch hospital with fear of discovery by the Nazis, he resourcefully improvised, using sausage skins, orange juice cans, a washing machine and other common items to make a device that could clear the blood of toxins. Today roughly 350,000 patients rely on kidney dialysis, which is costly and also takes a human toll. It is exhausting for patients and replaces only 13 percent of kidney function. As a result, only 35 percent of patients survive for more than 5 years.

A longer-term solution would be to build an implantable, self-monitoring, and self-regulating kidney that could continuously process circulating blood. This is the ultimate goal of The Kidney Project at UCLA. Their current hybrid device, operates just like a natural kidney, not requiring the use of dialysate solution. The device has a hemofilter module containing an man-made ultrafiltration membrane that passes toxicants and water from blood. It also includes a cell bioreactor module containing kidney cells which reabsorbs water back into blood. The concentrated waste solution is then exhausted into the natural bladder.

In considering What the Future will Hold, the serious question is not whether we will ever create a complete living bionic man like Alex Murphy, a terminally wounded cop who returns to the force as a powerful cyborg in the 1987 movie "Robo-cop." Rather, will we be able to perfect devices that can serve as reliable and affordable replacements for organs and limbs? This will require application and advances in engineering technologies such as nanotechnology, 3-D printing, and tissue engineering. We also need to learn more about the physiology of the human brain and its interface with electronic devices.

Questions from the audience: Does a person have to be physically connected with an operational/artificial body part? Must an artificial body part resemble its human form, even if its actual appearance is not fully functional? What happened to the Penn State Heart? How does this research relate to artificial organ donation and transplants for decisions made by physicians, family members, and patients?

Attendance tonight was 20 people, including 3 guests. Roy Hammerstedt announced that the next meeting, on 13 December, will feature Lee Stout speaking on "What Do We Learn from Centre County History?" The meeting adjourned 8:02 p.m.

Respectfully submitted, Art Goldschmidt, secretary

CENTRAL PENNSYLVANIA TORCH CLUB MINUTES (13 December 2017)

Roy Hammerstedt called the meeting to order at 6:43. The treasury is fine. Secretary invited a volunteer to go to next June's IATC meeting in San Antonio. Guests introduced: Bob Martin, Scott Kretchmar, Kathy Sillman, Karen Miller, Linda Hendrickson, and Dee Stout. Roy spoke about our rapid turnover of members and the need to recruit and retain them. He consulted five former presidents. We might consider new modes of operation to stimulate member interaction. Must we adjourn by 8 p.m.? Can some members continue our discussions after others have left? We might post questions on our website for online discussion. May we suggest topics for others to discuss? Can we invite two members to present opposing points of view briefly, followed by an open and civil discussion of the issue? How else might we expand our outreach? Can we extend our outreach to vetted groups? Can we promote professional links? Can we invite outsiders to access our website for online discussions?

He introduced Lee Stout, former University Archivist, who spoke on Centre County history. Earlier he had studied 18th century China but working one summer on an archaeological dig in Curtin Village and later working on Centre County materials in the Labor Archives led to an interest in Penn State's history. Having completed his book on Beaver Stadium, he may write a history of Centre County. Most of us have come as transplants but he feels that we must learn about our environment: its geography and geology, peoples, iron industry, post-civil war industries, and its role in higher education. Geographically, the county is part ridge and valley, part Appalachian plateau. The area once had high mountains that eroded, leaving dolomites and limestone in the valley, with out-croppings of iron ore. Lee showed a 1756 map, almost without information on what is now Centre, except Bald Eagle's Nest. Most native Americans used the area for transit and hunting. Indian raids into Penn's Valley during the Revolution led to settlers' flight to Sunbury. Some settlers were English, Scots-Irish, or German, but most were Pennsylvanians coming from the east via the Susquehanna River and Bald Eagle Creek. The main west-ward movement bypassed Centre County; most who came stayed. Agriculture predominated, but iron making rose in the late 18th & early 19th centuries: 13 iron furnaces and forges in Centre County at its height.

Most were in rural areas; ironworkers also grew crops to feed themselves. Lee illustrated how iron was transported, smelted, purified, and cooled into pigs. Blast furnaces ran for as long as there was charcoal and as long as men could work. They stopped to harvest their crops. Carried by mules. iron went out to Baltimore, later Pittsburgh, a hard task. The iron industry made Bellefonte rich, powerful, and the home of six state governors. It was one reason for the location of Farmer's High School, hence Penn State, when six other counties, all in central or western PA, wanted the school. The iron industry declined after the Civil War. Steam-powered factories arose in Bellefonte and Millheim, also coal mines on the Appalachian Plateau. Centre County's population was 11K in 1810; now more than 140K, due to Penn State's growth from Atherton's and Sparks' presidencies on. Penn State's focus on engineering helped, as did having major industrialists as trustees. Smokestack industries & railroads rose and fell in Centre as elsewhere in PA. Its workers and farmers were ethnically diverse. Jeffersonian Democrats prevailed in Centre's politics at first, then Whig industrialists, and later Republicans. Bellefonte was its largest city; now State College and its suburbs dominate. Local unemployment is low; people now commute to Penn State from great distances. He noted declining state support for higher education. A lively discussion ensued. Why was Centre chosen over all other counties for the school? A board visited all seven; local Whigs influenced its choice. Roger Williams explained the 1857 board's rationale. Lee explained the Land Grant Act. The County's area exceeds that of Rhode Island. Why the spelling of Centre? What is Penn's View? What kind of work did early students do? State funding for Penn State is sparse compared with Midwestern state universities, due to private colleges' competing for appropriations from the state legislature, causing a reluctance to build a Penn State endowment. The meeting adjourned at 7:55. 31 people attended.

Next meeting on 10 January. Gordon DeJong: "The Changing Demography of the American Family."

Respectfully submitted, Art Goldschmidt, secretary