Skeptic Driven Innovation
(A Presidential Guest-Speakers talk in POSNA, by Dr Roach)

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In my experience Guest Speakers have three tasks, they need to be somewhat interesting, a little funny, and not too long. Hopefully, I will achieve these goals. The talk is Skeptic Driven Innovation. I have no disclosures and really no claim to innovation. But I have always had an interest in business innovation and in the qualities that enhance one company’s success over another. In business it is clearly understood that the status quo kills companies and those enterprises that challenge the status quo often improve their products or even develop new industries.

Consider the railroads in the late 1800s. The second and third generation of railroad CEOs became enamored with their machines and themselves. They believed they were in the railroad business when they really were in the business of transporting people and goods. Failing to challenge their status quo, they played no role in the far bigger and more profitable automobile and aviation industries. This amazing screensaver captures just one moment of aviation activity on Thanksgiving Day 2012.
Railroads subsequently fell into a 50 year down cycle and have only recently begun to recover.

It may seem counter intuitive but throughout history, skeptics help drive innovation. Skeptical individuals require evidence and therefore they resist accepting either the status quo or new but unproven ideas. Skepticism is about testing beliefs for reliability, subjecting them to systematic investigation, and seeking empirical evidence.

Historically people have resisted change and not usually because they were skeptics but rather because they perceived new ideas as threats. Certainty brings comfort and the status quo was always perceived as secure ground, especially when there was scant understanding of the subject at hand. Consider the debate regarding the revolution of the planets about the sun or the shape of the earth. Limited personal experience also caused erroneous beliefs. In the middle ages people in northern Europe thought the earth’s equatorial region too hot for human life. While living at the equator, the King of Siam refused to believe that water could become sufficiently solid so an elephant could walk on it. Strongly held beliefs are only changed by overwhelming evidence. Questioning the validity of accepted knowledge plays an important role in discovery and implementation of new knowledge ultimately stimulates more discovery. Luckily for us, there were skeptics of the status quo and technological advancement has occurred and indeed has been accelerating.

Our species, Homo sapiens, appeared 200,000 years ago. Pottery came into being 25,000 years ago. Domestication of animals, cultivation of crops, and the creation of metal tools began between 12,000 and 7,000 years ago. Writing and the first sailing vessel date back 7000 years. California is known to be exceptional. But cultivated plants, farm animals, metal tools, writing, and sailing ships only came as recently as 1535. Nevertheless, in less than 500 years California has become the world leader in technological sophistication. Not unsurprisingly, California is known for a healthy skepticism of the status quo. Medicine similarly benefited from skeptics and the timeline of medical innovation has also been remarkable.

For thousands of years physicians were philosophers, such as Aristotle and Galen. Technical skill in medicine was personality driven with so called medical knowledge consisting of various unproven beliefs, usually based on false assumptions. Gradually skeptical individuals provided critical thinking and challenged the status quo with the requirement of evidence. Medicine then evolved from a profession of philosophersto one of scientists. Even so along the way changing established principles was strongly resisted—consider cholera and child bed fever.

London has substantial natural fog. As the population increased, wood fires for heating and cooking dramatically worsen the fog and turned it black with soot. In the early 1800s Thomas Carlyle, a transplanted Scot, described London fog as “black vapor brooding over the city, absolutely like fluid ink”. Later coal displaced wood as a heating fuel and these fumes combined with the London humidity producing a sulfurous, foul, thick, yellow fog which could be both smelled and tasted, the so-called pea soup fog. It was easy for London physicians to attribute disease like cholera to vile, airborne miasma. In fact, it was a common belief that “night air” could also transmit...
disease and some doctors in the early 1800s even suggested that obesity was the result of inhaling the odor of food. I personally find this theory useful. John Snow, a doctor of little standing, eventually convinced the prominent London physicians that cholera was being spread by the contaminated water in the Broad Street pump and not from the evil air. Plotting where each of the victims lived demonstrated a cluster around the this well. The epidemic stopped with the removal of the pump’s handle.

John Snow went on to further innovation and recognition. He devised an inhaler to provide safer dosing of the anesthetic, chloroform. He subsequently used the inhaler and chloroform for Queen Victoria when she delivered her son, Prince Leopold, and later her daughter, Princess Beatrice. And, perhaps, most importantly, a pub was named for him at the site of the Broad Street Well.

About the same time in North America, Oliver Wendell Holmes played a significant early role in advocating for proof of efficacy in medical treatments. In the mid-1800s Holmes was America’s best-known physician and bestselling author. Holmes directed substantial skepticism towards various unproven medical therapeutics of his day such as bloodletting and calomel purging medicines. Much of his criticism was aimed at Benjamin Rush and Rush’s promotion of such treatments. Not infrequently patients treated with calomel purging had their hair and teeth fall out. Holmes famously joked “that if all of contemporary medicine was thrown in the sea, it would be better for mankind, and all the worse for the fish”. However, he was more than just a naysayer and also proposed that child bed fever was contagious 20 years before the “germ theory of disease” was understood.

Slowly medical technical skill and medical knowledge became based in science and was acquirable and measurable.

With this came instruments to measure physiologic and pathological processes. Simple things such as the stethoscope, percussion hammer, and sphygmomanometer, all arose as recently as the late 1800s along with anesthesia and the sterile surgical field. Just less than a 100 years later, I was a medical student when the total hip made orthopaedic surgery one of the most popular residencies. And, as a resident in orthopaedic surgery, I struggled to learn to treat patients using only radiographs and bone scans to aid diagnosis. Ultrasound, CT, and MRI weren’t perfected until during and just after my fellowship in 1980.

Innovation in medicine now comes even faster. Peter Densen at the University of Iowa, estimated that the doubling time of medical knowledge in 1950 was 50 years; in 1980, 7 years; and in 2010, 3.5 years. In 2020 it is projected to be 0.2 years—just 73 days. People have enjoyed exponential advancement in technology with beneficial leaps seen not just in medicine but also in general conditions of living (transportation, communication, nutrition, etc.).

We have adjusted to rapid change and now the pendulum has swung so that the new in any field is expected to be better than the old; just consider the unrelenting desire for the never-ending sequences of I-phones. Now, instead of resistance to change, people are often willing, or even demanding, to adopt the new without much display of critical thought.

As surgeons, expectations that the new is better than the old also carries some risk for us and our patients. Before adoption, we still need habits of thinking that challenge new
treatments and procedures with the requirement of evidence. Lobotomy, electrical shock therapy, and hemorrhoidectomy were adopted with minimal investigation and then over utilized. In medical school I was told that in the 1930s approximately 5% of the population had had a hemorrhoidectomy. The American College of Surgeons polled its general surgery members, asking how many of them had undergone this procedure. The answer was less than .05%. It would seem what was good for the goose was not necessarily good for the gander and after this information was revealed, the rate of hemorrhoidectomy plummeted.

In short, our modern era still requires skeptics. Optimally treatments and procedures should be adopted into routine clinical care after demonstrated efficacy in scientifically based studies.

In my opinion Tim Ward is one of five excellent POSNA skeptics. The others are Charlie Johnston, Dennis Wenger, Colin Moseley, and the grandfather of all critical thinkers, Hugh Watts. There are many topics in orthopaedics that desire critical thought. Is platelet rich plasma helpful? Is patient funded research using adipose tissue to generate stem cells either beneficial or ethical? Considering the entire lifetime of a scoliosis patient, is a spine fusion during adolescence really the best treatment? Does operative intervention really benefit children with clavicle fractures or adults with grade III AC separations or degenerative rotator cuff tears?

Skeptics are needed to determine which interventions are truly beneficial and discard those that are merely new or are only equivalent but more expensive. Self-delusion must be avoided especially when economic self-interest is involved. Confirmation biases can easily affect our decisions regarding the treatment options we offer patients, especially when the literature demonstrates statistical differences in outcomes that may not truly be clinically significant to the patient. These research topics offer young investigators wonderful avenues to consider and what they find will undoubtedly improve patient care.

Everyone has a bias to confirm what they already believe is true. Aristotle thought ice floated because of its shape. He reasoned that flat objects do not penetrate the water and so remain on the surface. But ice was available in the mountains of Greece and Italy and for several centuries after Aristotle, it must have been obvious to everyone that all shapes of ice float but like hemorrhoidectomy, it took a skeptic, Archimedes, to question and then argue that objects float only if they are lighter than the water they displace. Like floating ice, a great many assumptions we hold in medicine still need further critical thought. And with that, I conclude with a wonderfully appropriate quote attributed to various people including Will Rodgers, Mark Twain, Satchel Page and Josh Billings. The quote “It’s not what we don’t know that hurts us; it’s what we know that just ain’t so.” I thank you, the audience, for your attention.