Testimony before the House Intelligence Committee
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Chairman Nunes and Members of the Committee, my name is Jim Phillips. Thank you for inviting me to appear here today. It is a rare privilege to have the opportunity to comment to you on the importance of deep science manufacturing, the constant threat of international cyber-warfare, especially from China, ...the importance of proper immigration policy relative to attracting and retaining in America our future Einstein's and Wernher von Braun's, and restoring U.S. competitiveness quickly to revitalize our most important economic engine of innovation.

I have had the opportunity to be involved in some of the most exciting developments of the digital revolution that have transformed our every day lives. By way of background I helped lead the teams that created and launched instant messaging, the cable modem and resulting universal broadband, immersive imaging —-the technology that makes virtual tours and augmented reality possible, the eBay imaging system, the VeinViewer medical device, The FedEx Institute of Technology, M2M-machine to machine wireless communications, and many other now ubiquitous products used by millions worldwide.

I have the privilege to serve on several boards including the Herff College of Engineering at the University of Memphis, the College of Engineering (TEES) at Texas A&M University, the executive committee as a Member of the U.S. Council

on Competitiveness, (which has been especially helpful in my report), The President's Material Science Genome, the US Technology Leadership Council, and the US Manufacturing Initiative, ...to name a few.

I now serve as Chairman and CEO of NanoMech industries, a leading nanomanufacturing firm and research company with hundreds of advanced material science products used by many of the largest iconic customers in the world especially in oil and gas, military, trucking, automotive, aerospace, marine, and retail.

Nanomech is a highly innovative material science based nano-engineering manufacturing firm, based in Northwest Arkansas, down the street from the likes of Walmart, JB Hunt, and Tyson's headquarters with a portfolio of international award winning inventions and commercial products including breakthrough innovations in machining and advanced manufacturing, lubrication and energy, aerospace, biomedical implant coatings, and strategic military applications such as the next generation US Army combat uniform. We are poised for continued dramatic expansion of our manufacturing operations, revolutionary inventions that join our fortress of over 3000 patents and claims, and growth throughout the globe. The world runs on machines, and increasingly machines and industry depend on NanoMech. All the problems left in manufacturing are at nanoscale, and therefore all the solutions are at nanoscale as well.

The United States is locked in a moon race with other major countries trying to take the lead in materials, digital, and bio-science platforms via Nanoscale engineering research, development and commercialization in what is sure to be the next industrial revolution of progress. While these competitive countries lost out, to an extent to the US in the information technology revolution, they are determined to put enormous amounts of public and private capital to work to win this even more important race in Nano-Engineering that undergirds many other inventions such as Big Data/AI, electronic and autonomous vehicles, robotics, and significant weaponization.

Given the monopolistic efforts of China alone to control all the worlds dwindling resources, the US is now at a great risk of not having material and rare earth metals that are core to our most important manufactured goods that are essential to our daily lives. Nanoscale engineering is our greatest hope in providing a way to do more with less materials in amazing and sustainable ways to keep America secure as the world leader in commerce, technology, agriculture, medicine, and defense.

MANUFACTURING TODAY

I take this opportunity to offer my perspective as an entrepreneur, innovator and manufacturer. Much of manufacturing in the United States centers on higher value – added activities that require highly skilled workers, unique knowledge from innovators or sophisticated infrastructure. Other US manufacturers are in sectors that require proximity to end-users due to transportation or other factors.

Still other producers have unique quality assurance relationships with larger firms or support America's defense base.

Many manufacturing jobs remain unfilled simply because people with the right skills are not available. That translates to 600,000 plus available US knowledge jobs.

Not only are manufacturing and services independent, they are distributed globally. For most of the 20th century, "Made in America" meant just that: design, development, fabrication, and associated transactions were performed in US factories in offices by US workers. Today, many goods are no longer designed produced and sold within a single country.

Instead, the activities needed to bring a product from concept to consumption is routinely performed in different countries.

"To live well, a nation must produce well," as concluded by the MIT Commission on Industrial Productivity.

Some manufacturers believe the global competition has made them stronger, more productive and more competitive. Gains in productivity and output, however are not translating into broader economic gains for the United States. The model of "invent it here, make it there," is not working to advance the economic interests and national security of the US. As Susan Berger, author of *Making in America* has said, "the US production ecosystem system has been hollowed out" over the past decade and we must rebuild it in order to feed our engine of innovation.

Furthermore, many US states and localities do too little to attract manufacturing facilities, imposing complicated and time-consuming procedures on top of federal rules to site and build production facilities. Permitting processes for a manufacturing facility in the United States might take months, if not years, whereas in some countries, the time required is merely a few weeks or less. This while the trade deficit in advanced technology products continues to deepen as high tech sectors of industry are doing better overseas than here.

Manufacturing also suffers from its public image. Many Americans still think about manufacturing terms of product fabrication — how many factories for the transformation of materials and new products, basically, "bending metal" in operations that are easily sent elsewhere. However, manufacturing today is part of a much more complex, high value added and tightly integrated global web of science at its very best.

To make matters worse, the US high school system did away with our most important Shop and Home Economics classes approximately 30 years ago devastating our manufacturing work force where the great majority of the men and women had attended classes designed to both teach and spur their interest, enthusiasm and discovery of their accumen for science and engineering trades and business leadership.

And the US abandoned this STEM based curriculum at one of the most critical junctures at the rise of increased innovation platforms for manufacturing while competitors in Germany, Russia, China, South Korea etc., were stepping up their

curriculum for these science, chemistry and mechanical engineering studies to increase their population's skilled labor.

For these reasons, the US finds itself in a position where we must reboot our high schools, Junior Colleges etc., to offer STEM curriculum ASAP. It is not too late! It is just imperative that we go all out as a nation to preserve US technology leadership. The Administration and Congress should sustain and extend the network of advanced manufacturing hubs; support the establishment of a next generation advanced computing ecosystem; and explore new ways to support technology commercialization and entrepreneurship.

American leaders also must secure critical infrastructure from cyberattacks and invest in the future of funding deep science research with accountability, but competitive with other nations such as China.

NanoMech is a case of successful tech transfer and full commercialization from the University of Arkansas. NanoMech has paid the University in excess of \$1,000,000.00 in royalties and now has capped royalty payments but has provided the University with valuable "Phantom Stock" in NanoMech so the University can participate in the future success of the spinoff corporation.

Consider, for example, Nanomech's product platforms. We are developing cutting edge technology that enables more efficient industrial processes, involving the synthesis and structuring of functional and multifunctional materials at the Nanoscale and microscale from what is referred to as the ground up, and therefore can save billions of dollars across several industries while dramatically

increasing performance, efficiency and sustainability. Basically creating a whole new generation of materials that have improved properties and dramatically increased accomplishment leading to atomically precise manufacturing. These include:

• Lubricant Additives: We have developed Advanced nano – lubricant additives (nGlide, AtomOil, AtomLube) that dramatically reduce friction for machines to the point of near zero, and thus deliver extraordinary performance and energy savings even leading to the birth of new types of machines. This work supports multiple industrial sectors including superior operating heavy machinery, HD Trucks, advanced machining, safer and more productive fracking, gas and oil, automotive transportation, wind turbines, aerospace, military vehicles, spaceships, marine shipping, and many others. Our nano-lubricants have even proved themselves in the last four Indy 500 races in the winning car each year.

Machining and Advanced Coatings:

Nanomech has developed the worlds most advanced coating for manufacturing cutting tools (TuffTek) allowing them to cut up to 1000% longer with better finishes that have never been attained before through nano-serrated edges, and in ways that allow the creation of new types and far better machines. It is not only an alternative for machining hardened steels and super strong lighter alloys such as titanium, but it enhances productivity by orders of magnitude ushering in far more advanced jet engines, and rockets, etc. Through this innovation, the company has also developed strategic know-how in ultrafast coating of nanoparticles for various applications such as machining, wear resistant surfaces,

eradicating corrosion, and resistance to the worst chemicals. In addition the company has developed advanced paints that can survive the most hostile conditions while providing faster drying, and maintaining the best in luster, durability, safety, scuff and wear resistance, anti-microbial, and tolerance to UV. Most importantly NanoMech has developed next generation coatings (GuardX) to eradicate corrosion in many forms, whether sub-sea or surface, in the most hostile conditions whether at point of manufacture, or stopping rust after it has already begun on existing machines such as HD Trucking vital to American commerce. Corrosion costs the U.S. over 3% of our GDP each year!

Advanced Textiles:

Nanomech has developed advanced additives (nGUARD) for fabric, polymers, and wood – polymer composites for delivering sustainability and security. For example, NanoMech is currently providing a Nano-engineered, very safe, durable and lightweight multifunctional fabric finish that is antimicrobial, antifungal, antimold, anti-mosquito, fireproof, anti-bacterial, super-hydrophobic (waterproof), and anti-odor, for the next generation U.S. Army combat uniforms and other military applications. This new generation of fabric fiber treatment will also usher in a new generation of better and safer textiles for consumers, outdoor sporting, and athletic gear.

WINNING POLICY

A broad array of government policies both foreign and domestic have important impacts on the innovation and production process, from research funding to taxes to market access. Presently US policies are not aligned with the full lifecycle perspective of innovation that includes production of scale.

The policies, programs, strategies and business models that worked in the past are inadequate to secure America's future in the digital and Nano Age.

Government, business, labor and academic leaders must rethink and retool the nation's business environment to seize arising opportunities and address several shortcomings. The leveling effects of globalization are diminishing the lost cost advantages offered in emerging economies and potentially opening the door to increase manufacturing in the United States.

Given the unbridled competion the U.S. faces from the likes of China Inc., and others, who operate as a gigantic monopoly funneling massive government capital and resources into a select one or a few state-run companies, without regard to normal costs for good working conditions, healthcare, regulatory including environmental regulations, etc., as opposed to the typical US manufacturer, both small and large, competing in their own country against scores of others, ...who find themselves at huge disadvantages building their manufacturing companies from scratch, absorbing all up front costs including developing IP, safeguarding it, dealing with massive regulatory, R&D, factory design buildout to code, legal expense, and seeking and finding growth friendly investment to drive the business and compensate a great management team.

Structural Changes in the Global Economy Create Opportunities and Challenges

The global migration toward free enterprise and open markets is driving growth and emerging economies. Several nations have rapidly developed into formidable manufacturing competitors. Chinese manufacturing output, for example, is now approaching that of the United States. As development spreads, a new consumer class is burgeoning around the world. About 2 billion people occupy the consumer class today. By 2030, this number could reach 5 billion, with 95% of the growth occurring in emerging and developing economies —— creating large new demands for manufactured goods.

US based operations must also compete with aggressive mercantilist policies from foreign governments. Many countries have put in place policies and financial incentives surpassing the U.S to attract investment, manufacturing facilities, for intellectual property and talent while protecting domestic business interest.

The digital revolution and the pace of technological change also profoundly impacts the way that business and production are organized. Digital technologies have made many facets of the global economy nearly borderless. In an earlier era, the location of natural resources often determine where manufacturing would take place. In today's economy, knowledge, know-how, technology, creativity and capital are the most important resources for production, and they are highly mobile. Put together, these trends —— emerging manufacturing nations, growing consumer class, neo—mercantilist policies and revolutions in the digital internet of things and other technologies driven by Nano and AI— create a hyper-

competitive manufacturing environment. Not surprisingly, firms are growing more sophisticated in their ability to react to these changes and, where possible, leverage them to their advantage in the marketplace.

Global Firms are Becoming More Sophisticated and Re-calculating the Total Cost of Production

Successful global firms must rely on their ability to react more rapidly than ever to changes across the global marketplace. In the early stages of offshoring, inefficient manufacturing operations were often relocated from higher cost economies to low-cost labor economy is to maximize returns and insure that products were price competitive.

With the new tax laws and reductions favoring manufacturing in the U.S., by this Administration, fortunately for America, manufacturing in the United States is beginning to turn more positive. Many firms are recalculating their total cost of production to take in account these changing conditions and factors. Also, the wage gap for example, between the US and key competitors is narrowing. Many factors influence where companies invest in new manufacturing capacity, including labor costs, supply networks, financial, tax, legal and regulatory systems, access to skills and resources, speed to market, intellectual property protection and market access.

The factors that might incentivize a return to or departure from US based manufacturing will vary by firm and industry. Industries that rely on intellectual

property or drawn to the strong protection offered by the US after experiencing the challenge of piracy elsewhere. Other firms have found that long supply lines in Asia add cost and reduce flexibility to serve customers in North America and Europe. Still others seek access to cutting edge US automation and robotics technology, albeit this area grows more competitive for the US by the hour.

Talent is perhaps the key drivers for manufacturing and National Competitiveness.

The United States needs highly skilled workers to realize the productivity gains essential to remain globally competitive. Yet current and anticipated human capital deficiencies especially in deep science manufacturing exist across the board. Not only are current openings for highly skilled workers challenging, manufacturing workers are retiring at a much faster rate than they are being replaced. The growing shortfalls represent a critical need for a wide range of skills across many occupational cuts, from the most rudimentary to the most sophisticated PhD level. Current and future realities command an intergenerational approach toward developing homegrown talent.

Two of the biggest pressures on joblessness and job generation are the bookends of the workforce: The would-be new entrants, 16–30-year-olds who need the skills to take on increasingly complex tasks, and mature workers, 55 years and older who are now the dominant demographic group in the workforce and exploding in numbers. Mature workers will fuel over 90% of the increase in the US labor market between now and 2025.

Another major focus continues to be graduating more students with advanced degrees in Science, Technology, Engineering and Mathematics, (STEM) disciplines, as well as improving STEM literacy in general. The US Department of Commerce expects STEM occupations to grow 17% over the next several years compared with 10% in other occupations. Based on trends and the arrival of new deep science occupations, STEM jobs will continue to climb rapidly as new innovations continue to flourish.

Current visa policies are reversing decades of openness to foreign scientific excellence. Foreign nationals with advanced degrees from American institutions are returning to their countries of origin and pursuing employment opportunities unavailable to them in the United States. With them they take the skills and knowledge necessary to create next generation goods and services, and reduce American competitive advantage while increasing that of the country to which they return. This after receiving the best University education in the world, often subsidized by scholarships etc. No one disputes the need for safeguards and assessments of foreign entrance, however a system that is transparent and efficient and also offers fresh incentives for the best and brightest can offset current obstacles. The US must pivot immediately to attract the best and brightest students from around the globe and encourage them to stay in America as they desire, by providing them a way through earning their advanced masters and Phd degrees, a quicker path to citizenship with fair and effective vetting. To do anything less will guarantee that the US loses its competitive position quickly as the leading innovation nation. Moreover, the US needs to quickly invest more

in providing more top STEM instructors and professors, drawing from the retiring corporate practitioners who desire in mass to continue working and in this case teach their trade, skills and scientific know-how to the next generation.

By opening more student seats in University STEM based curriculum, more American born qualified students desiring to attend our great university system will have the opportunity. Thus the US will have the best of both worlds, providing STEM advanced education opportunities for both our home grown and also the best and the brightest of foreign students desiring to matriculate in the US and seek American citizenship where they will be free to apply their skill sets and intellectual gifts in the best country with the most opportunities in the world, growing our competitiveness and GDP through top talent.

Speaking of the gift of intellectual talent, one cannot forget the huge disadvantage AMERICA has in population differential with just 5% of the world's population. It is often stated that one out of a million people is a genius. My friend John Kao writes in his book China -The Next Innovation Nation, given China's massive population creates the world's largest talent base as in with this paradigm China therefore has over 1000 such geniuses. Now add in India, and so on. America has built the best place to live through tremendous sacrifice and grit, and to remain competitive in this numbers game population wise we must continue to attract the best and brightest and welcome them into our melting pot, albeit with effective and friendly vetting.

This will allow America's technology and innovation capacity to remain among the greatest in the world. America must leverage its edge in innovation technology in

computing. In crucial fields like bio- technology, biomimicry, nano-technology, material science and computing, US researchers and entrepreneurs define the leading edge. American universities in research laboratories are unparalleled, pushing the boundaries of knowledge in life, physical and social sciences. Despite the nation's budget wells, Congress must be reluctant to impose cuts to scientific research funding that is viewed correctly as the engine of economic growth.

America remains the worlds largest investor in R&D albeit not as a percentage of GDP, losing to Germany, South Korea and Japan in this category, but is among the upper ranks in R&D investment as a share of GDP.

Lest we forget, in 1960, the United States accounted for more than 2/3 of global R&D. Today, 2/3 of global R&D is performed somewhere other than the United States. Although the more prosperous and innovative world is a welcome trend, the shift has significant implications for US manufacturing and security interests. America has long been the global leader in creating new, high value added goods and services. That lead will undoubtedly narrow and the greater issue will become whether Americans continue to develop and produce sufficient numbers of loyal STEM educated talent and high margin "must have" products to sustain and improve living standards and safeguard our national security with outstanding GDP and innovation.

America Also Must Better Leverage It's Entrepreneurial Enterprise

By combining innovation, entrepreneurism and risk capital, America has spawned more globally recognized brands in more sectors then any other economy over

the past several decades. This is a huge advantage over China when it comes to brands. American brands are the most wanted products in China. This speaks volumes about American quality and craftsmanship. The US entrepreneurial enterprise is a critical advantage since as much as 1/3 of the difference in economic performance among countries is attributed to the difference in their levels of entrepreneurial activity. Highly skilled entrepreneurs and business startups also create middle skill jobs though the number of new businesses has declined significantly.

Consistent with other facets of the hyper competitive manufacturing environment, many nations around the world — plus states and localities — are working to narrow the US entrepreneurship advantage. They are creating tax incentives, sovereign wealth funds, skilled immigration incentives, regional innovation clusters and global collaboration forums with varying levels of success.

STRANDED

America must do more to enable entrepreneurs to take risks and to translate ideas into innovation. America is still leaving ideas on the table as on average only one in 10 US patents is ever commercialized. Thousands of inventions lie dormant in the hands of universities, research centers and private companies. For those ideas that are pursued commercially, only seven out of every 1000 business plans receives even initial funding.

One of the United States biggest problems it faces in global competitiveness, is it's horrific weakness that exists at its tremendous Universities and outstanding

National Laboratories in successfully accomplishing tech transfer and especially commercialization of its R&D and resulting IP.

The tech transfer offices are staffed with wonderful, well meaning, hard working people who unfortunately typically have no experience in entrepreneurship, starting and running companies and for that matter....promotion.

The budget at a University for a football program may be in the \$50-100MM range, and perhaps even pays the football coach \$30MM per year, (we all do love football)...but the budget for one of the most promising sources of revenue and future foundation funding, ...the lowly tech-transfer office, ...will be comparatively minuscule.

Even though grants from NSF and NIH and many other agencies constantly funnel millions into the University and Research Labs for R&D, the Chancellor's and Lab Directors are almost always left wondering why they don't produce a Gator-Ade a week! On closer examination, it is typical to find the disconnect is in the wrong personnel without the necessary background managing the tech transfer office, including with their somewhat meager budget, and very little IP support to help convert far more of the scientific papers into patents and having a system in place to move ideation to invention to productization to innovation to full scale execution of advanced science fair projects being converted far more often into start-up corporations that attract risk capital and employ knowledge workers and turn great ideas into GDP and national security.

Worse yet this well-endowed research typically moves from science fair to "publish or perish" for the professor or researcher, and unfortunately is then handed to the Chinese or Russians free of charge on the internet. And then again

as it is often cited, "what we don't give away, is otherwise stolen through cyber theft by these same international pirates!"

The Reality of China, Its Goals, Actions, and Our Call to Action

This is very, very serious, as Jim Clifton, CEO of Gallup and author of *The Coming Jobs War says,...* "A country's GDP is the most important leading indicator. So as goes it's increase and decrease, so goes jobs, spending, tax base, and then everything else. Unless there is a miracle, China will vastly exceed the GDP of the United States in less than 30 years; 6 trillion compounding over 30 years at 10% blows away 15 trillion compounding at 2% over the same period. At that point China will have the new World – leading economy. China will be the new leader of the free world, free or otherwise." "When the GDP lines cross, America's reign as economic leader of the world is over. So are the designations of "place with the best jobs in the world" and "leader of the free world" because America will no longer have a disproportionate financial advantage that gives it the moral, economic, and the leadership authority it has now."

"When and if that happens, America loses. The world changes, everything changes. China may dominate the world. But it won't have to use it's military. When it's GDP surpasses Americas, it will dominate the world economically by a margin far more than the United States currently has. At that point China will be the new leader of the world. All decisions between countries on the subjects of peace, trade, environment, borders, laws, and human rights would defer to China. Because more than ever, the new golden rule applies: He who has the gold, rules. And the country with the dominant GDP has the gold and the good jobs."

Michael Pillsbury's book, *The Hundred Year Marathon*, excellently reveals China's secret strategy to supplant the United States as the world's dominant power, including its significant and very active cyberwarfare force, and China's amazing ability to mask its real identity-a Communist Military Dictatorship, is well orchestrated in a costumed camouflage of capitalistic, free trade entrepreneurship.

Reality Sets In For NanoMech

It is at this point that in my testimony, I report as a practitioner entrepreneur and CEO of an American deep science manufacturer, that I report NanoMech, in all our efforts to grow and prosper in the great American capitalistic system, has had to face down China (and others) and its' real threats and actions.

Not long ago the FBI showed up in force at NanoMech Industries headquarters to report to us they had observed we were the 2nd most hit firewall by the Chinese cyber-militia in the Southern U.S. while I suppose we could take this as a compliment to our superior science and technology, we moved fast to squash this attempt before it had a chance to succeed. The FBI were at NanoMech to help proactively under the directive of the National Nanotechnology Initiative signed into law by President George W. Bush to protect and promote the interests of American nanoscience. The FBI brought in an expert within the FBI on China to assist in how to confront these serious attempts at cyber-hacking we were experiencing. We involved at significant cost, our IT firm and as fast as possible

took many new precautions in addition to the double firewalls we had in place, and since have added many more software and physical security provisions and fortresses. We are told that the only way to be totally sure you are safe from hacking by the Chinese and others, is to go off the grid with your most secret proprietary property, in the form of log books using a certain method under advanced lock and code. We have done so in certain cases to protect our most secret inventions and research.

Through other courses by the FBI, related to our cyber security in our ISO:9000 certified factories and also remote offices we have had to take extraordinary precautions and continue to stay current as the cyber-threats increase and change in their tactics.

We have also been advised by our leading IP law firms to never file patents in China as we globalize our IP portfolio. We are told by our top law firms that the China patent system is corrupt.

Conclusion

It is time for America to lead. Some, even many perhaps, question whether America has the resolve and resources to right its own ship, let alone lead a global recovery in manufacturing. I believe steadfastly that the challenges are solvable and the Americans and their leaders will summon the will to act decisively. That action should start by correcting the macro challenge as outlined in this report — reducing the debt to sustainable levels, reducing the tax system and repairing infrastructure as proposed by the Administration. Those steps alone, however,

are not enough. America must also coalesce around a new vision focused on a business model of innovation and leadership in high value added next generation deep science manufacturing.

We must revisit the public private partnership's with our manufacturers in order to compete effectively with the monopoly known as China Inc. The United States has to have bolder ways to infuse capital into demonstratable successful deep science manufacturers, who will be competing against state run monopolistic China manufacturers that do not play by the rules whatsoever that the U.S. companies adhere to. There must be ways put forth to expand our SBIR/STTR programs to provide more capital timely to U.S. manufacturers that are demonstrating innovation to commercialization excellence for game-changing technologies and products that better the world, increase our GDP and national security.

It may be time to revisit the federal Earmarks program or a modified version with accountability, in order to compete against China and its unlimited investment capital for startups that are operating on imitated and stolen IP, and have unfair advantages too numerous and unsavory to name.

Most are predicting that more will be invented over the next Five years than in the history of mankind. This is an inflection point of massive technology invention acceleration caused by the relatively recent inventions of the chip, software, storage, and the Internet. This tremendous supercycle of innovation commands that America take action immediately to respond to the many challenges presented by China or suffer the consequences.

For more than 200 years, the United States has prospered because it is the home for people from every nation who are drawn to freedom, confident in their abilities to carve out a better life. That "can-do" optimism for which America is known is more than a cliché; it is a deep-seated cultural belief reinforced by experience on battlefield and board rooms, in classrooms and laboratories... And on the factory floor. It remains within America's ability to make its future.

We must capitalize immediately on our great University system, our National Labs, and tremendous agencies like the National Science foundation, to be sure this unique and best in class Innovation ecosystem, is organized in a way that promotes tech-transfer and commercialization in dramatic and laser focused ways so that we capture the best ideas into patents quickly, that are easily transferred into our capitalistic economy so that our Nation's best ideas and inventions are never left stranded, but instead accelerated to market at the speed of Innovation so that we build good jobs and improve the quality of life and security for our citizens faster and better than any other country on our planet. **The American Way**.

Thank You!

James M. Phillips