The 1st China-US Science and Technology Think Tank Symposium

Academy of Science and Technology for Development (CASTED)

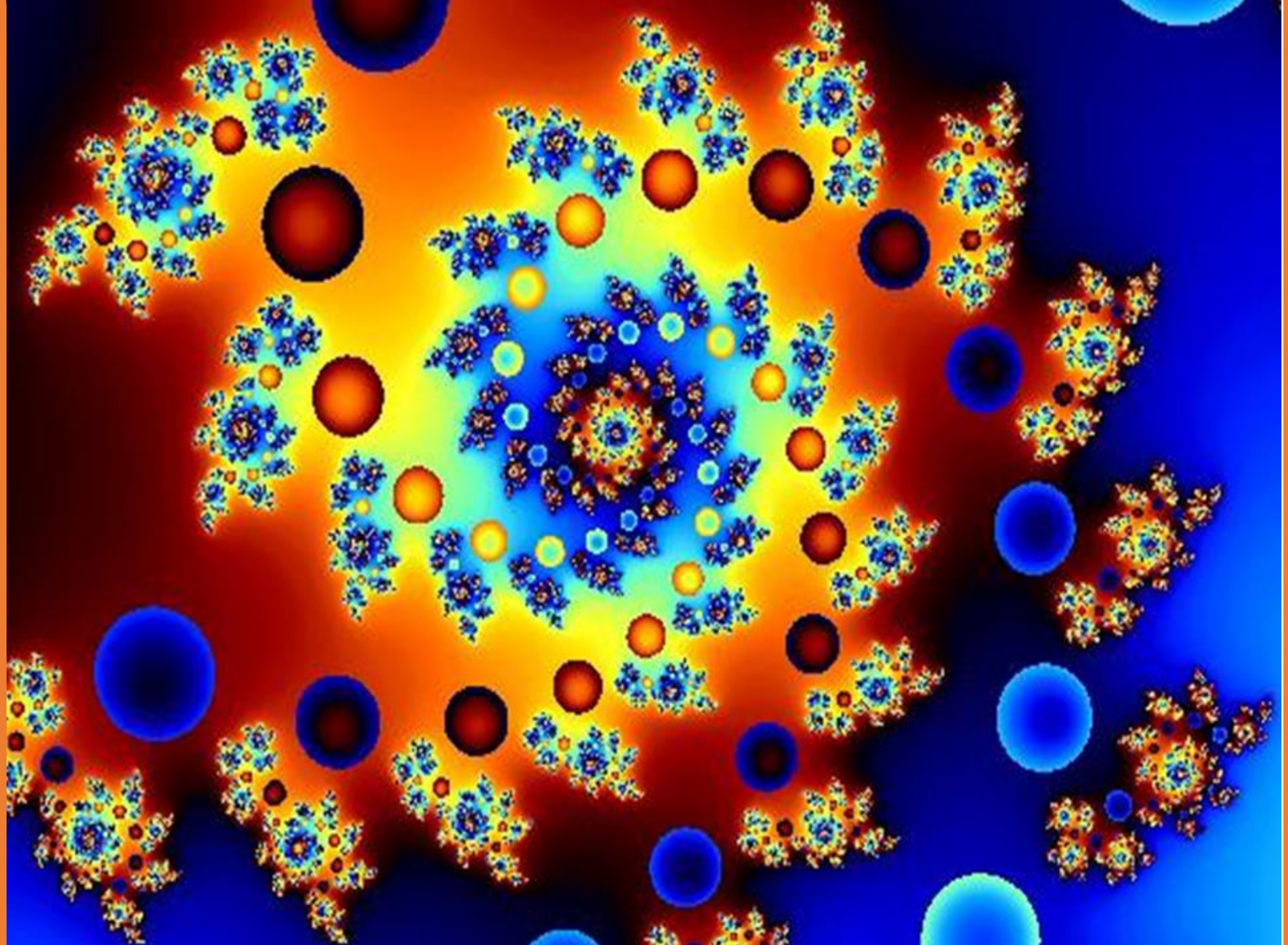
Host: Mr. HU Zhijian, President

Participating: Mr. WANG Zhigang (王志刚), Minister of Science & Technology

Mr. David Gross, 2004 Physics Nobel Prize recipient

Beijing, China October 26, 2019

COMPLEXITY



DISRUPTS!

James Cook

Introducing Jim Cook's talk, COMPLEXITY DISRUPTS!

For me, this is a homecoming and it moves me deeply to be here; thank you so much for inviting me. It's been 34 years to the month since CAS invited me to speak in Beijing about technology. Back then, I introduced an engineering and manufacturing software design platform. For the next decade, our CAD/CAM software was used to help Chinese engineers design and build China, from spacecraft and rockets, to air, rail, car, products, manufacturing, and infrastructure.

This launching of an engineering design and manufacturing platform was initiated and led by Madam Hu QiHeng, then Vice Secretary of CAS for Automation.

I've been immersed in innovation doing, managing, and consulting at the forefront of Information Technology. First at MIT's Aeronautics and Astronautics Department as a research engineer. Then heading up the research company where Siri began and got it financed by Exxon. Then did fun things with the math package and data base access in engineering software. I may have been three decades too early running engineering for the first commercially available autonomous robot. I ended up consulting to Bell Labs, DuPont, Motorola on a variety of management of technology challenges they faced.

My topic is Complexity with the goal of disrupting how you think about innovation

Please consider adding to the time-proven Scientific Methodology (that's served Physical Simplicity magnificently) a companion Methodology that's better suited to solving Nature's Complexity.

I'll begin with a simpler goal which is to ask you to appreciate the stakes in choosing a Complexity Methodology where it's appropriate.

Applying the right methodology, in the past, is the root cause of the West's innovation flourishing over and above China's which resulted in a Century of Humiliation.

But, really you might be asking, is how you think about solving a problem really that significant? Let's ask an expert …

The Scientific Methodology

Nice, but does it matter?

When asked,

"What single event was most helpful in developing the Theory of Relativity?"

Albert Einstein replied,

"Figuring out how to think about the problem."

Now, let's figure out how to think about innovation.

Today's Disruption is the Emergence of Complexity overtaking Simplicity!

The Scientific Method only works on Simple problems where the solutions are required to be repeatable.

Today's problems won't have repeatable solutions, rather context dependent solutions. These are the solutions to Natural problems like pollution, disease, agriculture, ecology, and life style, most of all.

These problems are complex, their solutions are likely complex, and our solutions often create problems. So, the process is never ending consequently Complexity is an Infinite Game (i.e., a never ending game).

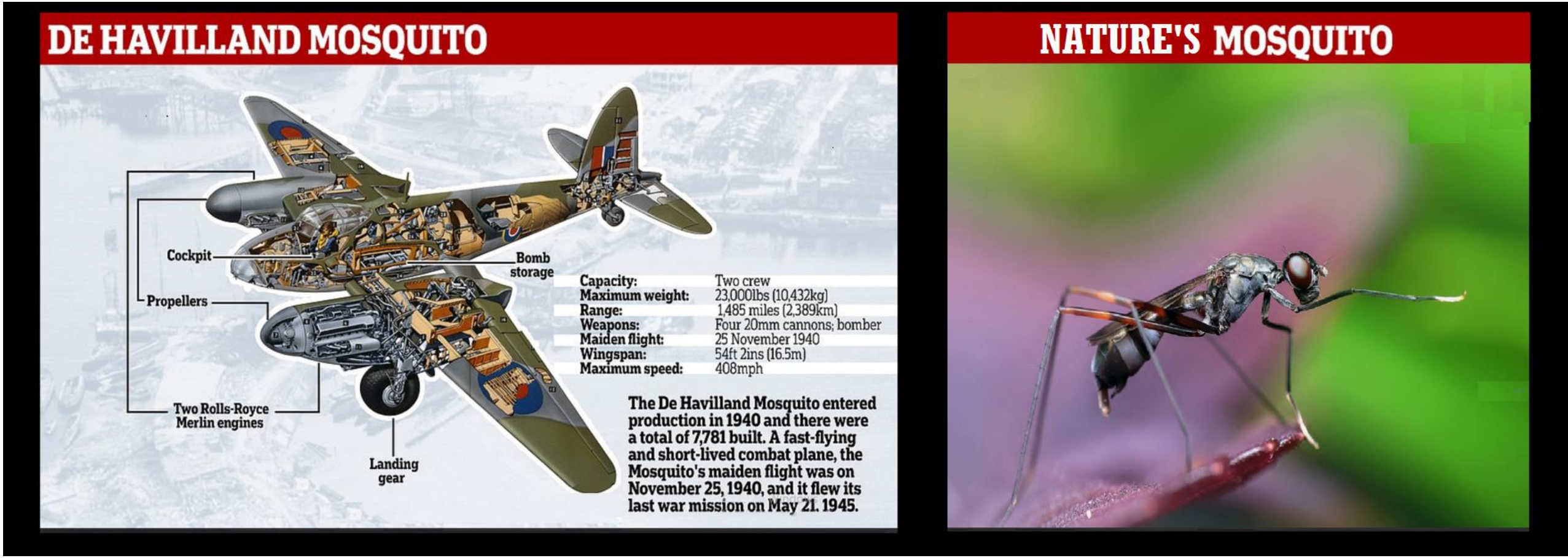
Our approach to these problems must be different; I'll contrast some major differences later.

First, I'll define what I mean by Simplicity and Complexity. Then, I will cite how historically, China's superiority over the West was disrupted by the West's mastery of Simplicity. Now, after a half millennium, comes a time whereby China can master Complexity, and achieve a balance with the West.

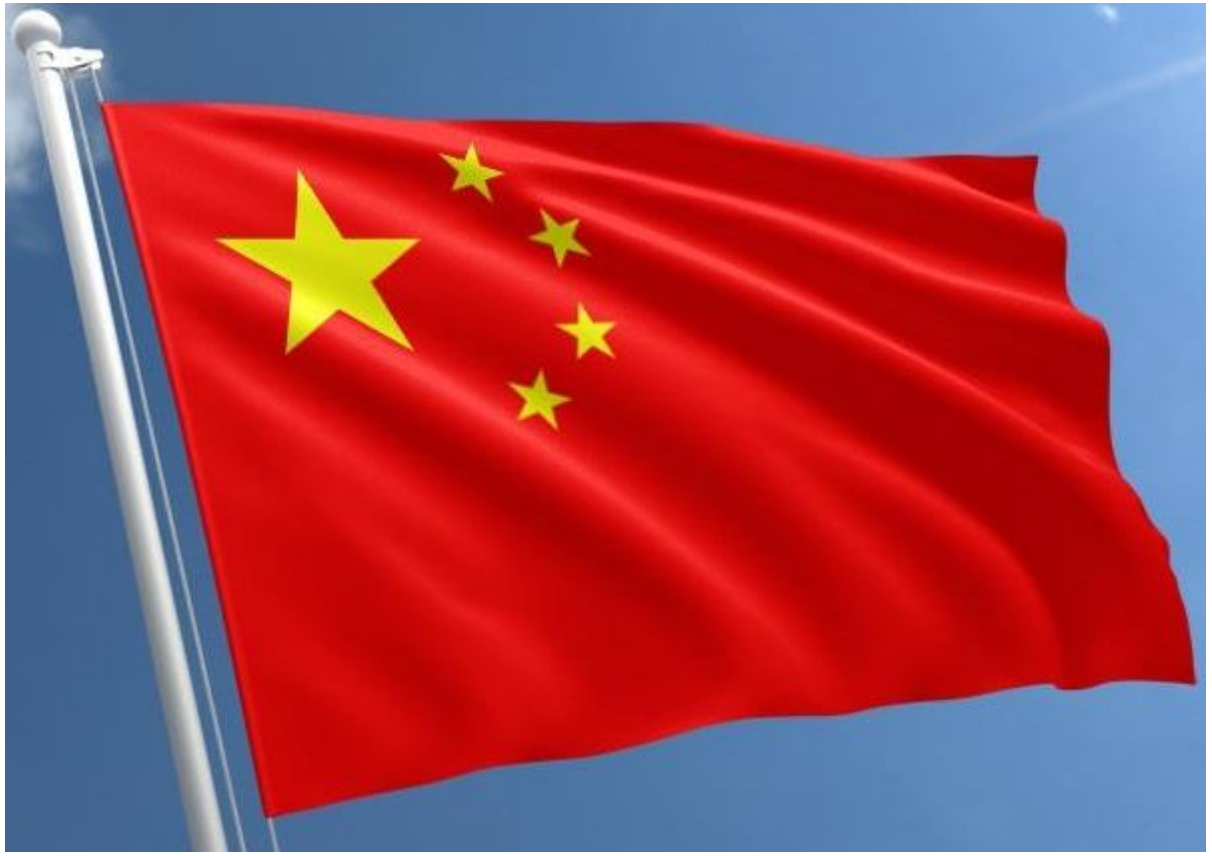
I will conclude with impacts on management, technologists, and collaboration. A big goal, wish me well!

Which is Simple, which is Complex?

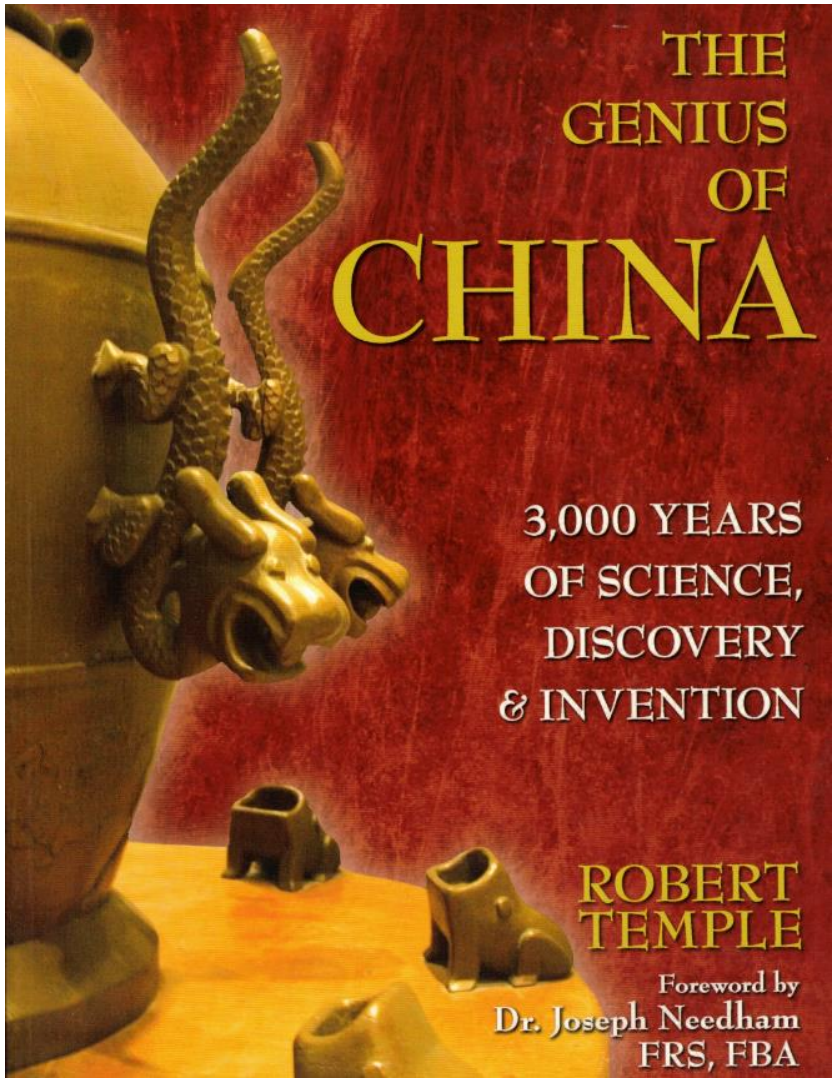
Which is Yang (阳) like, which is Yin (阴) like?



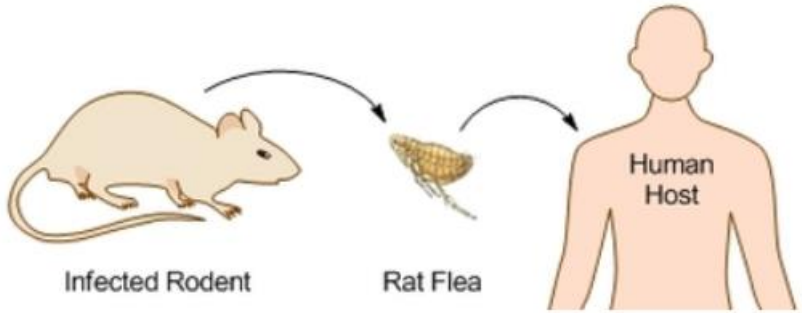
Which is more Yang (阳) like, which is more Yin (阴) like?



What caused the Fall of China and Rise of the West from 1450 to 1950?



Rise of the West began with the 14th Century Black Plague – History's worst!!



This set off the West's spectacularly successful disruption in thinking!

How?

With 30-50% of Europeans dying, people blamed the Catholic Church's leadership.

With the Catholic Church losing its authority, objective science was free to flourish.

Objective science used the Scientific Method bolstered by the Greek philosophers.

The Scientific Method was a way to construct knowledge that was free of context.

Ending Catholic Church censorship AND designing a robust process of building knowledge.

Enabling a solid way of thinking about science, engineering, and technology problems!!!

Now's the time to set off a spectacularly successful disruption in thinking!

The time right (tiān shí 天時):

- **We're able to meet our material needs: food, shelter, clothing, and transportation.**
- **We're in need of becoming more compatible with our environment and our evolution.**
- **China's had its own "Black Plague" in the Century of Humiliation and its Civil War.**

The place is right (dì lì 地利):

- **China can "leap frog" its thinking, because it's not bound to "Simple" methodology.**
- **China's leadership has a "5 Concepts" development framework which it supports.**
- **China's leadership has priority for "Complexity" problems like environment and health.**

And the Party agrees that the People's welfare is paramount (rén hé 人和)!!!

Embracing "Complexity" will be an Intellectual Revolution everyone can thrive in.

First, the basics

I define Simplicity as "reliably repeatable" and Complexity as "not reliably repeatable."

Complexity coexists with Simplicity. Newtonian physics was nearly pure Simplicity (until Poincare proved an orbit's collapse is indeterminate).

And then, Heisenberg and Schrödinger showed position of the electron is only statistically reliable proving quantum mechanics coexists with Complexity.

Complexity got a boost from Lorenz's simulations at MIT and then Mandlebrot's sets, and not to forget Feigenbaum's constants and the mysteries and beauty of the Golden Mean.

The contradictions & stability seeking of Complex phenomena's underly behavior which is woven into Chinese thinking by Lǎo zǐ's (老子) *Dào Dé Jīng* (道德經) is a profound advantage.

CONTRASTING

SIMPLICITY

- Reliably repeatable, therefore predictable
- Reductionist, vertical thinking; failures scorned
- Causes lead to expected consequences
- Usually low dimensionality – e.g., Engineered
- System behavior results from behavior of parts
- Processes flow rationally and can be combined
- Dead systems with Zero Sum results
- Plays FINITE GAMES (a definite end goal)

COMPLEXITY

- At best only statistically predictable
- Holistic, lateral thinking; failure commonplace
- Causes can have unintended outcomes
- Usually high dimensionality – e.g., Nature
- System behavior often a function of context
- Processes behave erratically and non-linearly as well as surprisingly stably robust and fail soft
- Live systems with Win-Win possible results
- Plays INFINITE GAMES (no end to pursuing)

Management, here's a menu of Complexity flavored "Ways"

1. Creativity followed by building on first principles (physics, math, chemistry, …).
2. Disruption welcome; holistic, creative, solutions over point solutions for Nature.
3. Platforms need to be designed towards delivering results fast to many users.
4. Platforms need to be designed to test many possibilities rapidly for diverse users.
5. Start with grand problems and let evidence lead you to partial/statistical solutions.
6. Become comfortable with ambiguity, contradictions, failure (cap when done).
7. Fluid, social, trusting networks instead of stable discipline hierarchies.
8. Have platforms (cooperating, programmable, rapid) replace Departments.
9. Rapid decision making, rapid feedback, rapid (24 x 7) test cycles=>rapid progress.
10. Earn trust and respect so you can leverage your human and budgetary resources.

And, Professionals, here's some items for your wish list

1. Review and contribute to your Managements' success in Complexity pursuits.
2. Data is gold: mine it, make it, mull it, swap it, machine learn from it, enrich it.
3. Indulge in history, read broadly, think in analogies, be curious and not satisfied.
4. Read widely, beyond peer reviewed, looking for what's right/new, not what's wrong.
5. Set out to do toughest first, ask 5 whys, go upstream for preemptive solutions.
6. Cost of success is overcoming disappointment and failures, but wins can be big.
7. Contradictions don't prove invalidity in Complexity, often lead to breakthroughs.
8. Make learning your personal mission (Learning Curve= K * e ^ (Q/(E*N)) where:

   K=knowledge, variety, spirit, fluidity, tools; Q = square root of number of tests;

   E = experimental design efficiency; N = noise; and "=" means product of factors.
9. Trust, respect, and conviviality are the leverage factors of your personal career.

Finally, here's some tips on collaboration with Americans

1. Nothing will amount to anything without TRUST (integrity), so make that a priority.
2. Ideas can move like lightening, but relationships can't; therefore proceed patiently.
3. Research is not well financed in US, so money helps collaboration happen a lot!
4. The lure of access to data, equipment, and/or instruments is valued, use it to trade.
5. Seek complementarity; American's research needs China and China's needs America.
6. In US high tech development, investment is scarce or concentrated, so China can shop.
7. Creating a counsel of luminaries can yield high value, but requires $$ & high purpose.
8. Learn to pick winners, not degrees and schools; seek accomplishments and boldness.
9. The best are right-minded, non-conformists who may not be published, but are right.
10. A top reference for both sides is: https://hbr.org/2003/10/the-chinese-negotiation.

Twice blessed; 1985 at the launch of China's Industrial resurgence, now in 2019, at the launch of China's Technological Takeoff

天時 地利 人和

Photo Record

Yes, there were some ladies in high positions, in attendance; welcome!

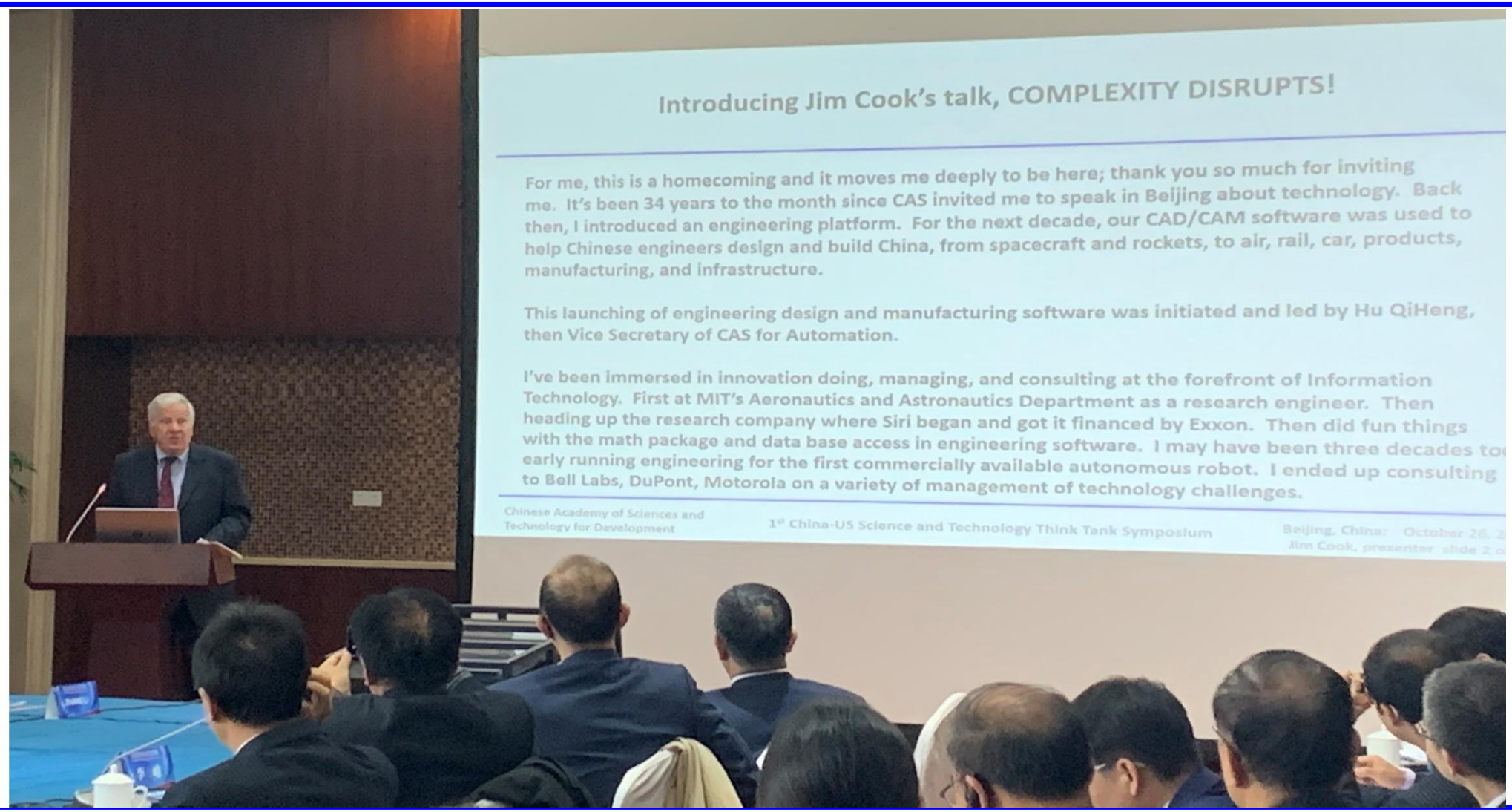


Photo Record

Attendees – Technology Policy wonks from government and Think Tanks

Photo Record – Followed by a 2 hour dinner

Photo Record – Exchanging ideas!!

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Time	October 26th, 2019 Wanshou Hotel, Haidian District, Beijing, China
9:00- 9:15	Mr. HU Zhijian, President, CASTED; *Welcome Speech and Theme Interpretation*
"Meeting with Human Common Challenges: The Role of Science and Technology Innovation"	
9:15-9:35	Mr. HU Zhijian, President, Chinese Academy of Science and Technology for Development
9:35-9:55	Mr. Keith Ross, Dean at NYU Shanghai; *Title: Privacy in the Era of AI & Big Path*
9:55-10:15	Mr. Jimmy Goodrich, Vice President, Global Policy, Semiconductor Industry Association
10:15-10:35	Ms. HUANG Ru, Vice Chancellor, Peking University
10:35-10:50	**Tea Break**
10:50-11:10	Ms. Nicol E. Turner-Lee, Fellow, Center for Technology Innovation, Brookings Institution; *Title: Future Benefits & Harms: Artificial Intelligence & Machine Learning Algorithms*
11:10-11:30	Mr. James Cook, Former MIT Research Engineer and President of Exxon's original Speech Recognition venture; *Title: Complexity Disrupts*
11:30-11:50	Mr. MU Rongping, Secretary of Institutes of Science and Development, CAS
11:50-14:00	Discussion and summary lead by Mr. HU Zhijian, President, CASTED
"China-US Science and Technology Innovation Cooperation: Opportunities and Challenges"	
14:00-14:15	Mr. HU Zhijian, President, CASTED, *This Topic's Theme Interpretation*
14:15-14:35	Mr. David Gross, 2004 Nobel Prize recipient, Director of Kavli Institute for Theoretical Physics, University of California, Santa Barbara
14:35-14:55	Mr. Steven W. Popper, Senior Economist, RAND Corporation
14:55-15:15	Mr. Scott Wallsten, President, Technology Policy Institute (TPI)
15:15-15:35	Mr. MA Mingjie, Director-General, Research Department of Innovation Development, Development Research Center of the State Council of PRC (DRC)
15:35-15:55	Mr. Richard P. Suttmeier, Professor Emeritus, Political Science, University of Oregon; *Title: U.S. Rationales for STI Cooperation with China: Where does a "Threat" Narrative leave us?*
15:55-16:10	**Tea Break**
16:10-16:30	Mr. Sean Randolph, Senior Director, The Bay Area Council Economic Institute;
16:30-16:50	Mr. WEI Shaojun, Director, Institute of Microelectronics, Tsinghua University; *Title: The potential of China-US scientific and technological cooperation*
16:50-17:10	Mr. Yusef Muhammad, President, American Institute of Corporate Development
17:10-17:30	Mr. Angelos Angelou, Founder & CEO, International Accelerator, Austin, Texas
17:30-18:10	Mr. WANG Zhigang, Minister of Science and Technology, PRC; Summary of Conference
18:10-20:30	**Discussion with Minister of Science and Technology; Group Photo; Banquet**