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It's Just Like That, Except Different

The Power of Analogy In Describing Nanotechnology

By W. Patrick McCray

HISTORICAL ANALOGIES HAVE POWER. Is Iraq circa 2008 like Southeast Asia in 1968? Can one think of the United States, as Cullen Murphy suggests, as an imperial power whose recent history and future fate compares with ancient Rome? Historical analogies help frame policy debates and, while they do not establish proof, they suggest possibility. For the broader public, analogies also generate useful connections and relations, emotional as well as logical. At the same time, false or poorly constructed analogies can promote misunderstandings and even bad policy.

When it comes to understanding emerging fields such as information technology, biotechnology, and nanotechnology, historical analogies are just as potent. They help shape debate and can validate, even suggest, possible futures. In the 1960s, as the United States and the Soviet Union raced to best each other with feats in space, historians debated over whether comparisons to 19th century railroad infrastructure could help society prepare for the shocks that robust programs of space exploration would surely bring. In 1962, in fact, NASA sponsored a project that encouraged scholars to consider the long-term implications—economic, political, and social—of the national space program.

When it comes to understanding potential societal and environmental implications of nanotechnologies, the historical analogy invoked most often by both nano-advocates and opponents is that of genetically-modified organisms. According to Kristen Kulinowski and Vicki Colvin of Rice University, GMOs followed a "wow to yuck" trajectory. Initially hailed as a solution to issues such as world hunger, activists saddled GMOs with a negative public image, criticized them as destructive to

the environment, and condemned genetically engineered crops for the harm they might visit on the public and developing world farmers.

The GMO-nano analogy, however, is historically inaccurate. The history of GMOs and the accompanying controversy cannot simply be reduced to a "wow to yuck" story in which public backlash derailed a promising industry or product. In reality, considerable ambivalence and critical debate about genetically engineered organisms existed from the technology's very beginning. Moreover, people hold food in a much different regard than, say, sunscreen or carbon nanotubes for high-tech television displays. We deliberately eat food; we don't ingest nanotech stain-resistant pants. By the same token, GMOs are developed for deliberate release into the environment, which is generally not the goal of most nano-oriented R&D. So while the comparison between GMOs and nanotech can help us understand some policy debates about social and environmental implications, other historical analogies would better inform policy debates and public understanding.

Another analogy that could help us understand the U.S.'s National Nanotechnology Initiative is the history of NASA's space program. (Since 2000, the NNI has been this country's multi-agency, multi-billion dollar nanotech program.) While not perfect, the analogy between the NNI and the formation of our national space enterprise provides several valuable points of comparison which might help us understand the nature of nano-research beyond the point where GMO/biotech association fails.

Like the space program, the NNI was conceived out of a spirit of competitiveness. Like competition with the Soviets through the long twilight struggle of the Cold War, concerns that the U.S. was slipping economically relative to European and Asian countries helped foster support for the NNI. One aspect of the NNI that has received robust funding support has been the creation of national research centers—the NSF alone funds more than a dozen such sites devoted to research and public engagement—just as the flood of NASA-directed funding helped spawn a whole host of 60s-era federal and university research centers for space science and exploration.

Like space science, nanoscience research is, in principle, highly interdisciplinary, bringing together scientists and engineers from fields such as biology, chemistry, and solid-state physics. NASA itself funds four such nano-research centers, suggesting the continuation of a decades-old trend. And just as space science research in the 1960s influenced pedagogy and student training, today's courses for budding nanotechnologists reflect a "new" hybridized approach to science education. While some skeptics have argued that the NNI's focus on practical (i.e. commercial) applications has distorted traditional university-based research and education, the fact remains that much of 1960s space science research was done both to produce new knowledge and to get the U.S. to a clearly defined place such as the Moon or an orbit around Mars.

Broaden the view and more similarities snap into focus that suggest the power of the space-nano analogy. In 1926, the Russian space visionary Konstantin Tsiolkovsky wrote "First, inevitably, the idea, the fantasy, the fairy tale. Then, scientific calculation. Ultimately, fulfillment crowns the dream." Whether or not today's nano-advocates wish to admit it, the fact is that an aura of the fantastical has surrounded nanotechnologies since the 1980s. As late as 2000, Nobelist Richard Smalley of carbon nanotube fame was still recommending K. Eric Drexler's 1986 techno-utopian *Engines of Creation* to government policy makers curious about what nano could do. Like the space frontier, advocates depicted the nano-frontier as the place where America's manifest destiny in science and technology would next unfold. In congressional testimony, Smalley even invoked powerful imagery from the Apollo era, saying that what was needed was someone bold enough to "put a flag in the ground and say: 'Nanotechnology, this is where we are going to go.'"

While such historical analogies can help us understand the past, and perhaps even the present, can they tell us anything about the future of emerg-

ing technologies? The now-comical phrase "power too cheap to meter" alone should be enough to induce caution when it comes to making predictions about future technologies. However, one can consider the directions the space program took after the Apollo era concluded and inject a note of caution for the U.S. nano initiative. To a large degree, as historians like Howard McCurdy have argued, NASA's public policies were shaped by the public's imagination as to what space exploration would be like. This entailed a strong focus on human (versus robotic) space exploration, elaborate manned space stations, and, eventually, bases on the moon and Mars. As satellites and space travel became routine, the Apollo era gave way to less exciting space shuttle flights and space probes that, while yielding tremendously exciting scientific information and inspiring vistas, did not have the same hold on the public's attention as did the first Mercury flights or Apollo 11. As one NASA official put it, "We don't give ticker tape parades for robots." Ultimately, NASA's grand ambitions were re-directed from the initial vision that many citizens found so compelling. How will the public react when it doesn't get the nanobots or molecular assemblers that early visionaries first proposed and which were so widely promoted in hundreds of newspaper stories and popular science magazines?

Today, it is almost a cliché for science policy makers to call for another Apollo or Manhattan Project-style effort to address pressing energy needs or global warming. We must carefully choose an appropriate historical analogy in framing these suggestions, however. What policy maker would want to initiate a program that eschews long-term goals for a single spectacular feat or develop a technology under classified, wartime conditions and not fully consider its potentially profound social and ethical implications?

While invoking the Apollo era may conjure nostalgic visions of America's past and what was right about the country at the time of great social unrest and an unpopular war, it should not be the pole star by which science policy navigates. When considering the implications of emerging technologies like nano, the power of historical analogies to shape discourse, frame media coverage, and inform the public demands more careful and reasoned attention. sp

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