As published in the October 9th, 1903 edition of the New York Times -- "The flying machine which will really fly might be evolved by the combined and continuous efforts of mathematicians and mechanicians in from one million to ten million years."
However, the Wright Brothers had a different idea.
And so from Orville's diary the same day came the quote: "We started assembly today."
This is DSO's approach - ignore the nay sayers and just do it!

Good morning.
Now that you have heard the other offices at DARPA talk about their challenges and opportunities, it is time for you to hear from the Defense Science Office - DSO -- and finally find out how -- like Wilbur and Orville -- we will make dreams come true.

The Defense Sciences Office is unique among the offices at DARPA.
Unlike any other office, DSO has been in existence with the same name and essentially the same mission for over 20 years.
Though you might realize by now that the names of most DARPA offices are ambiguous at best, we take very seriously the fact that we are the only office with the word "science" in our name.
But more importantly, the mission of DSO remains at the core of the mission of DARPA -- to prevent technological surprise by creating it.
To do this we use two approaches -- and you will hear about both this morning.

First, we exploit existing innovations in science and technology -- in order to create paradigm shifts in Defense capabilities.
Here we are generally problem driven, identifying and understanding the most significant shortfalls -- and then-- pushing on those technologies that we believe offer the best chance to make a revolutionary change.
With an emphasis on the word "revolutionary."
You have heard from the Systems Offices about a host of Defense problems including -- access to and operations in space, autonomous vehicles, complex non-linear networks, and detecting and mitigating weapons of mass destruction.
In the next 90 minutes you will hear from DSO about how we are exploiting innovations to attack these problems -- in dramatically new ways.

The second part of DSO's mission is the part we have the most fun with.
Dr. Tether talked about mining the far side.
At DSO, we like to think about mining the far side of the far side.
Here we are not looking to solve specific problems, but rather looking for breakthroughs in any field, with the idea that they might turn out to be something that can dramatically change the way we think about science and technology.
We do have some limitations.
Generally we frown on perpetual motion or violating more than one law of physics.
We also ask that no more than seven miracles need be accomplished-- in the first phase.

Other than that, the sky's the limit.
Of course, once we have demonstrated a crazy idea, then of course it is no longer crazy.
In fact, if we are truly successful, then the crazy ideas we push on today become exactly those innovations that we can later exploit to change paradigms -- in some sense coming full circle.

What I'd like to do this morning is give you some examples as a way of introduction to what you will hear from the rest of the office.
But before I do, let me first say a bit about how we accomplish our objectives.
We truly believe the success of the office is based on our ability to challenge one another-and to constantly ask questions in a different way.
When one does that, it turns out that the answer is often found in a discipline outside that in which the question was asked.
Thus, at the heart of the office is an interactive group of program managers that work in an eclectic set of disciplines.
For every successful program, there are usually a number of other DSO program managers who have contributed to making it better.
To steal a simile from this March Madness Basketball season, DSO is like an unselfish basketball team -- our program managers take as much joy in an assist -- as they do in a basket.
And thus, at the heart of our office are the players.

So now that's you've met the DSO staff, let me mention just a few of our programs and ideas as way of whetting your appetite for what follows.

One significant component of the office is about taking innovative technology and demonstrating how it can radically change the way defense does business.
For example, anyone who has had their laptop batteries run down at an inopportune moment, realizes how critical the availability of power is.
This is magnified on the battlefield -- where every watt-hour has to be carried in.
Consequently, the burden of bringing portable power to the battlefield is a ubiquitous problem for our soldiers.
But we did not to try to make batteries more efficient -- an approach that, through limitations in the periodic table, can only make a small dent in the problem.
Rather we began to develop portable fuel cells that will reduce the need for batteries altogether.

Before DSO's programs, fuel cells were unheard of for military applications.
But a few months ago -- a methanol fuel cell that will reduced the weight burden by a factor of over 6 -- was demonstrated for our soldiers.
By the end of our Palm Power fuel cell program, we will have developed a hand held, 20 watt fuel cell -- that uses logistic fuel - JP8.
This will reduce the weight burden of portable power by a factor of 10-15.
That means the Marine reconnaissance team that now has to bring in over 200 pounds of batteries only has to bring in 20 pounds of fuel cells and fuel.

But power is such a scarce commodity on the battlefield that we are thinking about even more unconventional ways to produce it.
For example, if we can convert military garbage to fuel, we can get a gallon of JP-8 for every 7 pounds of garbage.
Or we might be able to power sensors from the bacteria that are ubiquitous in the environment.
Obviously the holly grail is something akin to a credible approach to cold fusion.
At DSO, we don't reject anything out of hand so if you have ideas - send them in.

Even as we reduced the logistic burden of the soldier, it is likely that the weight we save will be quickly replaced by more weapons or electronics.
This means the overall weight a soldier has to carry, which hasn't really changed since Roman times, will stay about the same.
Enter the Exoskeleton.
Once just science fiction - who doesn't remember Sigourney Weaver putting on that suit in the movie Alien -- we have now been able to demonstrate an external structure that can move unobtrusively with a soldier and still carry more than 100 pounds with no effort by the wearer.
This has been made possible by breakthroughs in structures, actuators and power generation - with a bit of help from advanced microelectronics.

Only four miracles - simple by DSO standards.
As seen in the movie, we are well on our way to success.

But as I said, we have most fun with taking far side ideas and making them into paradigm shifting technologies.
As a great example, let me recount the evolution -- pun intended -- of biology at - - DARPA.
We have been involved with Biological Warfare Defense for over 10 years - changing the entire nature of Defense research in that area.
However, it became clear that there was much more to harnessing biology for Defense.
And so several years ago, we began to explore how we could use biology in other ways to improve defense capabilities.

How many Defense research agencies would spend time and money studying cockroaches on a treadmill? Yet, by so doing we learned to emulate the locomotion of animals.
When animals, including humans, change from walking on grass to walking on sand, they do not calculate the position of their legs or recalculate the coefficient of friction.
This is because the innate ability to walk is built into our body dynamics.
Learning how to copy this body dynamic, has allowed us to build the most robust walking robot ever made.
Because of its size -- something only just larger than a shoebox -- this robot probably couldn't make the Grand Challenge trip in 10 hours.
But like the tortoise in that fable, I am quite sure that at least it could complete the course.

And since we are a Defense agency, we need a robot for the Navy.

It has no problem moving in water because exactly the same biological motions that are used for walking are used for swimming.

I don't know if you ever watched a cockroach running very fast -- but if you did -- this is what you would see.

We are now pushing this technology into more capable robots that can climb up walls and jump - again by stealing from biology.

Ultimately, we might think of combining the control of the exoskeleton with biologically inspired mobility to develop a truly humanoid robot.

So as you can see DSO's crazy idea of studying cockroaches has come full circle to provide us with defense capabilities we never had before.

As part of our foray into biology, we began a major program designed to integrate the disparate fields of biology, information science and microtechnology.

The success of that program can been seen in the way universities have created new departments - and more importantly -- a cadre of graduates who now speak fluently in all three disciplines.

This had led to new ways to look at biology including the novel interaction of biology and magnetics.

It was exactly this kind of exploration that led us to the most dramatic program we have - one that the Director believes will be a legacy for DARPA.

It is our efforts to understand the language of the brain.

At the last DARPA tech we showed you some early results.

In fact, the performers won a DARPA Tech award.

But truthfully, that was just the beginning.

Over the last 18 months, the progress has been so dramatic that it has exceeded even our own, very high expectations.

With apologies to those of you who know the concept, let me just paint the picture.

We begin with a monkey trained to play a game with a joystick to get a reward.

Next we extract the neuronal signals from the brain that correspond to the monkey's thoughts about moving the joystick.

Then we use those codes to move a joystick in another room or even another city.

When we disconnect the joystick, the monkey continues to move it for a while.

But soon - and this is the dramatic part - she realizes that it isn't connected but that she can still think the motions and get the reward.

The chart you are seeing is the dramatic proof of the power of this accomplishment.

When the monkey is moving the joystick you can see both brain activity and muscle activity.

But when she finally realizes that moving joystick is not necessary, all you can see is brain activity.

The monkey is moving the joystick without moving a muscle.

Now imagine how great this would be for a paraplegic who could control his or her own prosthetic with just the mind.

Unfortunately this is a serious problem for our veterans - and thus we are working with the VA to make this transition.

You will hear more from Brett on how we are going to help our wounded veterans in this and many other ways.

So far you've heard about our past accomplishments and a few ideas about where they might lead.
But that's not why you are here.
So for the remainder of the time our office has today, we will present a range of topics that provide opportunities for you to participate in DSO's somewhat strange vision of world.

John Main will tell you how we have changed the way people think about materials and structures and offer his view of the next breakthrough in materials - truly intelligent materials that -- like biological systems -- are totally adaptable and totally malleable.
Materials that can protect themselves and, when all else fails, heal themselves as well.

Jay Lowell will then entice you with the strange world of light and matter and challenge you to help us turn the unbelievable into reality.
He will explore the world of quantum physics -- and tell you about how we can slow light to a stop -- or -- make it bend in strange ways.
The payoffs in this area are dramatic, but the challenges will make quantum computing look easy!

Next, Carey Schwartz will show you the growing importance of mathematical principles and algorithms to emerging defense problems.
How challenges such as the building and operating of sensors, the modeling of materials and biology and the representations of geometry for targeting and mapping, are all limited -- not by computer size and speed -- but rather by our ability to mathematically describe and manipulate these concepts.

Then, Brett Giroir, our new Deputy Director, will tell you another part of the biorevolution story - how we are harnessing nature to maintain our warfighter's performance on the battlefield.
You will hear how DARPA is changing the efficacy of medical care in response to the reality of the new way of fighting.
And Brett will tell of some revolutionary technologies that we are contemplating -- to provide faster recuperation and mitigate some of the most horrendous after effects of battle injury for our wounded military.

Finally we'll tell you about several new ideas that aren't as easily categorized -- but could well become critical to future warfare.

And so now, without further ado, the man who has the nerve to develop the exoskeleton without Sigourney Weaver, John Main.