

An astronaut and a scientist

NASA science chief seeks a better union between human exploration and science.

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On 4 January, John Grunsfeld, the fix-it-man for the Hubble Space Telescope, became the head of NASA's Science Mission Directorate. But the former astronaut is quick to point out that he is an astrophysicist too, having done a cosmic-ray experiment for his doctoral thesis on the space shuttle. More recently, while deputy director of the Space Telescope Science Institute in Baltimore, Maryland, Grunsfeld has worked on developing instruments to study the atmospheres of exoplanets. *Nature* caught up with him in his first week on the job.

Budgets are tight and many people are worried about NASA's future. Why did you take the job during such gloomy times?

From the viewpoint of a space-telescope person — as an astronomer and an astronaut — it is an incredible time because the agency is still formulating its exploration plans for humans. I see no difference between scientific exploration and human exploration. I see a continuum and an opportunity to contribute to the planning of Earth's future.



NASA/Getty

John Grunsfeld flew on five space shuttle missions between 1995 and 2009.

As an astronaut who helped to fix the Hubble telescope, you know the human exploration programme. How can that help you lead the Science Mission Directorate?

There's a perspective that I've gained as an astronaut that I didn't get from my science activities. In my science activities, I learned by the seat of my pants. Spending 17 years as an astronaut, I learned the NASA formalism of systems engineering as if my life depended on it. Literally. That perspective is one that I'm bringing to the Science Mission Directorate, and it will help a great deal in things such as executing programmes to cost and on schedule.

What do you say to those who might worry about your ability to advocate for Earth science, planetary science and heliophysics?

The most striking thing to me about human space flight and my own personal experience is that I've seen dramatic changes on Earth. We humans are rapidly changing the planet. I've watched Amazonia as the rainforest has been cut down. That's something I've seen out the window. I'm very worried about that.

The biggest surprise to me is that I never saw any place where I couldn't see the impact of humans — even the oceans. You can see smoke coming off the east coast of China, smoke and dust, travelling all the way across to the Yukon. These are things that the human eye can see. We ought to try to understand these dynamics in detail.

I see a continuum. The last time I looked, Earth was a planet. Venus is a planet. Mars is a planet. We're discovering hundreds, thousands, of exoplanets. The Sun is a star; Hubble studies stars. We tend to stovepipe things into budget lines, but there are very few scientists who also don't see it as a continuum.

What is one specific thing that you want to accomplish?

I would like NASA to articulate a plan to explore the Solar System with humans and associated science investigations, because I see them going hand in hand. We're not going to send people anywhere, unless we're out there doing science or enabling science as a part of an exploration framework.

My desire is to work more closely with the human spaceflight programme so we can take advantage of synergy. A good example is the Space Launch System (SLS). Right now, one of the big issues in launching science payloads — whether they be Earth science, heliophysics, planetary science or astrophysics — is the availability of launch vehicles. The current fleet is limited, and the things we can afford are relatively small. If you wanted to launch something much bigger, it would be very expensive.

There are two things that NASA is encouraging that could change that. One is commercial space flight. If we have new rockets that significantly break the current cost curves in a competitive environment, that money can go into making the payload more capable, or to launch bigger payloads.

The other is the size of the SLS. If down the road we wanted to launch a telescope that could, for instance, study the entire energy balance of Earth with pixel sizes smaller than clouds, it would take a big telescope. With a big rocket, you can think start to think about launching big optical systems. We think of the SLS as the human spaceflight programme, but it could be hugely enabling for science.

The James Webb Space Telescope (JWST) seems to be going well for the moment. But would there ever be a cost point at which you would advocate cancelling it?

I don't even think about that. I know what the cost is — it's capped at \$8 billion. All the technologies have been proven. We're going to execute a plan. It's always possible that problems are going to arise. But \$8 billion is what we're looking at with very high confidence, so I'm not thinking about what we would do if we go over that.

One of the problems we got into with the JWST is that there were breakdowns of communication, and breakdowns in the decision-making process. An enormous amount of work was deferred. It's easy to say: "Okay we'll defer the work." But a non-decision is also a decision. All of those increase the price of a project. The dollar you don't spend today to solve a problem — by not deciding on how to solve it — becomes two or three dollars down the road.

What is your opinion of this three-pronged plan for Mars Sample Return, which might cost \$8.5 billion over a decade?

I'm a huge fan of sample return. I'm a huge fan of getting the right samples. I'm not up to speed enough to talk about the specific programme, so I'm going to punt on that one.

But I'd like to have an integrated plan for the agency for how we're going to use our science programme to answer burning science questions. It would be integrated in that it feeds into the plans to put people on Mars and what the people will do once they get there. That integration is going to drive missions such as the Mars Sample Return in a much more productive way.

'International collaboration' is a nice-sounding phrase that is invoked a lot, but these marriages often fail. What can you do to make these collaborations actually happen?

I'm absolutely dedicated to finding a way to make our partnerships stick. The people change on both sides of the ocean, so a lot of it is about relationships. And one of the problems is that our decadal survey process — which helps us set priorities — is out of sync with the European survey process. But let me just talk about space exploration. I believe that the future of humans, and the future of Earth, depends on space exploration. That's not a French problem, or a problem for Alabama, it's a planetwide problem. International cooperation is crucial.

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