a mid-level Trump appointee — deputy chief technology director Michael Kratsios — represents the office at meetings of the president's senior staff, the anonymous White House official says. That slot is normally occupied by the president's science adviser.

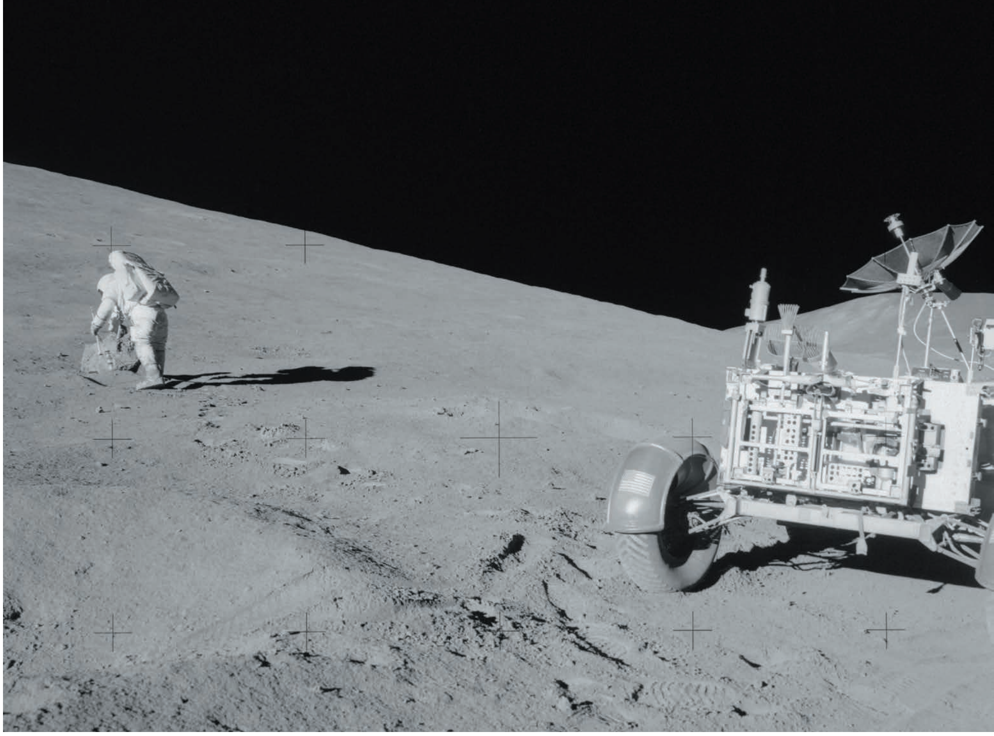
Kratsios, former chief of staff to venture capitalist and Trump donor Peter Thiel, has helped to hire eight people to work on technology issues in three of the OSTP's five Obama-era divisions: environment and energy, national security and the office of the chief technology officer. But two divisions — science, and technology and innovation — are now completely unstaffed, according to several former employees. "It begs the question: if science and technology is in your name and you do not have a science or technology division, what are you doing?" one former staffer says.

The White House says that there are 12 people "working on science" across the OSTP. "The scientists, policy experts and advisers at OSTP are constantly working together across the entire office," according to a statement provided to *Nature*. "What might have worked structurally under the Obama administration, with five separate divisions, actually looks pretty siloed today."

Despite these changes, some of Obama's big signature science programmes, such as the BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies), have matured enough for the agencies involved to continue them without White House support. "Most of us tried to get everything done so [our programmes] could be on autopilot for six months or so," says Tamara Dickinson, who left her job as principal assistant deputy director of the office's environment and energy division in January.

But the end of that period is approaching, and without a science adviser, OSTP career staff cannot establish new working groups, call meetings or approve budgets. As a result, says a former staffer, it is unclear which agency will handle science-education initiatives. And because Trump's positions on the environment and climate change clash with those of his predecessor, OSTP employees who work on these issues are at a standstill until they get clear direction from above. "Everyone's sort of afraid to step too far out in front of knowing what the new leadership is going to want," Dickinson says.

Meanwhile, individual agencies are doing what they can to keep projects on track. Jackie Richter-Menge, a polar researcher with the US Army Corps of Engineers' Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire, says that the 16 agencies that coordinate the US Arctic research programmes have been working harder on issues such as data collection, scientific infrastructure and international cooperation since Trump took office. "We know the leadership's not there at the top of the pyramid," she says. "We know we need to keep things going." ■



An Apollo 15 astronaut collects a soil sample on the Moon.

NASA

PLANETARY SCIENCE

NASA seeks better fake space dirt

Soils that mimic planetary surfaces often miss the mark.

BY ALEXANDRA WITZE

James Carpenter just needed some fake Moon dirt. Carpenter, a lunar-exploration expert at the European Space Agency (ESA) in Noordwijk, the Netherlands, works on a drill designed to hunt for buried ice on the Moon. His team recently ordered half a tonne of powdery material to replicate the lunar surface from a commercial supplier in the United States. But what showed up was not what the team was expecting. "The physical properties were visibly different," says Carpenter.

His experience underscores a longstanding problem with artificial space soils, known as simulants: how to make them consistently and reliably. But now there is a fresh effort to bring the field into line. Last month, NASA established a team of scientists from eight of its research centres to analyse the physical properties and availability of existing simulants. And, for the first time, an asteroid-mining company in Florida is making scientifically accurate powders meant to represent the surfaces of four classes of asteroid. It delivered its second batch to NASA on 28 June.

> *"NASA is trying to conquer the Wild West of simulants."*

"NASA is trying to conquer the Wild West of simulants," says Philip Metzger, a planetary scientist at the University of Central Florida in Orlando.

Such materials are meant to mimic the mix of dust and broken rock that covers the surfaces of planets and asteroids. Engineers use the artificial soils to test space-exploration technologies such as drills and rovers, and to determine whether astronauts could make structures by feeding space dirt into 3D printers or by compressing it (B. J. Chow *et al. Sci. Rep.* **7,** 1151; 2017). Scientists use simulants to explore geological processes such as how rocks weather in space.

THE DIRT ON DIRT

Over the years, space agencies and research groups have tended to make their own artificial soils as needed from mixtures of ash and grit, sand and crushed bricks, and even glass beads. This has led to a wild proliferation of soils; there are more than 30 lunar simulants alone (L. A. Taylor *et al. Planet. Space Sci.* **126,** 1–7; 2016). "There are a lot of people out there creating their own simulant with no geology or materials-processing background," says Jennifer Edmunson, a geologist at NASA's Marshall Space Flight Center in Huntsville, Alabama.

But no artificial soil can re-create all the physical and chemical properties of a planet's surface. A mixture that was developed for engineers to drive rovers in would probably be terrible for studying the geochemical properties of the Moon.

Researchers do not always pay attention to those limitations, says Clive Neal, a lunar scientist at the University of Notre Dame in Indiana. "We have no accreditation in terms of what this can be used for and what it can't be used for," he says. "If you use it for the wrong thing you end up with misleading results."

In 2010, a panel of lunar scientists recommended that NASA develop a database that researchers could use to compare the characteristics of different simulants and pick the best one for each use. But the agency had no money to support such a project. The new working group aims to outline how much it would cost to produce a database covering simulants for all types of planetary body. "Hopefully, we'll be able to develop this repository," says Brad Bailey, associate director of NASA's Solar System Exploration Research Virtual Institute, who is based in Washington DC.

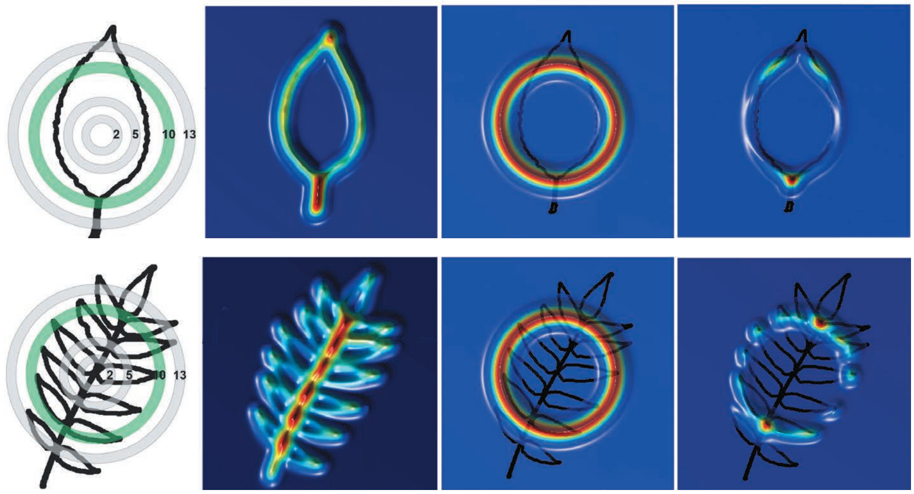
The database would include the four new asteroid simulants being made by the Orlando office of Deep Space Industries, an asteroid-mining company. NASA has ordered five tonnes for delivery over the next two years. Each simulant is based on a different class of meteorites called carbonaceous chondrites, which are thought to be chunks of asteroids.

SECRET RECIPE

To make fake asteroid dirt, technicians mix various minerals — including bronzite, which is sourced from jewellery suppliers as polished stones — compress them into bricks and then pulverize them. "We have to do something that is basically equivalent to hitting a solid rock with thousands of meteorites over a long period of time," says Stephen Covey, the company's director of research and development.

Deep Space Industries delivered 512 kilograms of the first simulant to NASA in March, and 532 kilograms of the second type in June. The agency plans to use the simulants in work on missions such as OSIRIS-REx, a spacecraft that is making its way to an asteroid to collect a sample and bring it back to Earth.

In Europe, Carpenter and his colleagues are still hunting for their perfect lunar soil — but they have given up on ordering it commercially. The researchers, who need 700 tonnes for a planned lunar habitat at ESA's astronaut-training centre in Cologne, Germany, are looking much closer to home. They have decided to grind up rocks from the nearby basalt mines of the Eifel region. ■



To compare leaf shapes, scientists assign values to pixels in an image and analyse them for patterns.

PLANT BIOLOGY

Atlas traces shape of 182,000 leaves

The data can be used to examine geographic and taxonomic relationships between species.

BY HEIDI LEDFORD

The story of a plant is etched in its leaves. A tree in a cold environment with plenty of water is likely to have large leaves edged with many serrated teeth. But if the same species lives in a warm, dry region, its leaves are more likely to be smaller and smoother.

Now, an atlas that traces the shapes of 182,000 leaves from 141 plant families in 75 locations around the world shows promise for refining scientists' ability to read that story. Using the atlas, researchers found that leaf shape alone accurately predicted where a leaf was collected 14.5% of the time, and plant family correctly 27.3% of the time (M. Li *et al.* Preprint at bioRxiv http://doi.org/b9gj; 2017). That is much better than predictions made using conventional methods.

Researchers hope that the approach will help them to learn more about the forces that shape plant leaves, and even to get a glimpse of ancient climates by analysing the shapes of fossilized plants. "It's an amazing data set," says Dan Peppe, a palaeobotanist at Baylor University in Waco, Texas. "We're getting closer and closer to automating measures of leaf shape, and using that to figure out the taxonomy of a plant and reconstruct climate."

The results were posted on 20 June to bioRxiv, a server that hosts biology preprints. Plant morphologist and lead author Dan Chitwood also presented the study at the Botany 2017 meeting in Fort Worth, Texas, on 27 June.

Chitwood, formerly of the Donald Danforth Plant Science Center in St Louis, Missouri, and his colleagues used a topological method called persistent homology to analyse the shape of each leaf. The method assigns each pixel in an image a value according to the density of the pixels around it. The researchers broke each leaf into 16 parts, and analysed the pattern of values in each one. Then they used the resulting catalogue of leaf shapes to look for taxonomic and geographic relationships.

Others are eager to apply the method to their own research. Plant morphologist Yannick Städler of the University of Vienna wants to use the technique to analyse X-ray images of flowers. He hopes that it will help him to overcome a stumbling block with conventional morphological methods, many of which involve placing landmarks — points on structures that recur across species — on images.

Those techniques work well for animals, he says, which tend to have obvious landmarks: the point at which two bones meet, the corner of an eye, the tip of a nose. But flowers often have smooth, curved surfaces, which makes it difficult to pinpoint specific landmarks. "This has been a horrible problem in leaves and in flowers," Städler says. "It has held us back." ■