

VANITY FAIR

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On Time

JESSICA CHASTAIN

"A woman commanding a mission to Mars is not out of reach"

By SARAH EDWORTHY

Photographs by MATT HOLYOAK

PLUS

Professor Brian Cox

HOW WE TRAVEL IN SPACE-TIME

Jack Forster

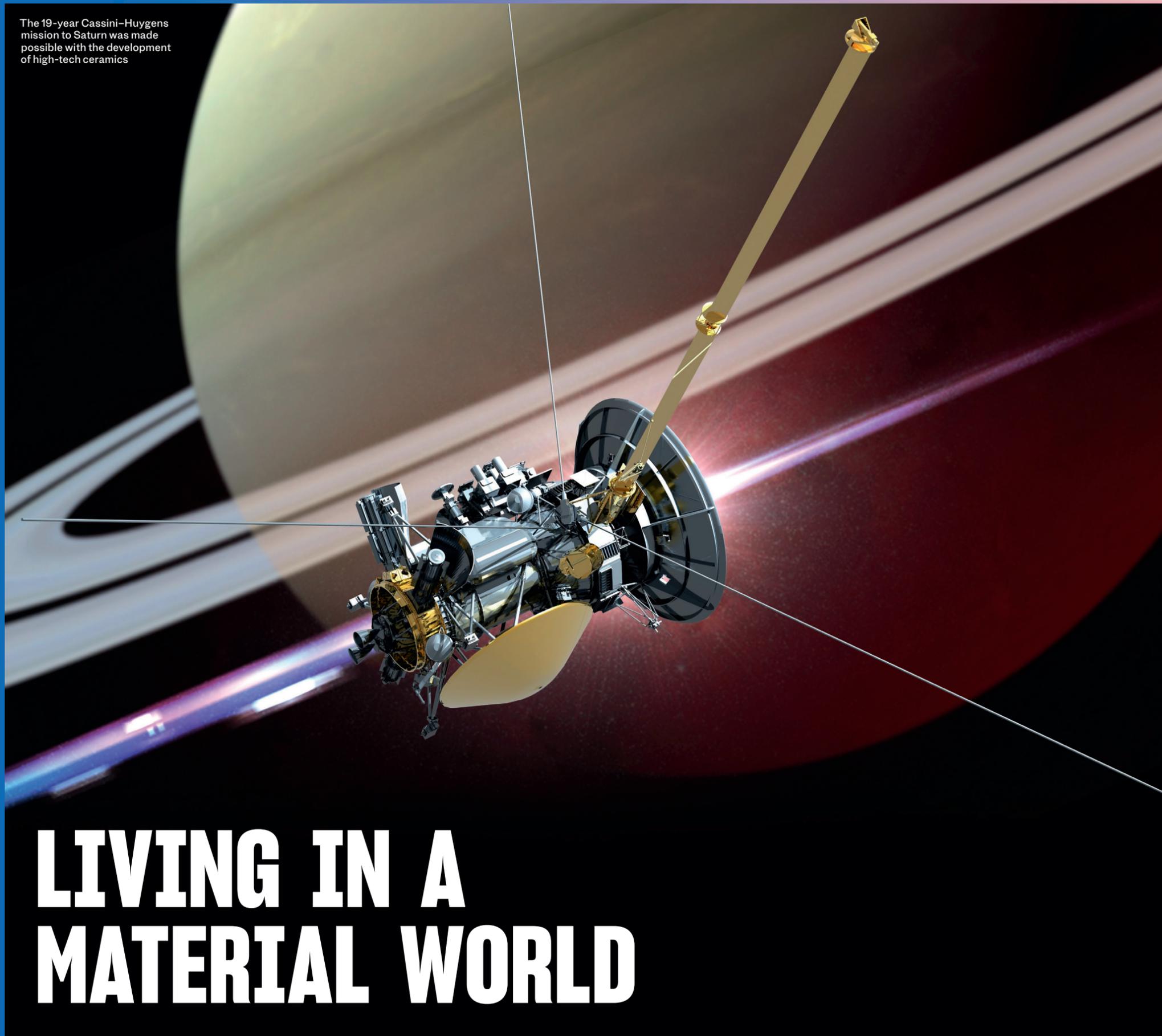
GRAVITY IS GRIPPING

Meteorite magic!

THE DIALS THAT FELL TO EARTH

The
Space
Issue

The 19-year Cassini-Huygens mission to Saturn was made possible with the development of high-tech ceramics



LIVING IN A MATERIAL WORLD

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From test centres for satellites and watches to developing perfect composite matter, the technologies behind space exploration and horology are made for each other

BY JAMES GURNEY

We know just about everything about the watches that went into space: which were taken into orbit, how they were bought and tested, who wore them—even how they performed in zero-gravity. But how have watches been changed by the race for space? How much “space” is in your watch?

This is about the technical advances the Space Race made possible, starting with the founding principle that NASA was given when President Eisenhower signed the Space Act into law in 1958. NASA came into being with a mission to extend knowledge of space and develop the technologies required to do so, and the Act included a provision that the public should enjoy the fruits of the research involved; the programme was to be for the “benefit of all mankind”.

Over the decades since, NASA and other agencies such as the European Space Agency (ESA) have lived up to the aspiration, inventing or developing technologies that have transformed life on Earth in large ways and small. Out of the Apollo missions came a flood of inventions—from new ways to analyse scanner results (that now underlie the use of diagnostic tools such as ultrasound and MRI) and methods to filter and clean digital signals (without which we wouldn’t have satellite TV or broadband internet through copper wires) through to memory foam, invisible braces for teeth made of polycrystalline alumina, and smoke detectors. Satnav, wound-healing bandages, ultra-high density capacitors and self-repairing structures have all emerged from space agency spin-off programmes. Indeed, so much research has been led by NASA, the agency spends tens of millions of dollars annually solely to manage the databases of patents it generates. Multiply that by space industries and agencies across the world, and you have a veritable flood of knowledge.

There’s irony as far as the watch world is concerned in that in an age where ion drive propulsion is a reality, some astronauts still wear mechanical watches—and the only one you’ll see being worn outside on a space suit is still, according to Hodinkee’s editor-in-chief and fellow *Vanity Fair On Time* contributor, Jack Forster, the Omega Speedmaster Professional, a model that’s much as it was when Wally Schirra first wore one to space in 1962. With the flood of technology transfers you might have expected something more noticeable to have filtered through.

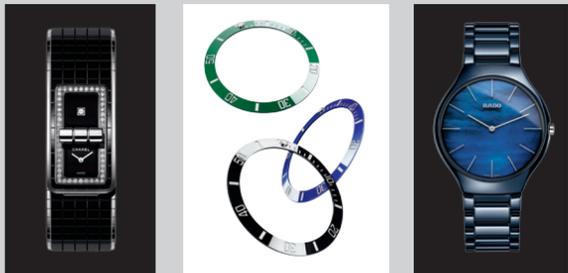
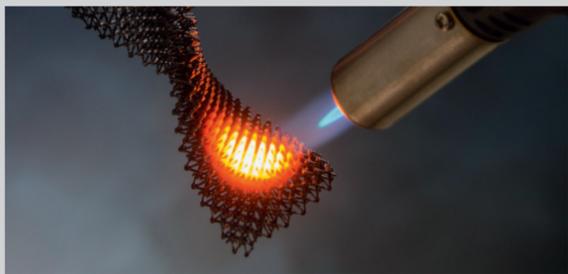
The answer is that technology *has* filtered through, it’s just that, sometimes, it’s not always obvious. One of the more surprising examples can be seen on the Loomes & Co Robin

watch. The cost of achieving any useful orbit means that satellites must be small, light and precisely engineered—all qualities that were much appreciated when Robert Loomes, having set himself the quixotic task of creating a purely English-made watch, was looking for someone to grind a sapphire crystal dial glass. He eventually persuaded a London-based company that provides lenses for satellites to supply him, only to discover that the lenses were polished on 1940s machinery originally designed to make watch glasses.

More conventionally space related is the use of high-tech ceramic cases as pioneered by Rado and Chanel. The essential usefulness of ceramic has made it critical to the success of missions such as Cassini-Huygens, which saw a probe successfully land on Saturn's moon Titan. The mission used machinable ceramics that combine a "high thermal conductivity with a high mechanical strength and with bending strengths of 30kg/m, a perfect combination of technical properties for spacecraft", according to Chris Bell of Birmingham-based Precision Ceramics.

While the likes of Hublot, Chanel, Rado, Omega and Rolex have concentrated research on the very tricky business of colour and texture (Rolex spent years perfecting a seamless transition from blue to black ceramic on the GMT Master II bezel), the mechanical properties and manufacturing techniques were developed with a more stellar purpose in mind. And you may soon see far more complex shapes emerge for ceramic watches. Conventionally, the near-impossibility of machining ceramic is avoided by using powder injection into moulds under pressure. Using micro-formed mould inserts, the process can produce parts with a tolerance of

CERAMICS

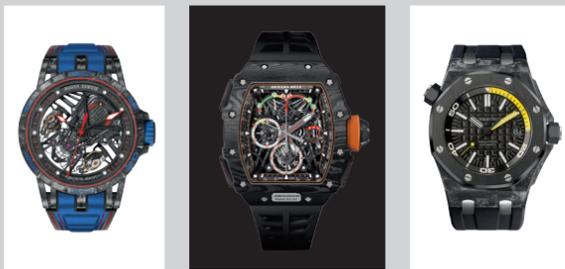


Clockwise from top: HRL Laboratories won NASA backing to 3D-print ceramic rocket engine components; the Rado True Thinline Water made with high-tech ceramic; Rolex ceramic bezels; the Chanel Code Coco in steel and black ceramic case

CARBON



Above: NTPT's Thin Ply Technology® carbon fibre processing. **Below, from left:** the Roger Dubuis Aventador S made from the same carbon as Lamborghini cars; Richard Mille limited edition RM 50-03 made of NPTT; Audemars Piguet used Forged Carbon® in the Royal Oak Offshore Diver



around 200 microns (a little more than a human hair) with densities between 97 and 99 per cent of the theoretical values. That's okay, but not good enough for the thread of a screw.

Last year, however, HRL Laboratories in California won NASA backing to 3D-print ceramic rocket engine components. The technique, and a similar process being developed by Rolls-Royce for its next-generation jet engines, uses "pre-ceramic resins" and will allow for far finer and more complex shapes. Polymer-derived ceramics, or PDCs, have been around for some time but were limited in use for precision components by the way the resins change density and release gases during the conversion from resin to ceramic. HRL's technique uses a laser to convert an improved pre-ceramic resin into a polymer layer by layer, which means there's almost no limit to the geometry of the component, and the precision is good enough for integration into micro-electronic environments. Given that ceramics are low friction and stable over temperature ranges, you can expect to see watchmakers experiment with key movement parts in ceramic. But in the meantime, look out for something special in the ceramic line from Chanel this spring.

Less directly descended from the Space Race are composites based on carbon. Carbon fibre-reinforced plastics are used today in spacecraft antennae and telescope reflector materials. The idea of using, initially glass, fibres to reinforce a resin base goes back to work done by DuPont in the 1930s. When carbon was tried out in place of glass in the 1960s, it was found to be exceptionally light, strong and durable (and



Above: the Loomes & Co Robin watch

more flexible than ceramics). Applications in aerospace soon followed, but carbon fibre reached watchmaking via a circuitous route. McLaren unveiled the first F1 car with a carbon-fibre chassis in 1981 in an attempt to gain strength and lose weight, a decision that almost certainly saved the life of John Watson when his McLaren MP4/1 spun out of the Monza Grand Prix that year, making him an unwitting advert for the new technology.

It wasn't many years later that carbon fibre began to appear on watch dials, but it was not suited to the fine tolerances that watch cases require (and might shed material into the movement). It was only when Audemars Piguet commissioned the development of "forged carbon" that its lightness and durability was taken advantage of in watchmaking. Since then a number of composite technologies have been used by the likes of TAG Heuer, Hublot, Roger Dubuis and Richard Mille. It is Richard Mille, however, that is pushing the possibilities of carbon fibre furthest through its relationship with North Thin Ply Technology (NTPT), the Swiss company that famously made carbon-fibre sails for the America's Cup-winning Alinghi team and wings for the zero-fuel Solar Impulse aircraft. Richard Mille works closely with NTPT, developing

Watchmaking looks for integrity, endurance, stability and strength

innovative composites that include quartz and other materials as well as carbon. And NTPT says it has found the exacting demands of watchmaking to be an excellent proving ground for its technologies. As well as insisting material be light and strong, watchmaking looks for integrity (you can't have flakes floating around within the case), endurance measured in decades, stability of colour and strength in the face of UV radiation, chemical attack and thermal shock (all of which a summer spent by the pool can deliver in spades). NTPT's ultimate validation, however, has come with its supply of key fuselage components for the Solar Impulse, including the wings' longitudinal beams, vertical and horizontal stabilisers, the engine gondolas and the pilot's cockpit.

The space programme has delivered any number of manufacturing techniques, but sometimes the link is a little more straightforward, as with Omega's Speedmaster X-33, apparently conceived in the mid-1990s by General Thomas Stafford, the former NASA Apollo X astronaut. Also an Omega board-member, he had the aim of updating the original chronograph, which even then was more than 30 years old. Launched at the Johnson Space Center in Houston, it was something of a surprise with its quartz-based multi-function analogue/digital design (derived from a mid-1980s Seamaster). It was developed in conjunction with serving ESA and NASA astronauts, cosmonauts and test pilots who helped to determine the set of countdown timers and the super-loud 80db alarm.



Above: Omega Speedmaster X-33

A new version, the Skywalker X-33, was launched in 2014 that was developed with ESA, who ran it through the same set of tests at the European Space Research and Technology Centre at Noordwijk in the Netherlands that satellites undergo before launch, including temperatures from -45 to +75 degrees C, being irradiated and being spun in a centrifuge. More robust than the original, it also had an improved suite of functions developed to include mission-specific purposes devised by ESA astronaut Jean-François Clervoy (there's a 10,000-word explanation of the value of "phase elapsed time" on the ESA's US patent application). Other improvements include a better LCD display (earlier versions could fade out when looked at through the polarised screen on a spacesuit

THE X-33



Top: ESA astronaut Jean-François Clervoy wears two watches on space shuttle *Discovery* in 1999. Clervoy contributed to the mission-specific functions of the Omega Skywalker X-33 (2014 model, above left). It was tested at the European Space Research and Technology Centre, Noordwijk (above right)

helmet). The X-33 and its successors—it is hard to imagine that Omega is not working on one already—will need to evolve with the technology they are used with. The new Boeing Starliner launch-and-entry suits will have touchscreen-sensitive gloves so you can assume some smart functionality, too.

The Space Race has plenty more to give—and it's only natural that the watch industry should take advantage. At heart, everything to do with watches derives from space: our idea of time, the way we measure it, the materials we use and the way we use them. But if you're looking for one watch that captures the history of space exploration as an intellectual journey, you might consider Van Cleef & Arpels' Midnight Planétarium. It uses rare elements and beguiling gemstones to recreate our small corner of the cosmos, and takes its pattern from an 18th-century planetarium in the Netherlands. ■

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