Links and Resources on Space

● **HERE The New Space Race Is Causing New Pollution Problems, *The New York Times, Jan 2024***
Earth's stratosphere has never seen the amounts of emissions and waste from rockets and satellites that a booming space economy will leave behind.

●BBC Inside Science – How Green is Space Science? – 26 Sept 2024

The images beamed back to Earth of the first civilian spacewalk have prompted a very pertinent question from one Inside Science listener: What effect is space travel having on our climate? We're used to delving into the carbon footprint of Earth-bound travel – so this week we're going to explore the impact of the rapidly growing space industry on our climate. How does a rocket launch compare to a flight taking off? Do we even know the true cost yet – and if it's significant, what might the solution be?
https://www.bbc.co.uk/sounds/play/m00237zq

● **Space is Full of Junk. Here's How to Clean It Up…, from Be Smart, PBS, 15 February 2024 (on CAHIER DE PREPA)**
https://www.youtube.com/watch?v=uJcXCdbm77g&ab_channel=BeSmart

● **How giant lasers could get rid of space trash – VOX – February 29 2024**
https://www.youtube.com/watch?v=VQKpMmBDtZo&ab_channel=Vox

● **What one Russian Satellite tells us – Space Race and nuclear Weapons**, ***The New York Times***, December 5, 2024
https://www.nytimes.com/interactive/2024/12/05/opinion/nuclear-weapons-space.html?unlocked_article_code=1.gU4.W2Zs.mzHn-POSf5q5&smid=url-share

● HERE is a lesson plan from The New York Times
Explore the Space Race With The New York Times's Archive

● **NOTE The digital version of the file, which is on Cahier de Prépa, is longer and contains illustrations**

Part one – The New Space Race

Document 1 - Who owns the Moon? A new space race means it could be up for grabs

BBC News, 9 June 2024
Rebecca Morelle, Science editor You can listen to Rebecca Morelle read her article HERE

We're in the midst of a Moon rush. A growing number of countries and companies have the lunar surface in their sights in a race for resources and space dominance. So are we ready for this new era of lunar exploration?

This week, images were beamed back to Earth of China's flag unfurled on the Moon. It's the country's fourth landing there - and the first ever mission to return samples from the Moon's far side. In the past 12 months, India and Japan have also set down spacecraft on the lunar surface. In February, US firm Intuitive Machines became the first private company to put a lander on the Moon, and there are plenty more set to follow.

Meanwhile, Nasa wants to send humans back to the Moon, with its Artemis astronauts aiming for a 2026 landing. China says it will send humans to the Moon by 2030. And instead of fleeting visits, the plan is to build permanent bases.

But in an age of renewed great-power politics, this new space race could lead to tensions on Earth being exported to the lunar surface.

"Our relationship with the Moon is going to fundamentally change very soon," warns Justin Holcomb, a geologist from the University of Kansas. The rapidity of space exploration is now "outpacing our laws", he says.

A UN agreement from 1967 says no nation can own the Moon. Instead, the fantastically named Outer Space Treaty says it belongs to everyone, and that any exploration has to be carried out for the benefit of all humankind and in the interests of all nations.

While it sounds very peaceful and collaborative - and it is - the driving force behind the Outer Space Treaty wasn't cooperation, but the politics of the Cold War.

As tensions grew between the US and Soviet Union after World War Two, the fear was that space could become a military battleground, so the key part of the treaty was that no nuclear weapons could be sent into space. More than 100 nations signed up.

But this new space age looks different to the one back then.

One major change is that modern-day Moon missions are not just the projects of nations - companies are competing, too.

In January, a US commercial mission called Peregrine announced it was taking human ashes, DNA samples and a sports drink, complete with branding, to the Moon. A fuel leak meant it never made it there, but it sparked debate about how delivering this eclectic inventory fitted in with the treaty's principle that exploration should benefit all humanity.

"We're starting to just send stuff up there just because we can. There's no sort of rhyme or reason anymore," says Michelle Hanlon, a space lawyer and founder of For All Moonkind, an organisation that seeks to protect the Apollo landing sites. "Our Moon is within reach and now we're starting to abuse it," she says.

But even if lunar private enterprise is on the increase, nation states still ultimately remain the key players in all this, Sa'id Mosteshar, director of the London Institute of Space Policy and Law, says any company needs to be authorised to go into space by a state, which will be limited by the international treaties. There's still a great deal of prestige to be had by joining the elite club of Moon landers. After their successful missions, India and Japan could very much claim to be global space players.

And a nation with a successful space industry can bring a big boost to the economy through jobs, innovation.

But the Moon race offers an even bigger prize: its resources.

While the lunar terrain looks rather barren, it contains minerals, including rare earths, metals like iron and titanium - and helium too, which is used in everything from superconductors to medical equipment.

Estimates for the value of all this vary wildly, from billions to quadrillions. So it's easy to see why some see the Moon as a place to make lots of money. However, it's also important to note that this would be a very long-term investment - and the tech needed to extract and return these lunar resources is a some way off.

In 1979, an international treaty declared that no state or organisation could claim to own the resources there. But it wasn't popular - only 17 countries are party to it, and this does not include any countries who've been to the Moon, including the US.

In fact, the US passed a law in 2015 allowing its citizens and industries to extract, use and sell any space material.

"This caused tremendous consternation amongst the international community," Michelle Hanlon told me. "But slowly, others followed suit with similar national laws." These included Luxembourg, the UAE, Japan and India.

The resource that could be most in demand is a surprising one: water.

"When the first Moon rocks brought back by the Apollo astronauts were analysed, they were thought to be completely dry," explains Sara Russell, professor of planetary sciences at the Natural History Museum. "But then a kind of revolution happened about 10 years ago, and we found out that they've got little traces of water in them trapped in phosphate crystals."

And at the Moon's poles, she says, there's even more - reserves of water ice are frozen inside permanently shadowed craters.

Future visitors could use the water for drinking, it could be used to generate oxygen and astronauts could even use it to make rocket fuel, by splitting it into hydrogen and oxygen, allowing them to travel from the Moon to Mars and beyond.

The US is now attempting to establish a new set of guiding principles around lunar exploration - and lunar exploitation. The so-called Artemis Accords state that extracting and using resources on the Moon should be done in a way complies with the Treaty for Outer Space, although it says some new rules might be needed.

More than 40 countries have so far signed up to these non-binding agreements, but China is notably absent from the list. And some argue that new rules for lunar exploration shouldn't be led by an individual nation.

"This really ought to be done through the United Nations because it affects all countries," Sa'id Mosteshar tells me.

But access to resources could also cause another clash. While there's plenty of room on the Moon, areas close to ice-filled craters are the prime lunar real estate. So what happens if everyone wants the same spot for their future base? And once a country has set one up, what's to stop another nation establishing their base a bit too close?

"I think there's an interesting analogy to the Antarctic," says Jill Stuart, a space policy and law researcher at the London School of Economics. "We'll probably see research bases being set up on the Moon like they are on the continent."

But specific decisions about a new lunar base, for example whether it covers a few square kilometres or a few hundred, may come down to whoever gets there first.

"There will definitely be a first-mover advantage," Jill Stuart says.

"So if you can get there first and set up camp, then you can work out the size of your zone of exclusion. It doesn't mean you own that land, but you can sit on that space."

Right now, the first settlers are most likely to be either the US or China, bringing a new layer of rivalry to an

already tense relationship. And they are likely to set the standard - the rules established by whoever gets there first may end up being the rules that stick over time.

If this all sounds a bit ad hoc, some of the space experts I've spoken to think we're unlikely to see another major international space treaty. The dos and don'ts of lunar exploration are more likely to be figured out with memorandums of understanding or new codes of conduct.

There's a lot at stake. The Moon is our constant companion, as we watch it wax and wane through its various phases as it glows bright in the sky.

But as this new space race gets under way, we need to start thinking about what sort of place we want it to be - and whether it risks becoming a setting where very Earthly rivalries are played out.

1390 words

Guest Essay

Document 2 - Don't Cede the Space Race to China and the Billionaires

The New York Times, Feb. 18, 2022 By Jeff Shesol

Credit...Golden Cosmos

Mr. Shesol, a historian, has written extensively about the space race. His most recent book is about John Glenn and NASA's Project Mercury.

Leer en español

The crowds that cheered the astronaut — about a quarter-million in Washington, four million in New York — adorned themselves in numerous ways. Some wore space helmets fashioned from cardboard and plastic. Others, less showily, wore buttons *proclaiming John Glenn* "the New Frontier man of the year," a nod to John F. Kennedy's famous phrase. Sixty years ago, Glenn became the first American to orbit Earth, opening up the frontier of human exploration in space — a frontier that stretched to the moon and beyond. The flight of Friendship 7 made it all seem possible.

Glenn's feat marked the start of a spectacular decade: spacewalks, trips around the moon, *six lunar landings*. Then the frontier receded. Since 1972, no human being has ventured outside Earth's orbit. A generation has reached middle age without any memory of Americans on the moon.

That could change soon. If *NASA's plan* holds, its Artemis program will land the first woman and the first person of color on the moon in 2025. And this, NASA says, is just the beginning. The agency envisions *at least 10* lunar landings. Its administrator, Bill Nelson, is waging a campaign to beat other nations in placing "*boots on the moon*" — not just boots but also, in time, a base. And "the sooner we get to the moon," *NASA has said*, "the sooner we get American astronauts to Mars."

But why bother? There is certainly much of interest on Mars — *NASA's newest rover, Perseverance*, and its companion, the tiny helicopter Ingenuity, have made that clearer than ever. What is less evident is the role, the value, of human explorers. To most Americans, machines seem sufficient to the task. A *Morning Consult poll* last year showed a general interest in space exploration but not in having humans do the exploring. (…)

Mr. Nelson has been making a persistent pitch for funding, but Congress appears unpersuaded. President Biden, for his part, has signaled support for Artemis but is more focused on the *nation's commercial and military capabilities in space*, as well as the vantage point that space provides to observe climate change. Vice President Kamala Harris, the chair of the National Space Council, rarely mentions human spaceflight, *stressing* instead "the responsibility to look to our home planet."

And reasonably so. Our planet has plenty to worry about, not least the damage we do to its atmosphere. But there is an argument to be made for the human exploration of space — a better argument, at least, than the White House and NASA have put forward. If the administration fails to sharpen and press its case, if it shies from insisting that humans, not just our inventions, should roam the heavens, the United States will likely cede the moon — and a good deal more than that — to more determined competitors.

Chief among them is China. Its goal is plain: to become a "great space power," *as President Xi Jinping has said*. China's Mars rover, arriving on the heels of our own, has been an impressive success; China also has a *probe on the far side of the moon* — a first for any nation. Its space station is nearly complete, while the International Space Station, after more than two decades orbiting Earth, approaches obsolescence and NASA turns to *private companies to build and run its successors*. Like the United States, China hopes to build a research station *on the lunar surface*. Unlike the United States, China gives no reason to doubt its resolve. It will also have a partner: *Russia*. The two countries have already begun to *align their efforts*.

Mr. Nelson cites an "aggressive" China as a reason for Americans to "get off our duff," but a few national security questions require a fuller airing. What if, for example, China stakes out strategic positions on the moon? What if it asserts control over the resources it and other nations are searching for there: silicon, titanium and, not least, the water that is needed to sustain a human settlement? As Namrata Goswami, an expert on China's space policy, *has argued*, "An advantage in accessing the vast wealth of the inner solar system could have an effect on the balance of power" on Earth.

If anyone is as bullish on the new frontier as China, it is the billionaires. Their ambitions, too, should spur NASA to stay in the game. Jeff Bezos and Elon Musk might or might not be visionaries, but they are easily the most powerful people on this planet to speak with a straight face about colonizing other ones. Mr. Musk *warns* of an "extinction event" that will require us to leave Earth behind. There is a certain egalitarianism in the idea of an escape hatch for humanity, though it is the egalitarianism of rats leaving a sinking (or overheating) ship. It would have to get pretty bad down here before ordinary people follow the billionaires into the black void of space rather than bid them adieu (…)

Of course, this takes nothing away from the achievements of Mr. Musk's aerospace company, SpaceX. Rarely in any industry has such boldness of imagination been matched by such brilliance in execution. The company is an indispensable partner to NASA; a SpaceX *landing system* will carry astronauts to and from the moon's surface.

But there is an essential difference between exploration and colonization, and both are a far cry from commercialization. Left to the billionaires, space is less likely to become a haven for humanity than a playground for its wealthiest members. In that event, there will be no more John Glenns — no more astronauts to look up to and emulate, astronauts whose humility and awe in the vastness of space define them as much as their bravery does. (…)

Science "is simply the exploration of the unknown," James Head, a planetary geologist at Brown who helped train the Apollo astronauts, told me, adding that "the moon is unknown. Mars is unknown." Perhaps this is what NASA should say, and without apology: We don't know what we'll find. We don't know what the moon and Mars can tell us about the origins of the universe and life on Earth and possibly beyond it. And that, above all, is the reason for going.

1033 words

Document 3 - Elon Musk's SpaceX has achieved something extraordinary

The Economist, Oct 13th 2024

THE LAUNCH was remarkable: a booster rocket with twice the power of the Apollo programme's Saturn V lancing into the early-morning sky on a tight, bright column of blue-tinged flame. But that wonder has been seen four times before. It was the landing of the booster stage of SpaceX's fifth Starship test flight which was truly extraordinary.

Just a kilometre or so above the surface of the Earth, having fallen back from the edge of space, and still travelling at roughly the speed of sound, the 71m-long steel cylinder, bigger than the fuselage of a Boeing 747, relit 13 of its 33 engines. Seconds later, having cut its speed to a couple of hundred kilometres per hour, it turned most of them off.

Those engines guided it to the 146-metre-tall gantry tower from which, just seven minutes earlier, it had taken off. (…)

The landing was a triumph for the engineers of SpaceX, a company founded and run by Elon Musk. It strongly suggests that the company's plans to use a huge reusable booster to launch a huge reusable spacecraft, the Starship proper, on a regular basis are achievable. That means that the amount of cargo that SpaceX can put into orbit for itself and its customers, including the American government, is set to grow spectacularly in the second half of this decade.

And the cost per tonne of putting that stuff up there should be reduced dramatically. According to an estimate by Citigroup, a bank, SpaceX's semi-reusable and frequently flown Falcon 9s have already brought down the price of launch by a factor of ten. A much bigger and fully reusable Starship should do at least as much again and possibly much more. It is potentially the biggest leap forward in spaceflight seen since the 1960s.

Further proof that such operations are a comparatively near-term possibility was provided when, an hour after the Super Heavy returned to the pad in Texas, the Starship itself splashed down softly into the Indian Ocean. (…)

The flight showed how far ahead of any competition SpaceX now is. (…) Blue Origin, owned by Jeff Bezos, the founder of Amazon intends to test such a rocket in the next few months and RocketLab, a smaller startup, plans to get one launched next year; various Chinese companies are working on the technology too.

There are more tests to come. (…) This flight's success strongly suggests that, though there are almost certainly some failures ahead, the company should have at least an initial operational capacity in as little as a couple of years' time.

Once that happens there will be plenty of work for it to do. NASA's Artemis programme of crewed human landings is completely dependent on Starships being able to reach orbit regularly—at least once a week, maybe more. The company's own plans to increase both the number and size of the satellites in its Starlink communications system—a number which already sits at over 6,000—also depend on Starship. And then there is Mr Musk's dream of settling Mars. He is talking of sending five uncrewed Starships there in 2026, and crewed ones fairly soon thereafter.

Mr Musk's ambitions for Mars are part of an ambition to safeguard civilisation which also entails, in his eyes, the re-election of Donald Trump (on which he is working hard), and, apparently, the use of X, a social network he owns, as a personal platform and a tool for the spread of misinformation. This is something about which many have strong concerns, and rightly. But with the Super Heavy cooling down in its elevated cradle, the getting to Mars bit, at least, looks more real than it has ever done before. 615 words

Document 4 - Europe must play to win—not just play nice—in a new space race, argues ESA's boss

Josef Aschbacher, the European Space Agency's director-general, says keeping up is not enough

The Economist, Oct 14th 2024

SEEING SPACEX's super-heavy-lift Starship soar into the skies on October 13th, and then its reusable booster fly back to the launch pad in a world first, filled me with awe. NASA, America's space agency, plans to use a human-rated version of the rapid-launch vehicle to return astronauts to the Moon in a couple of years. China—which has

made astonishing strides—aims to put people on the lunar surface by 2030. India hopes to do the same by 2040. A new space race is under way.

How does Europe define itself in that race? It has great ambitions, and much to offer. Space is not just about rockets and astronauts—although Europe has those, too. Europe has proven itself to be world-leading in programmes such as Copernicus, the world's largest Earth-observation programme, and Galileo, a satellite-navigation system more accurate than the much-heralded American GPS. Countries worldwide rely on these European systems, which have boosted industries from precision agriculture to parcel delivery. And Europe's world-class science missions seek answers to the secrets of the universe—the *Euclid* telescope casts light on dark energy and dark matter.

As the world becomes ever more complex geopolitically, space has become crucial to the strategic prosperity of nations. Our understanding of climate change, and how to mitigate it, is informed mostly from space. Advances in rocketry spur advances in missiles and other industries. Space is vital to daily life on Earth in other ways, too, from emergency services to banking.

Europe must not be drawn in by the false sense of security in isolationism. Instead it should reinforce its heritage as a sentinel of collaboration. When space is used to inform and implement climate, industrial, economic and security policy, co-operation becomes a powerful tool for Europe to address pressing global challenges.

Admittedly, Europe has lost ground in rockets. Ariane, a European family of launch vehicles, once dominated the commercial-launch market globally. Despite the recent success of Ariane 6, SpaceX, based in America, now has the lion's share of that market, offering more frequent launches than anyone else.

Europe is responding. As head of the European Space Agency (ESA), I have increased public and private funding for space programmes. ESA has also incentivised commercialisation by opening a series of competitions between space companies throughout Europe. (…)

But Europe cannot just play catch-up; it must leapfrog ahead. Innovative technologies that show promise on Earth—such as quantum communications for secure connectivity, or artificial intelligence and machine learning for pattern recognition—show equal promise in space. These technologies can keep governmental communications encrypted, for example, or alert authorities to dangerous weather conditions. ESA is helping companies based in Europe—and Canada, with which ESA has a co-operation agreement—to build novel spacecraft. We have just seen the launch of the second European AI-enabled Earth-observation satellite that processes data onboard to identify wildfires, for example, and alert firefighters more quickly.

Such innovations demand that people collaborate to generate new ideas and technologies. This is where Europe has a unique edge. ESA's 22 member states work together to enable individual countries to have international impact. ESA collaborates with America, Japan, China and India (and had a similar partnership with Russia until sanctions were imposed over the invasion of Ukraine). The agency is, for example, providing life support for astronauts in NASA's Orion spacecraft and will help power it to and from the Moon as part of the Artemis programme. And ESA has long collaborated with Japan to explore the solar system and to study climate change. The agency is also working with countries in the Middle East, East Asia, Latin America and Africa.

But while collaboration is vital for success, it is insufficient. Europe's space industry lags behind America's in both the level of government support and speed to market, mostly owing to Europe's risk aversion and its tedious bureaucracy.

I have started to cut red tape in ESA, for instance by slashing the time between companies bidding on a contract and the winners being selected. The next step is to speed up the commercialisation of space-enabled products and services across Europe. To do that, we must react more quickly to the needs of the many startups that ESA supports in Europe's largest network of space-startup incubators. (…)

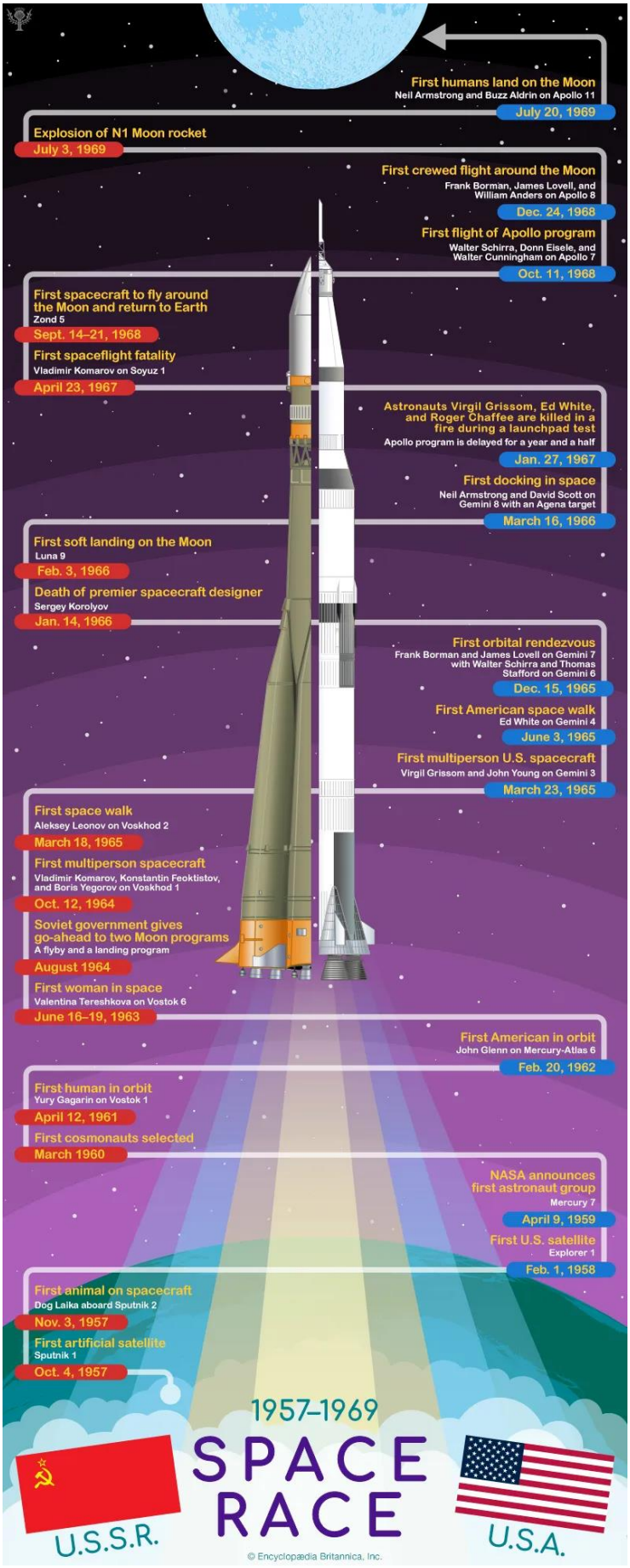
To prosper in the new space race, Europe needs not just talent and speed but also money. In America NASA, the US Space Force and other public institutions spent $73bn on space in 2023. In Europe the figure was less than $12bn. Europe needs to close the gap in funding, both public and private. (…)

A diverse, thriving space industry creates jobs and increases prosperity, as well as helping governments to formulate climate action and to respond to emergencies such as wildfires and flooding. Space missions inspire young people to study science and become tomorrow's technology leaders. To improve life on Earth, we must work together in space.■

816 words

Josef Aschbacher is the director-general of the European Space Agency.

DOCUMENT 5 : "1957 – 1969 Space Race" (*Encyclopaedia Britannica*) See digital File 5



This infographic presents a timeline of space-related achievements by the U.S.S.R. and the U.S. between 1957 and 1969. A description of the timeline is below.

On October 4, 1957, the U.S.S.R. launched Sputnik 1, the first artificial satellite.

On November 3, 1957, the U.S.S.R. placed the first animal in a spacecraft, the dog Laika aboard Sputnik 2.

On February 1, 1958, the first U.S. satellite, Explorer 1, was launched.

On April 9, 1959, NASA announced the first astronaut group, the Mercury 7.

In March 1960 the first cosmonauts were selected.

On April 12, 1961, the U.S.S.R. launched the first human into orbit, Yuri Gagarin, on Vostok 1.

On February 20, 1962, John Glenn, on Mercury-Atlas 6, became the first American in orbit.

Between June 16 and June 19, 1963, Valentina Tereshkova became the first woman in space.

In August 1964 the Soviet government gave the go-ahead to two Moon programs, a flyby and a landing program.

On October 12, 1964, the U.S.S.R. launched the first multi-person spacecraft, Voskhod 1, with cosmonauts Vladimir Komarov, Konstantin Feoktistov, and Boris Yegorov.

On March 18, 1965, the first space walk was performed, by Aleksei Leonov on Voskhod 2.

On March 23, 1965, the U.S. launched the first multi-person U.S. spacecraft, Gemini 3, with Virgil Grissom and John Young.

On June 3, 1965, the first American space walk was completed by Ed White on Gemini 4.

On December 15, 1965, the U.S. conducted the first orbital rendezvous: Frank Borman and James Lovell on Gemini 7 with Walter Schirra and Thomas Stafford on Gemini 6.

January 14, 1966, marked the death of premier Soviet spacecraft designer Sergei Korolev.

On March 16, 1966, the first docking in space took place. Neil Armstrong and David Scott on Gemini 8 docked with an Agena target.

On January 27, 1967, astronauts Virgil Grissom, Ed White, and Roger Chaffee were killed in a fire during a launchpad test. The Apollo program was delayed for a year and a half.

On April 23, 1967, cosmonaut Vladimir Komarov, on Soyuz 1, became the first spaceflight fatality.

Between September 14 and 21, 1968, the uncrewed Soviet probe Zond 5 became the first spacecraft to fly around the Moon and return to Earth.

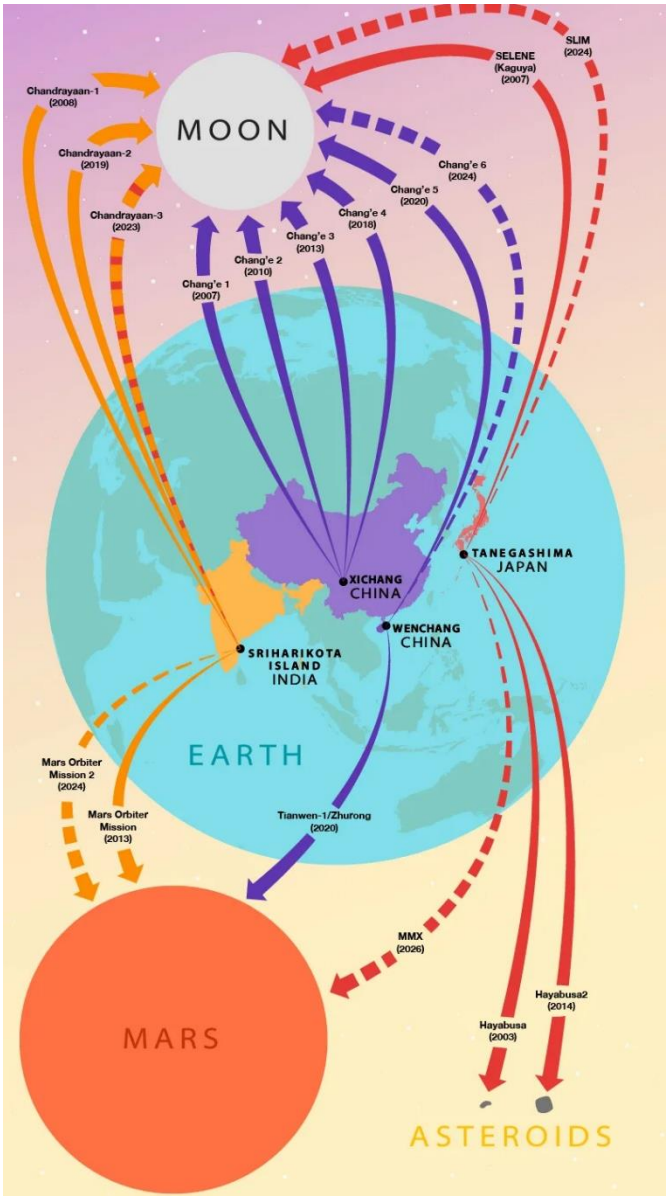
On October 11, 1968, the U.S. launched the first flight of the Apollo program: Walter Schirra, Donn Eisele, and Walter Cunningham on Apollo 7.

On December 24, 1968, the first crewed flight around the Moon took place, with Frank Borman, James Lovell, and William Anders on Apollo 8.

July 3, 1969, marked the explosion of the Soviet N1 Moon rocket.

On July 20, 1969, the first humans landed on the Moon: Neil Armstrong and Buzz Aldrin on Apollo 11.

DOCUMENT 6: "New Space Race" (*Encyclopaedia Britannica*) See long digital file 5



NEW SPACE RACE

Hayabusa	2003	returned asteroid sample to Earth in 2010
SELENE (Kaguya)	2007	orbited Moon for nearly 2 years
Chang'e 1	2007	was first Chinese Moon probe
Chandrayaan-1	2008	discovered water on Moon
Chang'e 2	2010	orbited Moon for 8 months, then flew by asteroid
Mars Orbiter Mission	2013	was India's first interplanetary mission
Chang'e 3	2013	placed lander on Moon with rover Yutu
Hayabusa2	2014	returned asteroid sample to Earth in 2020
Chang'e 4	2018	was first probe to land on far side of Moon
Chandrayaan-2	2019	orbited Moon and tried to set down lander with rover
Chang'e 5	2020	returned lunar sample to Earth
Tianwen-1/Zhurong	2020	was first Chinese mission to Mars
Chandrayaan-3	2023	placed lander with rover near Moon's south pole
SLIM (Smart Lander for Investigating Moon)	2024	landed near lunar lava tube entrance
Chang'e 6	2024	will return lunar sample to Earth
Mars Orbiter Mission 2	2024	will use orbiter to make detailed observations
MMX (Martian Moons Exploration)	2026	will return sample from Martian moon Phobos

Document 7 – VIDEO 6 How to clean up our space waste, *DW Planet A*, May 2023

https://www.youtube.com/watch?v=JM1jDq-8Cxk&ab_channel=DWPlanetA

DOCUMENT 8 : "The Rise of Private Companies in Space Exploration: Revolutionizing the Final Frontier"
(Sabiq Mirzai, *TechCrate*, July 12, 2023. Adapted.) SEE ONLINE digital File 5

The Growing Role of Private Companies in Space Exploration

Space exploration has long been the domain of government agencies like NASA, but in recent years, a new trend has emerged: private companies entering the space sector. While government agencies have made significant strides in space exploration, private companies are now making their mark, bringing innovation, efficiency, and commercial opportunities to the industry.

Technological Innovations Driving the Expansion of Private Space Companies

One of the driving forces behind the rise of private companies in the space sector is the rapid advancement of technology. Companies like SpaceX, Blue Origin, and Virgin Galactic are leveraging cutting-edge technologies to develop **reusable rockets**, **satellite deployment systems**, and **commercial spacecraft**. These technological breakthroughs have not only reduced the costs of space exploration but have also opened up new possibilities for private companies to venture into previously unexplored territories.

Financial Factors: Funding and Investment in Private Space Ventures

Another crucial factor enabling private companies to enter the space sector is the availability of funding and investment. Traditional government-funded space programs often face budget constraints, but private companies have attracted significant financial backing from both individual investors and major corporations. This influx of funding has allowed private space companies to pursue ambitious projects, develop advanced technologies, and compete with established government agencies.

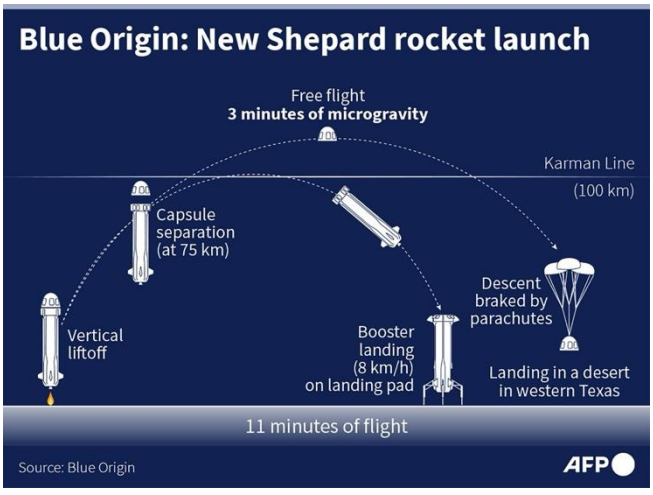
Private Space Agencies: Key Players and their Initiatives

SpaceX: Revolutionizing Space Transportation and Satellite Deployment

SpaceX, founded by Elon Musk, has quickly become a prominent name in the private space industry. With a focus on reusable rocket technology, SpaceX has revolutionized space transportation by successfully landing and reusing its Falcon 9 rockets. Additionally, the company's Starlink constellation aims to provide global broadband coverage through the deployment of thousands of satellites, further expanding communication capabilities worldwide.

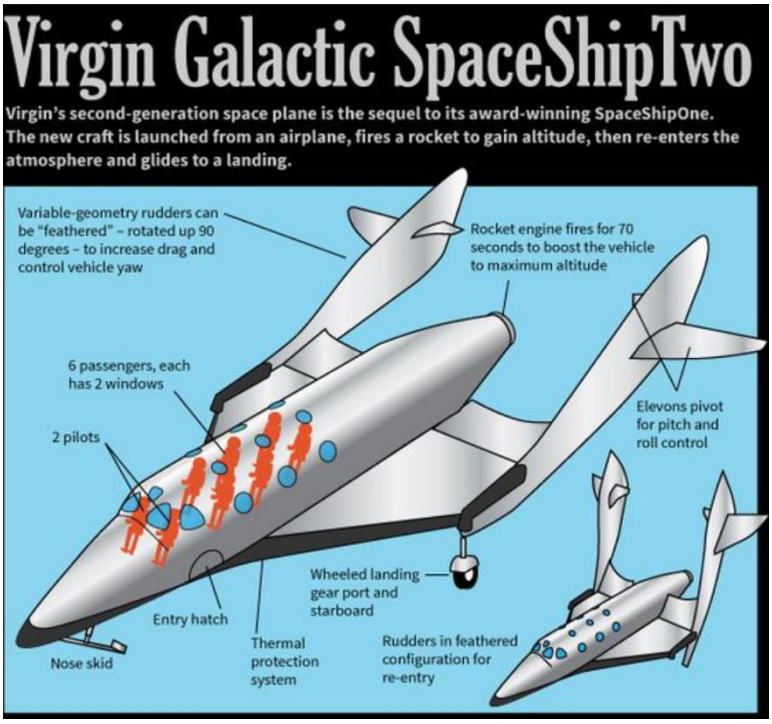
Blue Origin: Pioneering Reusable Rocket Technology and Lunar Missions

Led by Amazon's Jeff Bezos, Blue Origin is making significant strides in reusable rocket technology. The company's New Shepard rocket has successfully completed multiple vertical takeoff and landing missions, paving the way for reusable space travel. Blue Origin also has its sights set on the moon, with plans to develop a lunar lander and contribute to NASA's Artemis program, which aims to return humans to the lunar surface.



Virgin Galactic: Leading the Way in Commercial Space Travel and Suborbital Flights

Virgin Galactic, spearheaded by Richard Branson, is focused on commercial space travel and suborbital flights. With its SpaceShipTwo spacecraft, Virgin Galactic aims to offer tourists the opportunity to experience space firsthand. The company has already conducted successful crewed missions and is working towards expanding its commercial operations, with a vision of making space tourism accessible to a wider audience.



Competition and Collaboration: Private Companies and Government Space Agencies

There is both competition and collaboration between private companies and government agencies. Private companies bring flexibility, efficiency, and innovative approaches to space exploration, while government agencies provide expertise, infrastructure, and regulatory frameworks. Both parties aim to push the boundaries of space exploration, and their dynamic relationship proves crucial in advancing the industry.

Collaborations between private companies and government agencies have yielded impressive results.

- NASA's Commercial Crew Program, which partners with private companies like SpaceX and Boeing, has successfully developed crewed spacecraft to transport astronauts to and from the International Space Station.
- Similarly, NASA's Artemis program has collaborated with private companies like Blue Origin and SpaceX to develop lunar landers for future crewed missions to the moon.

Commercialization of Space: Opportunities and Challenges for Private Companies

The Growing Market for Satellite Services and Space-based Technologies

When you think about space, satellites may not be the first thing that comes to mind, but they play a significant role in our daily lives. Private companies are recognizing the growing demand for satellite services, from communication to imaging and navigation. The increasing dependence on space-based technologies by various industries opens up lucrative opportunities for private companies to provide these services.

Imagine being able to stream your favorite shows without interruptions, thanks to high-speed internet beamed down from space. Satellites also enable us to map and monitor our planet, helping in disaster management and urban planning. Private companies are capitalizing on these needs and offering innovative solutions to governments, businesses, and individuals.

Space Tourism: The Emergence of the Private Space Travel Industry

Private companies are revolutionizing the way we perceive space travel by making it accessible to privately-funded individuals. Imagine being able to take a vacation in orbit or experience the breathtaking views of Earth from a spaceship.

Private companies like **Orbital Assembly** are envisioning a future where space hotels and orbital resorts become the ultimate vacation destinations. Imagine floating in zero gravity while enjoying luxurious amenities and breathtaking views of the cosmos. These companies are investing in research and development to create habitats in space that provide comfort, safety, and entertainment.

While still in the early stages, the concept of space hotels holds immense potential for the future. It could be a stepping stone towards establishing a permanent human presence in space and paving the way for long-duration space travel.

Future Prospects: Private Companies Shaping the Future of Space Exploration

Humanity has always dreamt of reaching Mars, and private companies are now actively involved in making this dream a reality. With NASA's ambitious plans for exploring the red planet, private companies are joining forces to provide the necessary technologies and expertise. From designing efficient rockets to developing life support systems and habitats, they are playing a vital role in advancing human space exploration.

Private companies are also exploring the idea of utilizing resources found on other celestial bodies. The concept of interplanetary mining involves extracting valuable minerals and resources from asteroids, the Moon, or even other planets. This opens up incredible economic prospects and reduces the burden on Earth's finite resources.

DOCUMENT 9 : "Should we be travelling to space?" (*BBC*, 18 October 2021. Excerpt.)

What's the argument against space travel?

There has been lots of criticism of space tourism recently, where people pay money for a short ride to the edge of space. They argue that it is extremely wasteful, does not improve our understanding of space and damages the environment, with rockets burning huge amounts of fuel.

Currently, travel and tourism are some of the biggest polluting industries on the planet.

A return flight from London to San Francisco emits about 5.5 tonnes of carbon dioxide per passenger - that's twice as much as a family's petrol car would produce in a year.

By comparison, a space flight can produce up to 100 times that amount of carbon dioxide per passenger.

According to NASA, there were only 114 orbital launches in 2020, this number is set to get much, much bigger with increased space tourism.

As many as 600 people have already paid $250,000 (roughly £183,600) each for tickets on future Virgin Galactic space flights, with thousands more waiting for the opportunity. Richard Branson has previously said his ambition is to have 400 space flights a year, which could contribute a significant amount of pollution to the Earth's atmosphere.

DOCUMENT 10 : "Dead satellites are filling space with trash. That could affect Earth's magnetic field"

Our ozone is pennies thick – and soon we'll put at least an Eiffel Tower's worth of metallic ash into the ionosphere every year.

***The Guardian*, 16 April 2024. Adapted**

A dead spacecraft the size of a truck ignites with plasma and pulverizes into dust and litter as it rips through the ionosphere and atmosphere. This is what happens to internet service satellites during re-entry. When the full mega-constellation of satellites is deployed in the 2030s, companies will do this every hour because satellite internet requires thousands of satellites to constantly be replaced. And it could compromise our atmosphere or even our magnetosphere.

Space entrepreneurs are betting on disposable satellites as key to a new means of wealth. There are currently nearly 10,000 active satellites and companies are working as fast as possible to get tens of thousands more into orbit – for a projected 1m in the next three to four decades.

"We could get to 100,000 satellites in 10 to 15 years," Dr Jonathan McDowell, of the Harvard-Smithsonian Center for Astrophysics, told me. Those satellites power hyper-connected internet services and may turn some billionaires into trillionaires – at the cost of shrouding the planet with toxic trash.

The problem is that space, contrary to popular belief, isn't really a giant, self-cleaning void. Space holds systems like the magnetosphere that keep us alive and supplied with oxygen by protecting our atmosphere. The space around our planet is a plasma cocoon that is cradling life.

It is easy to assume that the magnetosphere is too vast and robust for humanity to ever have any impact on it, but I don't think that's true. I'm a plasma physicist at the intersection of aerospace and physics and the author of recent research in peer-review that found that the space trash generated by dead and dying commercial satellites could compromise our ionosphere or magnetosphere, also known as our planet's plasma environment.

Upon investigating just how much dust in the form of satellite and rocket debris the space industry has dumped into the ionosphere during re-entry, I was alarmed to find that it is currently multiple Eiffel Tower's worth of

metallic ash. I wouldn't have even been able to calculate that at all without a scientist's personally run website. Our ozone is mere pennies thick, and soon we will be putting at least an Eiffel Tower's worth of metallic ash a year directly into the ionosphere. And all of that will stay there, indefinitely.

How could we possibly think that burning trash in our atmosphere 24/7 is going to be fine? Although some study is being devoted to stratospheric loading – the phenomenon of satellite and rocket chemicals saturating the atmosphere with ozone-depleting alumina – humanity might also be forcing "magnetospheric loading" on our planet, as well. No one else is currently studying the pollution of the magnetosphere except for myself.

We don't even have a clear estimate of the mass of all regions in the magnetosphere, yet we are going to load it with the wreckage of countless giant spacecraft. These SUV-size satellites will soon be burning in the atmosphere on an hourly basis. Unlike meteorites, which are small and only contain trace amounts of aluminum, these wrecked spacecraft are huge and consist entirely of aluminum and other exotic, highly conductive materials. And highly conductive materials can create charging effects and act as a magnetic shield.

Our magnetosphere keeps us alive. It should be protected as an Earth environment. Instead, we're filling it with electronic waste so that billionaires can trade electromagnetic signals for dollars they really don't need.

Space companies need to stop launching satellites if they can't provide studies that show that their pollution will not harm the stratosphere and magnetosphere. Until this pollution is studied further, we should all reconsider satellite internet. 598 words

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DOCUMENT 11: "Why Should We Explore Space? What Are the Benefits for Us?"
(American Public University, by Dr. Gary L. Deel; 03/15/2024. Adapted.)

See Online version of File 5

Space exploration is a necessity with wide-ranging implications.

Space Exploration Advances Scientific Understanding

At the core of our pursuit for space exploration lies humanity's thirst for knowledge. The universe – with its galaxies, stars, and planets – awaits our full understanding.

By venturing into space, scientists can utilize a multitude of instruments – such as probes, satellites, and state-of-the-art telescopes. They can gather data about celestial bodies and investigate the universe in its natural state.

Exploring our solar system and beyond it not only deepens our comprehension of the cosmos, but also contributes significantly to advancements in astrophysics and cosmology.

Space exploration plays a huge role in expanding our understanding of the universe – from studying planets to learning the mysteries of black holes, dark matter, dark energy, and other groundbreaking subjects.

Space Exploration Is an Opportunity to Search for Other Habitats and Alien Life

The search for other potential habitats and intelligent life is an integral part of space exploration. Scientists examine the atmospheres of **exoplanets** (= a planet orbiting a star that is not our sun) and identify potentially habitable celestial bodies to determine if conditions exist that could support life beyond our planet.

Space exploration is also a chance to answer the question of whether we are alone in the vastness of the universe or if distant civilizations actually exist. It offers greater insights into the origins and existence of life itself.

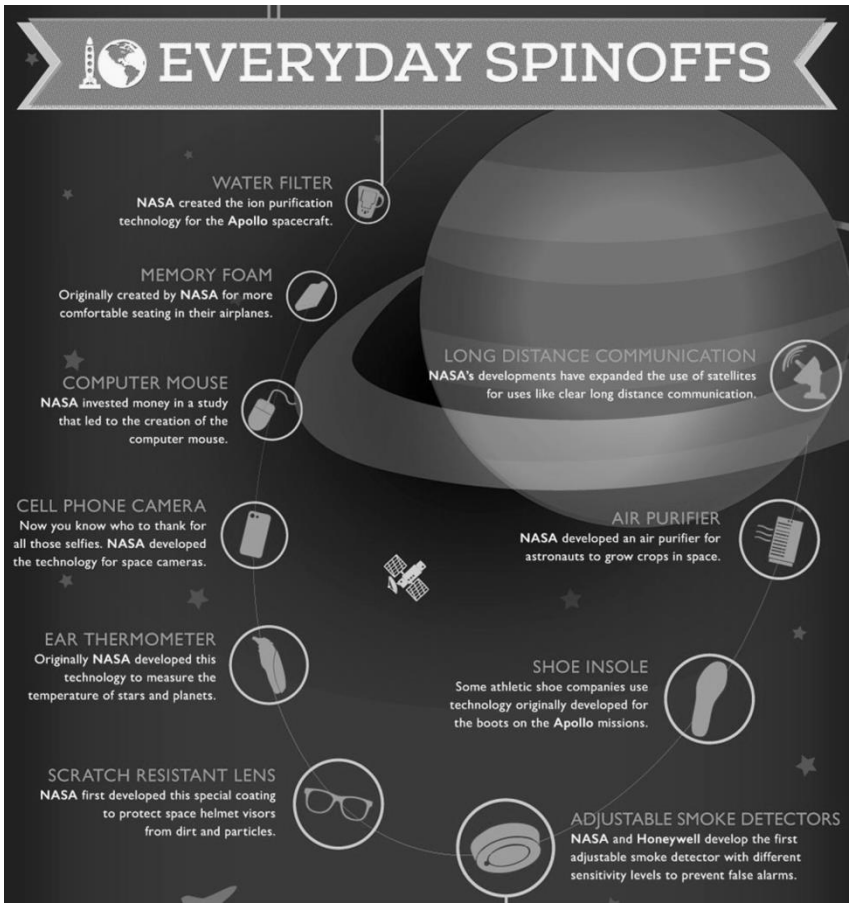
Space Exploration Is a Catalyst for Developing Technology and Economic Prosperity

The challenges of space exploration act as a catalyst for innovation and drive advancements in fields like astrobiology and astrochemistry, which leads to cutting-edge developments with far-ranging implications here on Earth. Many scientific breakthroughs have applications across different industries, benefiting society as a whole. The wonders of space exploration and human spaceflight push many young people to study **science, technology, engineering, and mathematics (STEM)** subjects.

GPS Technology and Other Valuable Space Exploration **Spin-Offs**

Throughout history, numerous technological products used for space exploration, such as cell phone cameras, solar panels, and emergency beacons that use satellite technology, have seamlessly transitioned into everyday technologies commonly used by most of the world's population. A prime example is the Global Positioning System (GPS), which relies on satellite navigation to provide location information.

Originally created for space missions, GPS has now become an important part of our lives. It influences a wide range of industries – including transportation and agriculture – while also offering precise location-based services around the world.



The Economic Promise of Space Exploration

But the economic advantages of space exploration go beyond mere technological advancements. The growth of the space travel industry – involving both government space agencies and private companies – contributes to job creation and economic progress.

Collaborative efforts between private entities in space exploration drive competition and innovation in this sector. As a result, there are technological advancements that benefit not only space missions but also various industries here on Earth.

Space Exploration Serves Human Survival Interests

Despite Earth's nature, it is not impervious to celestial threats that have the potential for catastrophic consequences on human life as we know it. One crucial aspect of space exploration is the identification and monitoring of **near-Earth objects** (NEOs) such as asteroids and comets that could pose a risk to our planet.

Developing the capability to detect, track, and potentially mitigate the impact of NEOs plays a critical role in defense strategies. Space exploration provides us with the tools, space resources, and knowledge to protect our planet from the dangers that exist in the vastness of space.

The Potential for Colonization

Exploration efforts also give humanity an opportunity to establish a presence beyond our own planet. As our population continues to grow and Earth's resources become more and more strained, the idea of colonizing space must evolve from being merely a dream to a potential solution for ensuring the long-term survival of our species. Perhaps one day, we might see a space settlement on Mars or other environment that could be made hospitable to human life.

By learning how to live in space environments such as the International Space Station (ISS) and other spacecraft, we can gain important insights into the challenges of sustainable space life, such as managing resources, discovering how the human body can remain healthy in space environments, creating life support systems, and being responsible stewards of our environment. Hopefully, these lessons for space explorers can also be applied back on Earth to avoid further catastrophes by interactions with other countries.

Space Exploration Fosters International Cooperation and Trust

Because space exploration is collaborative, it can foster cooperation and diplomacy between different countries. Geopolitical tensions often dominate the relations between different countries, but space missions requiring the joint efforts of two or more countries can bring them together as they pursue common goals.

The International Space Station, for example, involves collaboration with space agencies from the United States, Russia, Europe, Japan, and Canada. All of these agencies must work together in an international partnership to maintain a continuous human presence in space.

Participating in projects for exploring space goes beyond mere scientific cooperation, however. It also helps build trust among nations, facilitates the exchange of expertise, and promotes peaceful collaboration that will ultimately benefit the next generation of humanity.

The collective experience of venturing into the vastness of space brings people together, and it gives them a purpose, regardless of their political or cultural differences.

The Exploration of Outer Space Inspires Us to Improve Ourselves

The exploration of space showcases humanity's curiosity and our determination to conduct research and overcome challenges. New technologies in the space race – such as the Apollo moon landings, the James Webb Space Telescope, robotic spacecraft, the space shuttle program, and the construction of the International Space Station – not only demonstrated the capabilities of human innovation, but they also left an everlasting impact on all of us.

For everyone, the iconic images of Earth as seen from space with the aid of advanced technology instilled a sense of interconnectedness and environmental awareness. Through satellite imagery, we developed a greater appreciation of Earth's beauty. The impact of observing Earth from space is often profound. Called the "**overview effect**", astronauts report being deeply moved by the experience, as the planet's fragility and beauty became clear.

Canada, Colombia and several European nations are among the countries developing their own biodiversity observation networks – known as **BONs** – which researchers say should be combined into a global observation system. A BON system brings together raw data on seas, soils, forests and species to give an overview of a nation's biodiversity health – which could then be combined at a planetary level.

Part two – AI

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Document 12 - Audio - Researchers who helped lay the groundwork for AI win Nobel Prize in Physics

NPR, October 8, 2024

Document 13 –

'An AI Fukushima is inevitable': scientists discuss technology's immense potential and dangers

Ian Sample *Science editor, **The Guardian***, Fri 22 Nov 2024

When better to hold a conference on artificial intelligence and the countless ways it is advancing science than in those brief days between the first Nobel prizes being awarded in the field and the winners heading to Stockholm for the lavish white tie ceremony?

It was fortuitous timing for Google DeepMind and the Royal Society who this week convened the AI for Science Forum in London. Last month, Google DeepMind bagged the Nobel prize in chemistry a day after AI took the physics prize. The mood was celebratory.

Scientists have worked with AI for years, but the latest generation of algorithms have brought us to brink of transformation, Demis Hassabis, the chief executive officer of Google DeepMind, told the meeting. "If we get it right, it should be an incredible new era of discovery and a new golden age, maybe even a kind of new renaissance," he said.

Plenty could dash the dream. AI is "not a magic bullet," Hassabis said. To make a breakthrough, researchers must identify the right problems, collect the right data, build the right algorithms and apply them the right way.

Then there are the pitfalls. What if AI provokes a backlash, worsens inequality, creates a financial crisis, triggers a catastrophic data breach, pushes ecosystems to the brink through its extraordinary energy demands? What if it gets into the wrong hands and unleashes AI-designed bioweapons?

Siddhartha Mukherjee, a cancer researcher at Columbia University in New York and author of the Pulitzer prize-winning *The Emperor of All Maladies*, suspects these will be hard to navigate. "I think it's almost inevitable that, at least in my lifetime, there will be some version of an AI Fukushima," he said, referring to the nuclear accident caused by the 2011 Japanese tsunami.

Many AI researchers are optimistic. In Nairobi, nurses are trialling AI-assisted ultrasound scans for pregnant women, bypassing the need for years of training. Materiom, a London company, uses AI to formulate 100% bio-based materials, sidestepping petrochemicals. AI has transformed medical imaging, climate models and weather forecasts and is learning how to contain plasmas for nuclear fusion. A virtual cell is on the horizon, a unit of life in silicon.

Hassabis and his colleague John Jumper won their Nobel for AlphaFold, a programme that predicts protein structures and interactions. It is used across biomedical science, in particular for drug design. Now, researchers at Isomorphic, a Google

DeepMind spinout, are beefing up the algorithm and combining it with others to accelerate drug development. “We hope that one day, in the near future actually, we will reduce the time from years, maybe even decades to design a drug, down to months, or perhaps even weeks, and that would revolutionise the drug discovery process,” Hassabis said.

The Swiss pharmaceutical company Novartis has gone further. Beyond designing new drugs, AI speeds recruitment to clinical trials, reducing a potentially years-long process to months. (…)

A huge challenge for researchers is the black box problem: many AIs can reach decisions but not explain them, making the systems hard to trust. (…)

The climate crisis could prove AI’s greatest challenge. While Google publicises AI-driven advances in flooding, wildfire and heatwave forecasts, like many big tech companies, it uses more energy than many countries. Today’s large models are a major culprit. It can take 10 gigawatt-hours of power to train a single large language model like OpenAI’s ChatGPT, enough to supply 1,000 US homes for a year.

“My view is that the benefits of those systems will far outweigh the energy usage,” Hassabis told the meeting.

Not everyone was convinced. Asmeret Asefaw Berhe, a former director of the US Department of Energy’s Office of Science, said advances in AI could drive suffering, adding that nothing raised the concern more than energy demand. She called for ambitious sustainability goals. ■ 630 words

Document 13 - A.I. Program Aims to Break Barriers for Female Students

By Natasha Singer, technology and education reporter **-** ***The New York Times***, May 15, 2024

Over the last 10 months, Chelsea Prudencio, a junior at Baruch College in Manhattan, got a crash course in artificial intelligence through a new program for lower-income, Latina and Black young women majoring in computing.

As part of the program, called Break Through Tech A.I., Ms. Prudencio completed an intensive class developed by Cornell Tech faculty with input from a few tech executives. She threw herself into a student A.I. project for Pfizer to create heart disease prediction models. And she was mentored by a cybersecurity executive at Citigroup on how to ace technical job interviews.

These are the kinds of important learning and career opportunities that can help computing majors land jobs in fast-moving fields like A.I. and data science. But students like Ms. Prudencio, who attend public colleges not known for top computing programs, often face challenges gaining access to them.

“I was never made aware of health tech before my project with Pfizer,” said Ms. Prudencio, 20, who works part time at a tennis center. Now she hopes to pursue a career in health A.I. “This is a lot more fulfilling, I personally think, because you’re building models that could potentially save lives.”

Break Through Tech is at the forefront of university-led efforts to reduce obstacles to tech careers for underrepresented college students, including lower-income, Latina and Black young women. The new A.I. program, the largest of its kind in the United States, takes a novel approach in a tech industry whose recruiting criteria — technical interviews, hackathon wins, internal employee referrals, previous internships — often advantage wealthier students at top universities. It aims to help lower-income students, many of whom have part-time jobs on top of their schoolwork, learn A.I. skills, develop industry connections and participate in research projects they can discuss with job recruiters.

Hosted and supported by M.I.T., the University of California, Los Angeles, and Cornell Tech, the A.I. program is free. And it is intended primarily for students attending public institutions — like campuses of California State University, City University of New York and the University of Massachusetts systems — or minority-serving institutions like historically Black colleges.

Participants take an online summer course in the basics of machine learning — that is, A.I. systems that teach themselves to detect patterns in data sets. The students, who receive stipends of $2,000, are also assigned career mentors from institutions like Columbia University and Accenture. They work on student A.I. challenges set up by employers like Google, JPMorgan Chase and Memorial Sloan Kettering Cancer Center. (…)

Break Through Tech’s approach seems to be working, at least in one important measure: paid tech internships, a crucial career step that can lead to full-time job offers.

Last year, for instance, only 36 percent of graduating college seniors nationwide reported having had a paid internship, according to data from the National Association of Colleges and Employers, an organization for recruiters and college career advisers. By contrast, of the nearly 150 students who completed the A.I. program over the last two

years, Break Through Tech said it had placed 82 percent in paid internships at employers including Accenture, Amazon, Fidelity, Google, Mass General Hospital and Microsoft. (…)

"These students are not in schools with well-known names or from families that can open doors," said Judith Spitz, the executive director of Break Through Tech. "We are just giving students the opportunity to show what they are capable of."

Computer science remains a heavily male-dominated field. In 2022, men accounted for nearly 78 percent of the bachelor's degrees awarded in computer science, while Latina and Black women combined earned just 2 percent of the bachelor's degrees, according to an annual report by the Computing Research Association on universities with Ph.D. programs in the field. Likewise, at some large tech firms, only a tiny percentage of computer programmers and software engineers are Latina or Black women. 638 words

Part three- Genetics

Document 14 - Science has made a new genetic revolution possible

Now let it flourish

Leader, ***The Economist,*** Aug 25th 2022

Thanks to great strides in fundamental research, biology is becoming ever more programmable. Two recent scientific advances show just how powerful the possibilities could be. The genetic modification of plants is allowing the mechanism of photosynthesis to be tinkered with, as research published in *Science* on August 18th sets out. This could lead to dramatic improvements in the productivity of plants, and eventually to a second green revolution. Tweaking the genes of people who suffer from fatal incurable diseases, meanwhile, has also had remarkable results. A series of genetic therapies has arrived, or is arriving, in clinics to treat blood cancers, spinal muscular atrophy, haemophilia and sickle-cell disease. The task now is to spread these gains far and wide.

The consequences of both advances could be momentous. The genetic modification of crops promises cheaper, more nutritious and more climate-resilient food for a hungry planet. Genetic therapies offer the hope of curing devastating diseases. They also allow for one-time treatments that can be transported to the four corners of the Earth, bringing years, decades or a lifetime of benefits to the seriously and incurably ill. Imagine a cure for aids or sickle-cell disease that could be taken to the continent of Africa or across the Middle East. The accompanying benefits would be similar to the eradication of smallpox.

This tantalising promise has been made possible by a prodigious investment in fundamental research over the years. Basic knowledge of genetics and the functions and structures of proteins has proved to be a motor for discovery across medicine and agriculture. The private sector, to be sure, plays an essential role in the cycle of innovation. But these advances are a reminder that investment by governments and charities is crucial in areas that offer little commercial benefit in the short term, but which in the long term promise to greatly advance well-being. Much of the

success in treating rare diseases is a consequence of the efforts of charities, often thanks to fundraising by patients and their families. Research that benefits low-income countries frequently relies on philanthropic donors with deep pockets, such as the Gates Foundation. The investments made in fundamental science today yield the productivity gains of tomorrow.

Unfortunately, there is no guarantee that these gains will be realised. Gene therapies are a remarkable technical accomplishment. But their current enormous cost—often well over $1m to treat a single person—makes them hard for health-care systems to afford, even when they are reserved for fatal rare genetic diseases. The idea of using them to treat more prevalent conditions looks prohibitively pricey.

In the past, novel medicines that started out extremely costly have become cheaper. Monoclonal antibodies, useful laboratory-made proteins, were expensive when they first arrived, before a decade of advances brought them down in price 50-fold, according to Boston Consulting Group. If gene therapy is to live up to its promise, it will need to do even better than this. More efficient photosynthesis, too, will need further investment if it is to be commercialised.

The long-term manufacturing costs of a new green revolution will, thankfully, be low; plants make more plants in a way that treatments never can. Gene therapies, however, need innovation to reduce the cost of making them, whether this is in bioreactors or some completely novel way. If they are to become more affordable, new therapies also need to experiment with payment mechanisms, such as charging in instalments or by results. Pooling demand internationally to purchase therapies could help lower prices, too. Here governments, charities and the private sector could usefully work together.

Last, regulators also need to be quicker and more understanding of the gains to society from helping these technologies reach their potential. Innovations can languish without appropriate or timely rule-making. The regulation of genetically modified crops has been held back by misinformation campaigns, delaying benefits and raising costs. Likewise, although experimental drugs obviously need scrutiny, regulators should remember that the alternative in otherwise untreatable genetic diseases is often death. Science has made a genetic revolution possible. Now that revolution must flourish. ■

Document 15 - Audio – Customised CRISPR Treatment could help with genetic disorders

https://www.npr.org/2024/12/03/nx-s1-5090880/customized-crispr-treatments-could-help-people-with-rare-genetic-disorders

Document 16 - Ces Américains en croisade pour faire le plus d'enfants possible, et sauver l'humanité

Par Raphaëlle Besse Desmoulières, ***Le Monde,*** 29 octobre 2023

Reportage- Persuadés que notre espèce est en train de disparaître, Malcom et Simone Collins, un couple en attente de son quatrième enfant, appellent depuis leur demeure cossue de Pennsylvanie à faire le plus d'enfants possible. Dans le sillage d'Elon Musk, ces pronatalistes admirateurs de Donald Trump prônent aussi une sélection génétique des embryons.

C'est une entrée en matière peu commune. *« J'espère que votre article sur nous sera bien salé »*, lâche très sérieusement Malcolm Collins, à peine installé sur son canapé de velours bleu roi. Son épouse, Simone, opine du chef : *« Les choses tièdes n'intéressent pas. »* Avec leurs lunettes noires épaisses – carrées pour lui, rondes pour elle – et leur look de geeks branchés, les Collins ne ressemblent pas à de dangereux agitateurs. Mais les deux trentenaires – il a 36 ans, elle, 35 – sont en croisade pour faire vivre le mouvement pronataliste, dont ils se veulent la face respectable. Depuis des mois, ils alertent sur la catastrophe qui s'annonce, selon eux, à savoir *« l'effondrement démographique »* de la civilisation. Leur credo : encourager les gens à faire le plus d'enfants possible.

Les époux reçoivent dans leur maison en pierre de style colonial, à une heure de route de Philadelphie, en Pennsylvanie. Le soleil automnal pénètre par les larges vitres de leur véranda. Leurs trois petits sont encore à la crèche. Tricycle et camions de pompiers patientent devant les étagères de jouets. Après plusieurs articles dans la presse américaine et internationale, la communication des Collins se veut au cordeau.

On a affaire à des têtes bien faites – il est diplômé de Stanford (Californie), elle de Cambridge (Grande-Bretagne). Selon eux, un *« effondrement démographique »* est donc à venir et ses conséquences économiques et sociales seraient catastrophiques. *« Notre espèce est en train de mourir »*, écrivaient-ils en janvier dans une tribune envoyée au *New York Post*. Avec son débit de mitraillette, Malcolm Collins, polo noir sur jeans brut, pourrait en parler des heures. *« Collectivement, l'Amérique latine est déjà passée sous le seuil de remplacement des générations, l'Inde vient de franchir cette barre, la Chine est bien au-dessous… »*,

expose-t-il. Soit 2,1 enfants par femme, le seuil fatidique au-dessous duquel une génération ne peut se renouveler.

En vogue dans les milieux de la tech

Les Collins n'ont pas inventé le terme « pronataliste », utilisé depuis longtemps pour décrire des politiques gouvernementales mises en place pour favoriser la natalité. Celui-ci renvoie aussi à des groupes disparates, religieux ou non, extrémistes, qui ont en commun leurs positions en faveur d'une forte natalité et que l'on trouve aux Etats-Unis parmi les anti-avortements, les nationalistes chrétiens, les juifs ultra-orthodoxes ou les suprémacistes blancs.

La version des Collins, en vogue dans les milieux de la tech, se veut au contraire ouverte, moderne et scientifique. Pour faire entendre ses différences, le duo cultive l'art de la polémique. C'est en Corée du Sud, quand il travaillait il y a une dizaine d'années pour une société de capital-risque, que Malcolm Collins dit avoir pris la mesure du phénomène : *« La Corée du Sud a un taux de fécondité de 0,79-0,8. Cela signifie que, pour cent Sud-Coréens en vie aujourd'hui, il y aura 6,4 arrière-petits-enfants. Aucune économie ni culture ne peuvent survivre avec un tel déclin démographique. »* Et de faire remarquer que les Etats-Unis sont aujourd'hui dans la situation démographique *« dans laquelle se trouvait la Corée dans les années 1990 »*.

S'il est admis que la croissance humaine ne sera pas éternelle, les débats se centrent sur l'estimation de la date et de la hauteur du pic de cette vague. Selon les dernières projections de l'Organisation des Nations unies, la population mondiale devrait atteindre un pic dans les années 2080, avec environ 10,4 milliards d'habitants et se maintenir à ce niveau jusqu'en 2100.

Quant au taux de fécondité, il devrait passer de 2,3 enfants par femme en moyenne dans le monde aujourd'hui à 2,1 en 2050. Et continuerait de baisser jusqu'en 2100 pour se stabiliser à 1,8. Une étude de HSBC, elle-même controversée, estimait en 2022 qu'au rythme actuel de baisse du taux de fécondité le pic pourrait être atteint dès 2043 et la population mondiale diminuer de moitié en 2100, à 4 milliards d'habitants.

« Nous sommes sur le Titanic »

De là à parler d'*« effondrement démographique »*, il y a un pas que Leslie Root, démographe à l'université du Colorado, refuse de franchir. *« Les Collins projettent les comportements actuels en matière de fécondité dans un avenir lointain et disent que, si les choses continuent exactement comme elles le font actuellement, la population finira par s'effondrer,* note-t-elle. *Mais il n'y a aucune raison de croire que cela se produira. Prenez leur calcul sur la Corée du Sud. Il repose sur des hypothèses infondées et suppose que le taux de fécondité actuel de 0,8 reflète réellement le nombre d'enfants que chaque femme aura au cours de sa vie, ce qui n'est probablement pas le cas – pas plus que le postulat d'une fécondité identique sur plus d'une centaine d'années. »*

Les Collins, eux, sont persuadés de l'effondrement à venir. *« Nous sommes sur le Titanic, nous voyons arriver l'iceberg, mais il est déjà trop tard pour l'éviter,* déclare Malcolm. *Notre but est d'essayer de faire monter le plus grand nombre de personnes, et le plus diverses possibles, sur les canots de sauvetage. »* Ce n'est pas gagné, ils en conviennent, surtout à une époque où nombre de jeunes, angoissés par le dérèglement climatique, se demandent s'il est encore bien raisonnable de fonder une famille. Et pas question pour eux de laisser cette affaire entre les mains de gouvernements dont ils se méfient.

La solution ne viendra pas non plus de l'immigration, jugent-ils. *« L'Amérique latine est déjà aux prises avec sa propre crise démographique, tout comme l'Asie et l'Europe, ce qui nous laisse l'Afrique, où les taux de natalité sont également en baisse »*, relevaient-ils dans leur tribune au *New York Post.*

Eux-mêmes ont choisi de se dévouer pour la cause. Peu importe de passer pour des extraterrestres, ils savent qu'ils sont considérés comme des individus *« bizarres »*.

Un puissant porte-voix

Dans leur offensive, les deux époux disposent d'un puissant porte-voix : le milliardaire Elon Musk. Même s'il ne revendique pas l'étiquette pronataliste, le patron de Tesla emploie le même vocabulaire pour mettre en garde contre la baisse de la natalité – *« un danger bien plus grand »* que le réchauffement climatique, selon lui. Si la tendance se poursuit, écrivait-il en mai sur sa plate-forme X (anciennement Twitter), *« la civilisation mourra en gémissant dans des couches pour adultes »*.

Il a aussi renvoyé ses « amis » qui n'ont pas d'enfants au film dystopique *Idiocracy,* une comédie de 2006 dans laquelle l'élite intelligente cesse de procréer, laissant les idiots peupler la Terre. Lui-même père de onze enfants qu'il a eus avec trois femmes, le fondateur de Space X entend s'ériger en exemple : il a donné son sperme à l'une de ses employées qui a eu des jumeaux qu'il a reconnus, a trouvé un donneur de sperme à sa sœur et a eu recours à une mère porteuse pour son dernier enfant, comme le raconte Walter Isaacson dans *Elon Musk* (Simon & Schuster, Fayard), la récente biographie qu'il lui a consacrée.

Son parcours fait scintiller les yeux de Malcolm Collins. *« C'est la nouvelle figure de proue intellectuelle du mouvement conservateur »,* s'enflamme-t-il. A écouter sa conjointe, c'est surtout l'un des rares à parler publiquement d'un sujet que beaucoup préfèrent évoquer à l'abri de portes fermées, notamment dans le monde de la tech où leur version trouve de plus en plus d'écho. *« Pourquoi ? Parce que c'est un univers qui concentre nombre de personnes qui réfléchissent au futur à long terme et se soucient beaucoup de leur impact sur Terre »,* avance Simone Collins.

Ultra-connecté, le couple, qui fait défiler sa vie sur les réseaux sociaux, connaît bien la Silicon Valley. Simone a grandi dans la baie de San Francisco et a brièvement travaillé pour Peter Thiel, le cofondateur de PayPal. Malcolm, lui, a fait ses études à Stanford, l'université où ont démarré certaines des plus grandes entreprises de la tech. Aujourd'hui, ils gravitent dans la communauté de *l'« altruisme efficace »*, une pensée en vogue dans ces milieux, que l'on pourrait résumer par la formule « gagner plus pour donner plus » (autrement dit, n'est-il pas plus utile de travailler dans la finance et de reverser une partie de son gros salaire que d'être médecin dans un pays pauvre et de ne sauver « que » quelques vies ?).

Le plus généreux soutien de ce courant, Sam Bankman-Fried, créateur de la plate-forme de cryptomonnaies FTX, est actuellement jugé pour fraude. Cette théorie a trouvé une seconde jeunesse grâce au long-termisme, concept qui entend donner la priorité à l'amélioration de l'avenir à très long terme. Peter Thiel ou Elon Musk financent tous les deux des programmes en ce sens. Tout comme Jaan Tallinn, le cocréateur de Skype.

Aussi posée que son mari est exubérant

Rien ne prédestinait les Collins à mener cette bataille. Malcolm a grandi avec son frère dans une famille d'entrepreneurs de Dallas, Simone avec des parents post-soixante-huitards en Californie. Veste en jean sur pantalon noir et rouge à lèvres vif, elle est aussi posée que son mari est

exubérant. Elle pianote sur son smartphone, s'excuse de répondre à un mail professionnel avant de quitter la pièce et de revenir avec des gants de ménage, un vaporisateur et de l'essuie-tout. La voilà qui fait les vitres. Malcolm poursuit comme si de rien n'était.

L'étonnante mise en scène trouvera une explication plus tard dans la discussion : on peut mener de front sa vie de famille, ses activités professionnelles et militantes et… l'entretien de sa maison. *« Je ne suis pas capable de jongler avec autant de choses à la fois qu'elle ! »*, s'exclame Malcolm Collins dans ce qui se veut un compliment. Quand ils se sont rencontrés, elle ne voulait pas d'enfants. Il l'a convaincue de fonder une famille en lui promettant qu'elle n'aurait pas à renoncer à sa carrière. C'est lui qui va chercher les enfants à la crèche, les conduit chez le médecin quand ils sont malades, assure-t-elle. Pas question de laisser penser qu'ils sont misogynes et de laisser planer le spectre de *La Servante écarlate (1985)*, le roman dystopique de Margaret Atwood, où certaines femmes sont contraintes à devenir des reproductrices pour faire remonter un taux de natalité tombé très bas à cause de la pollution. *« Si mes filles voient ma femme avoir un certain pouvoir dans le monde et être glorifiée dans notre relation, elles voudront aussi devenir mères*, pense Malcolm Collins. *Idem avec mes fils et leurs futures femmes. »*

« Un bébé sélectionné pour son intelligence »

La fin de la journée approche, il est l'heure de récupérer leurs deux fils, Octavian, 4 ans, Torsten, 2 ans, et leur fille, Titan, bientôt 1 an. Les trois bambins arrivent dans la véranda, remplissent l'espace de leurs cris et vident les étagères de leurs jouets. Au milieu du brouhaha, Simone Collins réussit à glisser qu'elle est de nouveau enceinte. N'essayez pas de leur objecter qu'élever des enfants coûte cher, surtout aux Etats-Unis. *« Il faut faire des sacrifices*, assène son époux. *C'est vrai, Simone et moi, nous ne pourrions jamais nous permettre de vivre à Manhattan et d'avoir le nombre d'enfants que nous souhaitons. »* Ils en espèrent au moins sept.

Mais les époux ont des problèmes de fertilité. Ils ont eu recours à des fécondations in vitro (FIV) et disposent encore d'une trentaine d'embryons congelés. Un traitement douloureux et très coûteux, rarement pris en charge aux Etats-Unis – ils ont dépensé près de 20 000 dollars (soit 18 910 euros) par cycle. *« Se battre contre l'infertilité n'est pas la chose la plus drôle au monde*, reconnaît Simone. *Mais je suis tellement reconnaissante que cette technologie existe. Et c'est aussi génial de pouvoir sélectionner pour nos enfants ce qu'on veut leur éviter, comme les risques d'anxiété, de cancer, la schizophrénie… »*

Car les Collins ne veulent pas simplement beaucoup d'enfants, ils les souhaitent les plus optimaux possible. *« Nous avons des raisons de croire que beaucoup de choses sont héréditaires et nous voulons ce qu'il y a de mieux pour eux »*, énonce Simone Collins. Ils se sont adressés à plusieurs sociétés, dont Genomic Prediction. L'entreprise propose aux futurs parents, avant qu'ils procèdent à une FIV, d'effectuer des tests génétiques complexes, appelés « scores polygéniques », sur leurs embryons. La promesse est d'évaluer les risques de maladies dans lesquelles interviennent de très nombreux gènes : certains types de diabète, de cancers, de maladies cardiaques ou la schizophrénie.

Une fois leurs résultats en poche, les Collins ont établi un classement et choisi l'embryon qui leur semblait correspondre le mieux à leurs attentes. Pour l'enfant que Simone attend, ils prétendent être allés plus loin encore. *« A ma connaissance, il s'agit du premier bébé qui sera sélectionné pour son intelligence »*, s'enthousiasme la mère de famille, qui refuse d'en dire plus sur ceux avec qui ils ont travaillé pour ne pas que ces derniers soient *« blacklistés »*. *« C'est encore très controversé »*, euphémise-t-elle.

Qualifiés de « hipsters de l'eugénisme »

La vitesse à laquelle se sont démocratisées ces technologies, qui ne sont pas régulées aux Etats-Unis, a alerté, en 2022, la revue *Nature*, qui s'est inquiétée de *« l'essor alarmant »* des scores polygéniques, *« dont on connaît encore mal les bénéfices et les dangers »*. Professeur de psychologie à l'université de Virginie et spécialiste de génétique comportementale, Eric Turkheimer observe cela d'un œil circonspect : *« Si* [les Collins] *utilisent les scores polygéniques pour influencer la personnalité ou l'intelligence de leurs enfants, ils vont surtout gaspiller leur argent. C'est une arnaque. »*

Katie Hasson, du Center for Genetics and Society, une organisation non gouvernementale qui milite pour une utilisation responsable des biotechnologies, est également critique : *« Dans la mesure où il s'agit d'essayer d'améliorer la population ou d'éliminer certains traits par le biais de la reproduction, c'est tout à fait conforme à l'eugénisme,* estime-t-elle. *Ce n'est pas la même chose que l'eugénisme de masse promu par l'Etat au début du XX^e^ siècle. Il s'agit davantage d'une approche individuelle, facilitée par la technologie, mais qui pourrait conduire aux mêmes résultats. »*

Il n'en fallait pas plus pour que les Collins soient qualifiés par certains médias de *« hipsters de l'eugénisme »*. Le terme possède une forte charge historique de ce côté de l'Atlantique. L'Amérique a été la première à adopter des législations eugénistes à l'échelle des Etats dès le début du XX^e^ siècle, notamment en rendant obligatoire la stérilisation de certains malades et criminels. Ces politiques ont ensuite servi de modèle à l'Allemagne nazie.

« Aux Etats-Unis, l'intérêt pour l'eugénisme est né de l'anxiété démographique, rappelle l'historienne Laura Lovett, professeure à l'université de Pittsburgh et autrice de *Conceiving the Future : Pronatalism, Reproduction, and the Family in the United States, 1890-1938* (University of North Carolina Press, 2007, non traduit). *Les Collins utilisent un vocabulaire qui tourne autour du droit de sélectionner des embryons et tentent de remettre cela au centre des discussions autour de la reproduction. C'est presque exactement le même type de langage que celui des eugénistes du début du XX^e^ siècle. »*

Simone Collins dénonce cette *« étiquette facile »* à leur coller sur le dos et se défend, avec son mari, de vouloir obtenir des bébés sur mesure. *« Nous ne croyons pas aux bons et aux mauvais gènes, nous croyons en notre famille et en notre culture,* insiste le père de famille. *Si l'un de mes enfants meurt à cause de quelque chose que j'aurais pu choisir de lui éviter, j'en serais partiellement responsable. Il s'agit de maximiser le nombre d'enfants en bonne santé que nous avons. »*

Mieux vaut pour eux une mauvaise publicité

Le couple refuse de la même façon d'être renvoyé à l'extrême droite pronataliste, adepte de la théorie complotiste du « grand remplacement », qui postule que les non-blancs, ou les juifs, selon les versions, chercheraient activement à « remplacer » les Américains blancs « de souche » avec des taux de fécondité et une immigration plus élevés. Les époux, eux, vantent le pluralisme, une question de survie biologique. *« Une société homogène, même si elle reflète nos valeurs personnelles, est fragile,* écrivent-ils dans *The Pragmatist's Guide to Crafting Religion*, un livre autoédité en 2023 dans

lequel ils développent leur pensée. *Quiconque connaît la "famine de la pomme de terre" [une grave crise alimentaire qui a touché l'Europe du Nord-Ouest au milieu des années 1840] en Irlande sait le risque qui accompagne toute monoculture.* » Le couple assure : « *Notre plus grande crainte, c'est que le récit des racistes l'emporte, ce serait le pire des scénarios.* »

Cela ne les empêche pas d'être les guest-stars de la Natal Conference, un obscur colloque destiné à réunir la galaxie pronataliste dans sa grande diversité, prévue en décembre, à Austin (Texas). « *Le simple fait d'aller là-bas ferait de nous des racistes ?,* s'agace Simone. *Il faut discuter avec tout le monde.* » Mieux vaut pour eux une mauvaise publicité que pas de publicité du tout.

« *Il faut décortiquer leurs propos et les implications réelles de ce qu'ils disent, qui revient à expliquer que certains êtres humains sont à privilégier par rapport à d'autres et qu'en quelque sorte il faut plus de pronatalisme pour les enfants en bonne santé et moins pour les enfants avec des problèmes de santé. Volontairement ou pas, les Collins s'inspirent des idées d'extrême droite d'une manière hautement problématique* », observe Alexandra Stern, professeure à l'Institute for Society and Genetics de l'université de Californie, à Los Angeles.

Système éducatif sous l'emprise des « progressistes »

En 2021, les Collins, qui se disent laïcs mais de tradition calviniste, ont mis sur pied la Pronatalist Foundation, dont ils préfèrent taire le budget. Ils disent travailler avec une petite équipe de bénévoles qui les aident à collecter des ressources documentaires destinées aux familles pronatalistes et à mettre en relation investisseurs et entreprises dans le champ des biotechnologies et de la famille au sens large.

Jake Kozloski, cofondateur de Keeper, un site de rencontre en ligne consacré au mariage, appuie leur démarche. « *Nous aimons ce qu'ils font, ils sont drôles et attirent l'attention.* » En 2022, le couple a reçu une bourse de 482 000 dollars du Survival and Flourishing Fund, un site en ligne chargé par Jaan Tallinn de distribuer ses dons. Pour le reste, mari et femme assurent financer eux-mêmes leurs activités pronatalistes. Ils tirent l'essentiel de leurs revenus de leur agence de voyages, Travelmax, et de la vente de leurs livres – une série d'ouvrages qui se veulent des guides « *pragmatiques* » sur des notions comme la vie, la gouvernance ou le sexe.

Le couple s'apprête aussi à lancer le Collins Institute for the Gifted, une méthode d'éducation alternative à domicile destinée aux lycéens et aux étudiants « *surdoués* ». L'école occupe une place importante dans leur discours et ils n'ont pas de mots assez durs pour vilipender le système éducatif américain, qu'ils considèrent être sous l'emprise des « *progressistes* ». « *Je suis allée à l'école publique en Californie*, se souvient Simone. *Tout au long de ma scolarité, la maternité m'a été présentée comme un désastre à éviter. Aucun de mes amis ne voulait être parent.* »

« Trump a brisé le plafond de verre »

D'un point de vue politique, la présidence de Donald Trump les a plus que convaincus. Le couple n'hésitera pas à glisser un bulletin de vote à son nom s'il est de nouveau désigné candidat des républicains pour l'élection présidentielle de 2024. « *Il a brisé le plafond de verre pour nous, il a montré que des gens bizarres peuvent gagner* », s'enthousiasme Simone Collins.

Sur la question de l'avortement, ils préfèrent botter en touche. « *Ce n'est pas un bon moyen d'augmenter les taux de natalité* », répond l'époux, qui reconnaît cependant qu'« *interdire l'avortement ne règle pas le problème* ». Entre deux grossesses, Simone Collins envisage de se présenter aux élections locales de 2024 en Pennsylvanie. Sa décision n'est pas encore prise, mais elle semble tentée.

Il est l'heure de la photographie, direction le jardin. Grands et petits enfilent des bottes jaunes. Malcolm décide que le poulailler fera une bonne illustration. D'une main experte, son épouse attrape un volatile. « *Voilà Pol Pot* », annonce-t-elle fièrement, nom du dictateur khmer rouge qui dirigea le Cambodge de 1975 à 1979. « *Simone, ça va faire un effet désastreux* », s'amuse son mari. Elle s'accroupit dans l'herbe et éclate de rire. Malcolm est à ses côtés, les trois enfants autour. Tout est parfait.

• Radio - The 'pronatalists' trying to engineer a baby boom

Front Burner - CBC News · Posted: Jun 20, 2024

https://www.cbc.ca/radio/frontburner/the-pronatalists-trying-to-engineer-a-baby-boom-1.7240325

The Script is on Cahier de Prépa