the weekly anthropocene

Dispatches From The Wild, Weird World Of Humanity And Its Biosphere

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Phytomining

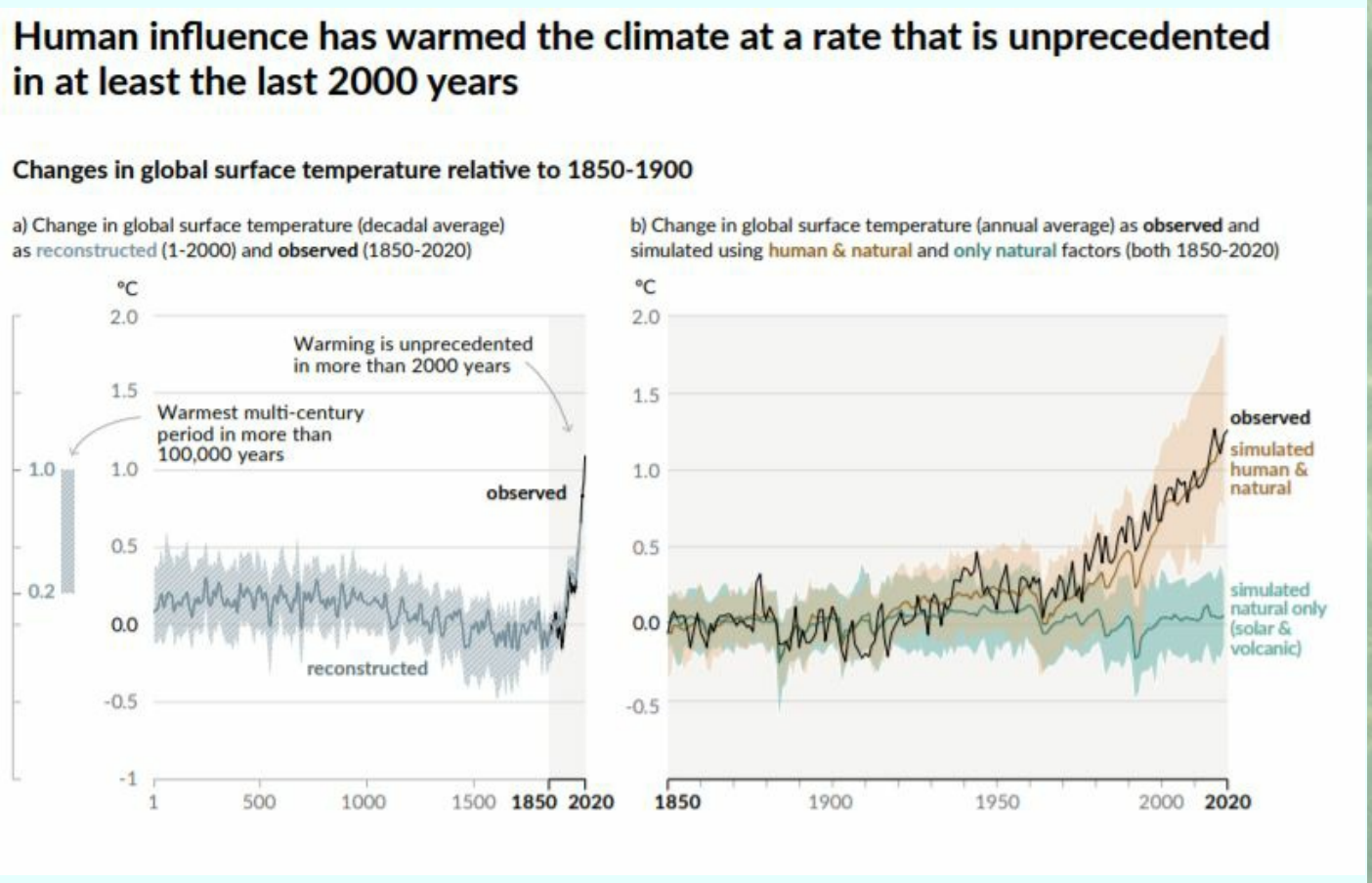
On the slopes of Mount Kinabalu in Malaysian Borneo, there is a mine like no other (pictured): four acres of greenery that produces nickel. The secret is *Phyllanthus rufuschaneyi*, a rare "hyperaccumulator" plant that has evolved to extract nickel from the soil at a tremendous rate and accumulate it in its tissues. When the crop is harvested (a foot of growth at a time, keeping the main plant alive) and burned, the resulting ash, or "bio-ore," can be up to 25% nickel by weight. This extraordinary method of "farming for metals" is known as phytomining, and it has the potential to be an absolutely transformative new practice.

Without knowing more, the immediate thought here might well be "Isn't this terribly inefficient? No matter how good this plant is at getting nickel in its tissues, it's still a plant, and it's going to made of mostly not-nickel substances." And it is-but traditional mining is often even *more* inefficient. The traditional picture of mining as hacking big chunks of the desired mineral out of the ground has become outmoded, as we've exhausted most of those hyper-available deposits already. Industry standard nickel mining now involves strip mining soil that's generally only 1 to 10 percent nickel (devastating to anything that might be living there), and then using massive diesel-powered machinery and acid-leaching baths to separate out the nickel from the soil. It's an environmental

mess, responsible among others for the epically terrible polluted wastelands around the Russian city of Norilsk. However, nickel is a critical ingredient in stainless steel and many electric car batteries-we really need it. This "bio-ore," the ash you get when you burn plants that have been planted in nickel-rich soils, is actually far *more* efficient as a source of nickel than ordinary nickel-rich soils, as the plant has already done most of the work.

And the Malaysia trial has been so successful, it's starting to interest major investors and mining companies. "We can now demonstrate that metal farms can produce between 150 to 250 kilograms of nickel per hectare (170 to 280 pounds per acre), annually," said Antony van der Ent, a researcher who pioneered phytomining. Next steps include partnering with several Indonesian mining companies, experimenting with using phytomining methods on metal-polluted soils, and expanding the Malaysia trial to 50 acres. Great news!

Climate Impacts



The Intergovernmental Panel on Climate Change, the UN's climate science authority, has released the first section of its Sixth Assessment Report, the first fully comprehensive update of the state of humanity's understanding of climate change since 2013. This section, the first of three, focuses on the physical changes happening and projected to occur on Earth, with the second and third sections of the report, focusing on adapting to these impacts and preventing worst-case scenarios, set to release in 2022. The report was compiled by 234

scientists and synthesizes the results of over 14,000 studies. The full report is thousands of pages long: for a summarized and accessible version, check out their Summary for Policymakers (source of the graphic above, comparing observed warming with models of a climate with and without human impacts).

There are a range of key takeaways, many of them disturbing but unsurprising. First, the obvious: climate change is happening right now, everywhere in the world, and it's definitely caused by humans. We've been sure of that for years, and now we're *really definitely* sure, with our understanding of Earth's atmosphere having improved to the point that an array of studies have calculated exactly how much more likely and more intense individual disasters were made by climate change. (*We* seems like the appropriate pronoun to use in this article, when discussing a meta-issue that affects all humans and must be addressed on a global scale). Human civilization's emissions have caused a global temperature increase of 1.1 degrees Celsius since the 1850-1900 period, and we'll likely pass 1.5 degrees C before 2040. (A previous IPCC report summarizes how that is a really big deal). The statistics are mind-bending: already, trillions of tons of water have poured from ice caps into the oceans, carbon dioxide levels and concomitant ocean acidification haven't been this high for over two million years, heatwaves, heavy rains, and drought are increasing in 90% of the world's regions for which there are good data.

We as humanity have likely missed our window to avoid major sea level rise. In a best-case scenario where the renewables revolution zooms into overdrive and we substantially reduce our emissions by mid-century, we will see some immediate benefits, like cooler land temperatures and a less acidified ocean, by the 2050s and 2060s. But it's hard to un-melt an ice cap: even in an optimistic scenario, about two feet of sea level rise is expected by 2100. And if the West Antarctic ice sheet collapses-one of the big question marks of climate science right now-that could change to six feet by 2100 and sixteen feet by 2150. Those dates may seem abstract, but there are likely children alive today who will live well into the 2100s.

An array of "tipping points," events like that potential West Antarctic ice sheet collapse, have also become more likely, from mass melting of permafrost, the fall of the Amazon Rainforest, and a worrying shift in Atlantic ocean circulation. These are hard to predict, but would be an additional layer of rapid-impact *bad* on top of the "slow burn" of climate change in general.

Another key point was that methane pollution (primarily from natural gas leaks, agriculture, and abandoned coal mines) has skyrocketed, and new science has found that methane has caused about a quarter of global warming. It's much less abundant in the atmosphere than CO_2, but it has 84 times stronger an impact as a greenhouse gas. This is sort of good news/bad news: it's bad that it's causing so much of the problem, but it's good because methane pollution should be easier to fix than carbon pollution once governments actually start to deal with it, for several reasons. First, carbon dioxide is a by-product of burning fossil fuels, so there's a lot of powerful moneyed interests invested in keeping it burning, but methane emissions are mostly from sources considered economic

waste, like "uncapped natural gas wells being left to flare," and "the digestive systems of the millions of cows humans are raising for meat." That is, no one needs methane emissions to continue to make money. Also, methane only lasts in the atmosphere for about 12 years, compared to 20 to 200 years for CO_2. So there's potential for a quick win here: transitioning our agriculture systems and plugging a bunch of leaks in the fossil fuel system could slice off a big chunk of the climate threat, and we'd see results in decades, not centuries.

The good news, if it can be called that, is that the final outcome is very much up in the air, and every single action we take, from setting up a new solar farm to preserving a forest, really, really, REALLY matters. The report's pretty sure we'll pass 1.5 C in the next few decades, and some sea level rise and other changes are already "baked in," but what the world looks like in 2100 is essentially up to us. To quote, "It is virtually certain that global surface temperature rise and associated changes can be limited through rapid and substantial reductions in global GHG emissions." Total warming in 2040 will probably be somewhere around 1.5 C (although whether temperatures going up, plateauing, or going down at that point is incredibly important!), but predictions for total warming by 2100 range from an already-on-the-path-to-healing 1.4 C to a nigh-apocalyptic 4.4 C, with the uncertainty dependent on what choices human civilization makes in the intervening period.

As the IPCC report outlined the bigger picture, the climate crisis continued to cause disasters around the world. Greece and Turkey faced titanic wildfires. (Pictured: a man fighting a wildfire that reached a residential area north of Athens). Evia, Greece's second largest island, effectively burned to the ground and 2,000 people had to be evacuated. This is increasingly a world of wildfires, with massive blazes currently occurring in Greece, Turkey, Lebanon, Italy, Siberia, California, Canada, and the Brazilian Amazon. Amidst the destruction, there is one thing to be proud of: thanks to space-based weather monitoring and improved government competency across much of the world, deaths from natural disasters have decreased immensely in the last few decades. Even as the wildfires and storms get worse and worse, we're getting better at saving people from them. Now, we need to keep working on saving the world.

United States: Electric Vehicles

On Thursday, August 5th, the federal government, industry, and labor committed to a shared goal of rapidly moving the United States towards electric vehicles. (This is critical, as transportation accounts for 29% of US greenhouse gas emissions, more than electricity generation at 25% or industry at 23%).
President Biden signed an executive order setting a goal for electric vehicles to account for 50% of the US car market by 2030, up from just 2% in 2020. This is not legally binding, but it is supported by an array of US automakers. The "big three" of Ford, GM, and Stellantis (formerly Chrysler) jointly announced at the event on Thursday that they were targeting 40-50% of their sales to be electric vehicles by 2030.
On the same day, Biden's EPA and NHTSA (National Highway Traffic Safety Administration) announced new fuel-efficiency regulations, mandating an average of 52 miles per gallon for new cars by 2026 and tightening pollution regulations on heavy-duty trucks. These steps partially reverse Trump's rollback of Obama's similar standards.

Finally, Biden and the Democrats are pushing for strong federal investment in EV and renewables infrastructure in the bipartisan infrastructure bill and its likely more-impressive sequel, a second Democrats-only reconciliation omnibus bill. These appear to be progressing through Congress surprisingly successfully, but this newsletter will not report on every step in the legislative process-we'll give a full rundown in a few weeks or months, when these bills are signed into law!

Thursday's events strengthen a nationwide industry- and government-led consensus: before Thursday's announcements, General Motors had already announced that it would be selling *only* electric vehicles by 2035, and both California and Massachusetts had pledged to end the sale of new gas-powered vehicles in their states by 2035. Getting to majority EVs will be a big lift, but it will lead to immense benefits for local air pollution and the climate! Great news.

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