The *Puna* is not a Triangle

[image 01]

Under the guise of the 'green' transition and implementing pathways to decarbonisation, a new frontier of capitalist expansion has emerged, in the form of a planetary race for minerals such as cobalt, copper, rare earths and in particular, lithium. Most of the world's exploitable reserves of lithium are located in an area commercially known as the 'lithium triangle', a geometric figure delineated by the *salares* (salt flats) of Uyuni in Bolivia, Atacama in Chile and Hombre Muerto in Argentina. Salares are dried lake beds with underground reservoirs containing high concentrations of dissolved salts, such as lithium, potassium and sodium. This is a result of activity in the surrounding volcanoes of the Andes cordillera. Over millions of years, minerals accumulate in these peaks that descend with melting ice during the spring melt, leaching into the lower-level soils, and eventually settling in the depressions at the bottom of the *salares*.

In 2017, I created the Lithium Triangle research studio, at the Royal College of Art, London, with the goal of examining the socio-environmental impacts of lithium extraction. This was a collaboration of environmental architecture students and teachers from the RCA, with lawyers, archaeologists, indigenous leaders and others working on the Atacama Desert in Chile. At the time there was very little being published (both academically and in newspapers) on the negative impacts of lithium extraction, and so it seemed crucial to foreground the realities of the 'green transition'.[1]

While the ea-lithiumtriangle.org online platform showcases most of the collective and individual works we've developed during these years, in what follows I will speak to the aspects I found more significant. Our work focused mostly on the Salar de Atacama. Its hyper-arid climatic conditions make it perfect for lithium-rich brine extraction. This entails pumping the salt rich brines from beneath the *salar's* crust, into a series of large, shallow ponds. Brine is rich in water while containing only traces of lithium. Initially containing 200 to +1,000 parts per million (ppm), the lithium brine solution is concentrated by solar evaporation to achieve a ratio of up to 6,000 ppm lithium after 12 – 16 months. This means that on average, for each ton of lithium, 500,000 gallons of water are required. Lithium and copper mining corporations (Albemarle, SQM + Minera Escondida and Zaldivar,) hold most rights to extract water from the aquifer, facilitating rates of water pumping that overtake its recharge capacity. Water is crucial to all mining operations, not only for material processing, for dust setting, and for drinking.

This does not even include the additional rights to brine extraction: brine is made of 34.7%% salt and 65.3% water. In other words, obscene rates of water extraction are taking place in the driest desert in the world, whose unique geo-climatic conditions give it a complex and delicate water cycle that has maintained a natural balance for thousands of years - despite an extreme lack of precipitation. And across the region, lithium extraction is expanding into dozens of other *salares* – including Salar de Uyuni in Bolivia, containing the largest resources of lithium in the world, and whose government recently signed (January 2023) a deal for lithium extraction with a consortium led by CATL, the world's largest battery manufacturer. Following from silver, gold, nitrate and copper, lithium continues the long history of extraction in the Atacama.

Governments and mining companies have historically described the desert as empty – *despoblado* (literally unpopulated) - occupied only by small groups of 'underdeveloped' or 'primitive' peoples. That such depictions and their explicit racism are aimed at easing the processes of land appropriation for the extraction of resources is abundantly clear. Other depictions portray the Atacama Desert as a

[1] EA-lithiumtriangle.org

desolate site that is home to unique geological and environmental curiosities, an aggressive and arid landscape not made for living, but better suited to explore what life on Mars would be like. The Atacama is a frequent background for multiple science-fiction films and documentaries. The desert, of course, has always been the most exaggerated figure of the colonial-extractive gaze, a world described as inhuman, the presupposed impossibility of inhabitation justifying its role of sacrificial zone for resource extraction. In my mind it is obvious how in its pure geometric construction, the idea of a 'lithium triangle' captures the essence of colonial plunder: the projection of the extractive gaze over territories and communities, a pure geometry that sees as much as it unsees, that in the same gesture of exhuming precious riches, bringing them from below, erases all those others considers un-precious, be human or other, made inanimate, inhuman, invisible, irrelevant.

[image 02]

While the studio's broader investigation has looked at lithium across local and global scales, both contemporary and historical, design efforts focused on strategies to take back the land from the control of mining corporations. The International Labour Organization's Indigenous and Tribal Peoples Convention, 1989 (ILO169), to which Chile is a signatory, provided context for our work, for it requires mining projects to undergo a process of consultation with affected communities, opening possibilities for environmental claims on both techno-scientific and ontological bases. With that in mind, our collaborations with advocacy teams and indigenous organisations explored architectures of environmental sensing and monitoring to be used by locals against mining companies. Drawing on the expanding field of counter-mapping as well as on the emerging forensic approach to architectural activism, in its first stage, the project made use of remote-sensing, multispectral analysis and GIS to produce reports on environmental change (vegetation, soils, water) to be used in legal disputes. We equally proposed the development of a series of tools to allow ground observations to be interpreted in relation to invisible data such as concession boundaries, aquifer location, soil depth, real-time measurements of water and wind, and vegetation health in time.

Many of our students suggested the development of collective and collaborative devices to bring multiple scientific data together, including online platforms, apps, and AR systems. And overall, we explored how these might enter into composition with non-academic modes of knowledge production, including oral histories, environmental knowledge developed by farmers, as well as those inherited from Atacameño knowledge traditions of reciprocity, care and respect for the ancestors. Several projects in the studio investigated the architecture of microbial mats and of stromatolites – sedimentary rocks produced over 3.5 billion years by the accumulation of layer upon layer of cyanobacteria – and how they have become unlikely protagonists of a legal conflict that pits one of the world's major lithium producers, Chilean chemicals company Sociedad Química y Minera (SQM), against environmentalist and Indigenous groups. Stromatolites are precious sources of environmental knowledge about the development of life on Earth. And in being delicate sensors of water quantity and quality, microbial ecosystems can demonstrate the invisible impacts of mining operations. Existing in different forms across most of the Atacama' *salares*, they have become a crucial site of resistance against the expansion of mining.

[image 03]

The other key component of the work was to complement struggles for land with proposals for environmental care and maintenance, towards the possibility of alternative modes of coexistence. In collaborating with local groups – such as the *ayllus* of Tulor and Beter, San Pedro de Atacama, on the north of the *Salar* – the aim was to redeploy conceptual and practical aspects of *Atacameño* environmental thinking to address contemporary challenges around land management, desertification, water scarcity and reproductive justice. Many of our proposals centred land, focusing on the possibilities contained within research-based tourism, environmental pedagogies and new types of botanical economies, for the constitution of alternatives to the lack of local jobs outside of extractive industries. Our contribution did not lie on the novelty of these ideas – many people we spoke with had been thinking about these issues for a long time, with a detailed understanding of economic, social, and environmental potentials and

difficulties. Our contribution focused simply on providing further depth to these ideas, by conducting research on their feasibility and speculating on their potential visual and spatial reality. Our hope was that we could contribute towards their eventual development, by providing simulations that would allow others to recognise the planning expertise of those that live in the Atacama.

Often the projects emerging from the studio noted the necessity of developing hydrological forms of environmental planning, taking into consideration water's potential as a maker for a just energy transition. This means not only the guaranteeing aquifer replenishment capacity, or equitable water rights in accordance with different social and environmental needs but beyond that, towards using water as an index for environmental relations of care. Broadly speaking, this interest in water stemmed from the idea that water is and should always be at the centre of planning modes of coexistence, bringing together communities around the flows of life in space and time. Be it in the Atacama, or elsewhere around the globe, water has always informed ways of inhabiting territories, leading to the emergence of both architectural and legal forms, agricultural practices, and cultural rituals, giving consistency to the most different kinds of communities across the planet. Water needs to be placed front and centre of any climate justice conversation.

[image 04]

Overall, we were able to confirm local people's and other researchers' findings on the impacts of extraction. Through multi-year remote-sensing analysis we noted that the extraction of water for lithium and copper mining has impacted the lagoons and water table in the *Salar de Atacama*, how the depth of the water table has been steadily decreasing and how vegetation cover has decreased across the edges of the *Salar*. We encountered cases where animal and microbial ecosystems have been affected by the reduction in water levels, by shifts in the flow of water and by changes in the water's chemical composition; we observed how dust and particulate materials released by mining activities generate a white haze that is permanently over the *Salar*. We confirmed how water is extracted not just in the *Salar*, but also upstream, near the small oases that surround it - precarious settlements that are very much dependent on the little water that trickles down from the top of the mountains. We confirmed that comparatively, *Atacameño* communities circumscribing the *Salar* de Atacama hold an amount of water rights barely sufficient for their survival.

On a personal note, the most important aspect I've noticed was how mental ecologies have deteriorated across the *Salar's* communities. Little academic attention has been dedicated to the entanglement of social, material and mental ecologies, be it in the Atacama or at large. And even less on the mental and psychological impacts of extractivism. And yet that are undeniable. Extractivist mental pollution is manifest in prevailing suspicion and intra-community conflicts centred on differing relations to mining companies. There are multiple reasons for this: sometimes it's a matter of differing positions on the buying of land by mining companies; sometimes it is a matter of the direct impacts of extraction over agricultural modes of existence (impacting both waters, vegetations, airs and soils); other times it is due to the heavy burden of contesting extractivism; and frequently it is a problem of deciding on compensations. Compensations (be it as royalties or in the form of building a school or a sports field, etc.) are seen by some as a lesser evil and the opportunity to benefit at least in some aspect from a dire situation. In a context where centuries of plunder and racial discrimination means that people have very little expectations from the government or from their own capacity to influence the future of their lands, such decisions are common. But for others, entering negotiations with mining companies or allowing for compensations is a betrayal to the struggle for the protection of ancestral territories. Moreover, the decisions on when to negotiate or not, with whom, and in the name of whom, are riddled with social and political tensions and pitfalls. Finally, all these aspects are magnified by both state and mining companies' political and financial pressure over local leaders and representatives. In the Atacama as in every other area of resource extraction, the arrival of mining signals a drastic reduction in the range of possible futures, a trauma that is both to the environment as it is to its peoples.

[image 05]

This project came to an end in 2022. And yet, it highlighted the importance of continuing to develop this type of work - both transdisciplinary and cutting across academic and non-academic knowledge divides; research and activism, ethical and aesthetical - in the Atacama and across other geographies, resisting the ongoing multiplication of 'lithium triangles' across the world. As a researcher my objectivity does not rely on some sort of neutral detachment, but on taking a clear stand. Unfortunately, the frontier is in constant expansion and lithium is currently extracted across South American, China, Australia, the US, and Europe. For the past couple of years, my attention has turned to similar struggles in the north of Portugal, where I am from, and where several lithium mining projects are threatening unique ancestral environments. The Atacama is one among many other territories across the world that stand in the frontlines of a mode of development from which those affected stand to gain very little. As for the negative impacts of extraction, a few I described above, but there are many more.

While too much focus on lithium might miss the forest for the trees (the real problem is the capitalist dependency on extractivism and lithium is only one among *many* other metals needed for the current 'transition') I note how the hypocrisy with which it is marketed as 'green & clean' has led to the contrary effect of many people deciding to join the struggle. Many across the world are increasingly 'speaking truth to power' regarding the cynicism of a 'green transition' that is led by extractive businesses instead of real environmental or climate concerns. The recently signed Jadar Declaration by Serbian, Chilean, Argentinian, Portuguese and US based environmentalist groups speaks to the importance of international alliances in the struggle against extractivism. But there is much more that needs to be done. Extractivism is constantly inventing 'lithium triangles' and similar pseudo-geographies to justify the creation of more and more sacrifice zones. But the *desert* is not a triangle; *Uyuni* is not a triangle, and surely the *Puna de Atacama* is not a triangle. These are real environments, inhabited by many different beings, be it microbial, human, earthly or celestial, ancestors or future generations. Only together do we stand a chance. We urgently need the many worlds of the world making common cause if we are to resist the digging machines of capitalism.