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Phosphopraxis

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Nutrients are not neutral

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Audrey Samson

This article introduces *phosphopraxis* as a critical spatial methodology to examine the entangled material, discursive, and geopolitical domains of phosphate rock. Moving beyond technical picturing of soil health and scalable solutions, it retraces phosphate's journey from mineral to commodity, revealing how its extraction and circulation underpin colonial genealogies, infrastructural violence, and contemporary governance regimes. Through archival research, fieldwork, and visual documentation, the study foregrounds the historiographical invisibility of extractive architectures in Western Sahara and their enduring impact on land, bodies, and sovereignty. Challenging dominant narratives of development and neutrality, *phosphopraxis* advocates for multiscalar investigations that resist abstraction and instead attend to the situated complexities of mineral relations. Ultimately, the article calls for epistemic practices that bridge site specificity with planetary interdependence, illuminating phosphate's spectral presence in the built environment and its role in shaping both dispossession and resistance.

THE BIGGER PICTURE

Walking along the last "open field" in England, Stuart Rose explains the use of field rotation, the role of the fallows, and how the agricultural system they have operated for centuries diminishes (and potentially abolishes outright) the need for industrial fertilizers, maintaining a relatively high level of soil health (Figure 1)[1]. However, he explains, this system is becoming less "viable". The reasons for this have nothing to do with agriculture, the weather, or the soil we are meandering upon, but rather the financialization of land. How can we make sense of these complexities, which seem to reside *elsewhere*, somewhere between global supply chains, the commodities market, and policy. The site unfolds through these webs of agents, meanwhile the rentier economy incrementally prices out small-scale farmers. Leaving fields fallow becomes less economically feasible, thereby multiplying demand for industrial fertilizer. The extraction of phosphate rock continues to intensify, leading to widespread contamination of river systems through agricultural runoff. As a result, smallholder farmers are increasingly displaced from the sector, while control over production becomes progressively concentrated in the hands of a few. In parallel, a plethora of well-meaning alternatives and often brilliant "solutions" have been developed to tackle the "problem" of soil and river health. The issue escalates further despite this innovation, and the failures are usually attributed to scalability, or lack thereof. In other words, regenerative practices could only make "a difference" if scaled up. Yet, this is hardly feasible across geopolitical contexts with widely varying resource availability, soil conditions, and crop types, to name but a few of the multifarious conditions.
Pressing questions that emerge are:
How can we pay attention to specificity in relation to a wider context?
How can we bridge the site, often the *materia prima* of the built environment, with a wider network of complex global finance, trade, and governance?
More importantly, can we afford not to?

The following traces a practice that aims to do just that, that is, to unfold, stretch and pull at the dependencies and interconnectedness of a site, through what we term *phosphopraxis*, to make sense of the worlds which phosphate rock builds (and unbuilds) as it moves from the shallow bench of the mine to industrial farms, leaching into water ways and bodies.

01 Montage collating documentation from FRAUD's 'In Praise of Fallows' (2022), a walk along Laxton's open field system, curated by RADAR and in collaboration with LUArch, with archival documentation including a hand-drawn map of the parish of Laxton, 1820, and an photography from Laxton open fields; Source:Beckett, J. (1989). A history of Laxton: England's last open-field village. Basil Blackwell.

1 The Open Fields of Laxton operate under the three-field farming system, one which includes a field rotation with land being left fallow one year out of three. One of the properties of this system is that it requires less fertilizer as a result of the regenerative rest period. See http://www.laxtonnotts.org.uk/open_fields.htm

A NOTE ON METHOD

Phosphopraxis is a name which suggests that a specific material, phosphate, becomes the catalyst to devolve the entanglement of the geological with its political, social, financial, and planetary relations. This praxis gestures towards what may emanate from a material if we consider it from the perspective of interconnectedness rather than an isolated element (in reference to the periodic table of elements or a resource traded on the commodity market). Phosphate is itself a construction which can refer to a salt or an orthophosphate depending on which discipline is categorizing it. This *poly-geo-entity* is often referred to as phosphates, which is not a stand-in for all phosphate-related minerals; it rather points to a plurality. Partially because we were drawn to this material's *geo-promiscuity*, we considered how we might peer at the world through the lens of phosphate. A myriad of factors also coalesced. On the one hand, a personal systemic relationship[2] and responsibility to consider the underexamined colonial extractivism mobilized in the former colonies, such as Western Sahara, and on the other, the realization that this material brings into focus the relationship between earlier colonial narratives, and the current planetary exhaustion, with specific respect to nutrient contamination in water bodies. The desire to understand materials beyond the resource narrative and across scales is one that can be turned towards other materials, such as silica sand, carbon, or even the biotic, such as fish, as we have developed through our long-standing research under the umbrella of EURO—VISION: Undergrounding the Critical Mineral[3].

We thus define *phosphopraxis* as a material-discursive investigation of/through phosphate, which tends to the critical interdependence and re-circularity of minerals, as well as the 'historiographical invisibility' of extractive practices central to the production of industrial fertilizer. Drawing from Arlene B. Tickner's and Amaya Querejazu's[4] reading of the term 'cosmo-praxis', we argue that novel forms of sensitivity might be necessary to notice and pay close attention to the modes in which phosphate and other industrially derived 'nutrients' form a myriad of relations and practices, each with their respective worldings. Practically speaking, this entails considering material from various disciplines such as geology, environmental science, trade policy, architectural history, colonial studies, finance, international relations, etc., as well as knowledge produced by what the academy might deem as non-experts. Witnesses range from human to non-human, and there is no hierarchy associated with this continuum. Faced with this vast expanse of information, fields, and associated complexity, the traces chosen to follow are often arrived at through collective sense-making[5], and do not portend to be a comprehensive study, which would arguably be impossible. As such, the research method is not scientifically objective, in the sense that it is not reproducible under a set of determined conditions, because each collective moment encounters the material differently across situated and planetary geopolitical domains. We argue that this form of nurturing the epistemic commons is generative and empowering, cultivating the kind of non-extractivist epistemologies that can address climate injustice.

2 Fanon, 1961/1963, pp. 35-37
3 Gallardo & Samson, 2025
4 Tickner, A. B., & Querejazu, A., 2021
5 We do this in many forms, for example by organizing knowledge sharing events, or *décollage* workshops. The latter refers to a format in which we collectively examine complex questions, see https://euro-vision.net/projects/phosphate-rock/decollage.

PHOSPHATE(S)

Before examining this practice in detail, we introduce the subject of this inquiry: phosphate rock. It is by no means the central figure, but rather a cut, in the Baradian sense. In Karen Barad's agential realism, the apparatus, as understood in quantum physics, has agency in how knowledge is produced. In other words, the apparatus is always biased; to claim unbiased neutrality is not of this world. The cut is a term Barad uses to refer to what is chosen and what is discounted by the apparatus. Importantly, for Barad this does not pave the way for uncritical exclusionary practices, but rather introduces a rigorous notion of ethics, which considers and is held accountable to these biases. Phosphate therefore becomes the lens through which we choose to engage with the wider landscape of soil and river health with respect to the built environment, with the partiality that this implies.

On Earth, phosphate is found in many of its apatite forms. Apatite refers to a group of phosphate minerals such as hydroxyapatite, the main stuff of human bone, also present in breast tumors, or fluorapatite, the primary mineral composition of mined phosphate rock, also found in tooth enamel. Its presence ranges from DNA to lithium batteries, and most crucially, industrial fertilizer. Phosphate rock is a finite, non-renewable resource that gained widespread recognition during the Green Revolution. The development of high-yield cultivars requiring nutrient inputs like nitrogen or phosphorus exacerbated the global demand for synthetic fertilizer. Phosphate's intensive use in agriculture has since been toxifying soils and nearby waterways. In 2011, the Baltic Sea experienced the largest recorded dead zone in history, covering an area equivalent to Lithuania due to its increasing levels of eutrophication from agricultural (and forestry) run-off, a now well-known phenomenon in Scandinavia[6,7]. In the UK, the birthplace of superphosphate fertilizer (Figure 2)[8], phosphorus is the main cause of water quality failure, and though sewage used to be the main culprit, agriculture is now the most important source. Eutrophication is deeply affecting European waterways and their wildlife, as well as the farmers who face increasingly strict EU regulations, while needing to maintain, or increase, crop yield due to rising costs of fuel, land, and of course, fertilizer[9]. The latter has significantly contributed to the polarized political landscape, where convoys of farmers have periodically descended onto Brussels in protest[10]. The 2023 Dutch general election result was also said to be at least partly due to the far-right weaponizing the growing farmer's discontent[11]. Fertilizer use has quickly become a matter of concern.

In addition to these entanglements, phosphate is mined in few places on earth. During the Cold War, European geologists traced the genesis of the geostrategic resource to the deposition of aquatic marine life over eons[12], such as the glassy exoskeletons of microfossils, *Frondicularia phosphatica* (Figure 3). The EU only accounts for a small portion of those deposits, located in the county of Siilinjärvi, Finland, and owned by the Norwegian corporation Yara International ASA. The planet's main concentration, at 71%, is located in Morocco/Western Sahara, with a significant portion in the Bou Craa mine[13,14]. This part of the Sahara Desert is particularly rich in such deposits, as it was originally part of the Atlantic

6 Conley et al., 2011
7 EASA, 2011
8 Patented No. 9353 granted to John Bennet Lawes in November 1842. Together with Sir Joseph Henry Gilbert, he then established the Rothamsted Experimental Station in 1843, a long-standing agricultural research institution.
9 European Environmental Agency, 2019
10 Henley, 2024
11 Van der Ploeg, 2020
12 Camprubí, 2015
13 Chernoff & Orris, 2002
14 Muñoz Cabezón, 1989

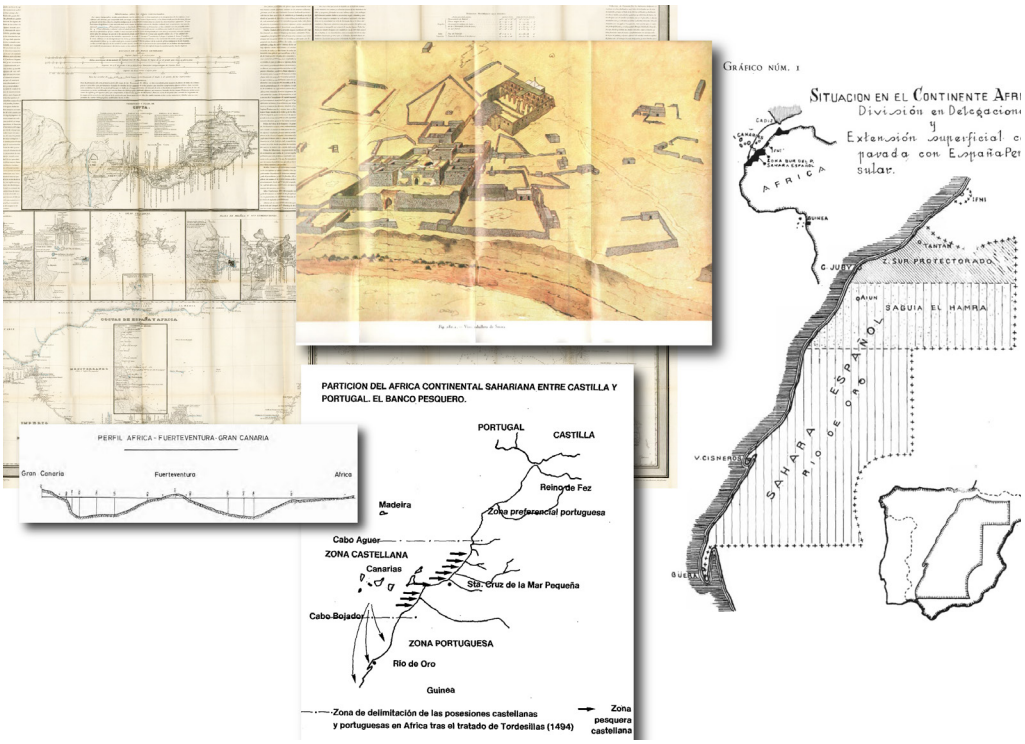
seabed's shallow marine environment, which enjoyed a rare combination of upwelling, low sedimentation rate, anoxic conditions, and a geologically stable continental margin[15]. A similar geological history is found across the north-west part of the African continent, which holds most of the world's phosphate reserves[13].

15 Taib, 2023

02 FRAUD's visit to Anthony Reinold's pioneering no-till farm in Lincolnshire; soil runoff visibly—as per satellite image—reaches the North Sea and Atlantic Ocean due to fields left bare between crop seasons; abundant presence of worms on soil clumps in fields that use no-till systems; images courtesy of FRAUD.
A 1943 cased display comparing plant size as well as average yields for the "Squareheads master" variety of wheat when using different fertilizing methods (including no input) at the experimental fields of Rothamsted Research Station; field phenotypying platform measuring wheat growth and health in the field at Rothamsted; soil samples and different fertilizers used (ranging from mangold leaf ash to animal blood); images courtesy of FRAUD.
Counting grains and cataloguing plants at the Sample Room; Illustrator Heather Perry working in 1932 at the Sample Room of the Rothamsted Experimental Station for a mural commission © Rothamsted Research, Rothamsted Library archive RUS 2.7.

03 Microscopic view of the fossil *Frondicularia phosphatica* Russo. A porous lagenid foraminifer with a calcareous skeleton, glassy in appearance and finely perforated. Madrid, EMNIMSA, 1966. Image courtesy of Lino Camprubí.

Beyond phosphate's reliance on the social and environmental impacts of mining, as is often the case, it is ensnared with the politics of governance. Western Sahara was occupied by Morocco in 1975, following the Green March, which occurred immediately after the region gained independence from Spain (Figure 4). Francisco Franco's regime sold its occupied territories for fisheries rights and shares in the phosphate operations of the Bou-Craa mine. The dependency on this mineral is thus tightly embroiled with the (im)possibility of self-determination for the Saharawi people (largely living as displaced peoples exiled in camps along the Algerian border). Colonial genealogies perdure, and unfortunately remain current, particularly so after Spain officially recognized Morocco's governance of Western Sahara in 2022, despite the 1963 UN mandate to the contrary at the time[16]. Contemporaneously, phosphate has been deemed critical to the EU's economic subsistence. As a result, it is included in the EU's Critical Raw Materials Act, which intensifies mining and propels new prospection efforts, as well as trade agreements and financial incentives. Phosphate therefore moves across multiple registers: food security, environmental justice, water health, political sovereignty, and (post-) colonization. Consequently, it becomes increasingly relevant to examine the historiographic invisibility of extractive practices and architectures of exhaustion central to the production and circulation of industrial fertilizer.



04 Montage including images from Caro Baroja, J. (1955). Sahara: Estudios saharianos. Calamar Ediciones [n.p.]; Del Río Joan, F. (1914). África occidental española (Sáhara y Guinea). Revista Técnica de Infantería y Caballería [n.p.]; García Cabrera, C. (1970). La pesca en Canarias y banco sahariano. Consejo Económico Sindical *Interprovincial* de Canarias [page 124]; Mulero Clemente, M. (1945). Los territorios españoles del Sáhara y sus grupos nómadas. Talleres Tipográficos El Siglo [page 123]; Suárez Acosta, J. J., Rodríguez Lorenzo, F., & Quintero Padrón, C. L. (1988). Conquista y colonización. Centro de la Cultura Popular Canaria [page 41].

PHOSPHOPRAXIS, CAN IT BE SCALED?

The present article aims to study how architecture and large infrastructural and territorial developments turn rocks into resources, ultimately transfiguring them into commodities. It is our argument here that spatial practices utilize scale to mediate the relationship between resources and sovereignty[13]. As such, *phosphopraxis* as a method is embedded within a particular understanding of scale that critiques a purely technical understanding, in favor of espousing the relationality it mobilizes.

16 At the time of writing, this changed significantly and swiftly. The United Nations Security Council has adopted a resolution which now supports Morocco's claim over Western Sahara, a position backed by US President Trump.

13 Chernoff & Orris, 2002

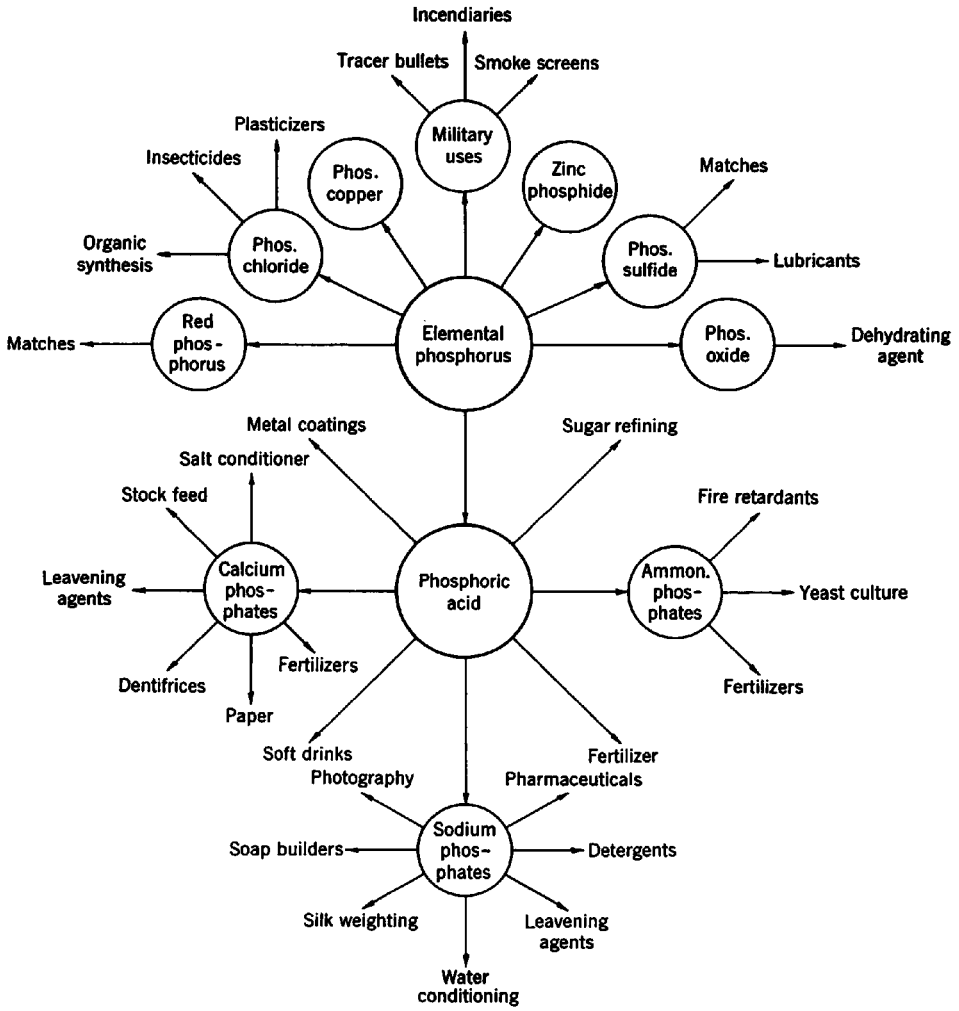
A technical understanding of scale is embedded in discourses that laud economies of scale or scalable metrics. From this perspective, what cannot be scaled appears to be unworthy of attention. As countless guides for scalable solutions would have it, whether in the sectors of business, tech, green solutions, or governance, we seem bound by the International Style's curse: to universalize, to flatten the edges of specificity, so that it can be applied *anywhere*. Precisely in the age of customization, is it possible that we might still be haunted by CIAM's ghost[17]?This question serves as a provocation that problematizes scale and its applicability, to acknowledge its powerfulness, while questioning its authority.

The Eames' infamous Powers of Ten, iconic in its address of scale, effectively captured the emerging perspectives enabled by satellite imagery and nanotechnology. Its fluid transitions across scale were hypnotic. Modernism's simplicity was, and perhaps still is, seductive. Contemporaneously, drones offer remote-controlled views from above, which can seamlessly zoom from the macro to the micro scale. In *phosphopraxis,* we might ask, what does the capture through sleek transitions obfuscate? For example, in Western Sahara, the Royal Moroccan Armed Forces strike using technologies from Elbit Systems and BlueBird Aero Systems. In cooperation and with the assistance of these Israeli defense firms, Morocco produces surveillance drones, loitering munitions also known as "kamikaze drones", and mobile artillery systems, which are deployed in Western Sahara to continue securing its occupation of the territory[18]. We are reminded of Achille Mbembe's words: "Africa is the living laboratory in which the figures of the world to come are sketched out"[19]. Under the lens of *phosphopraxis*, Western Sahara, like Gaza, is a testing ground for military weapons, and we might consequently begin to understand the fluid drone maneuver across scale as one that distracts from the interests of the Morocco-Israel alliance and the suppression of self-determination. This flattening also points to the linear logic inherent in such an understanding of scale. However, as Max Liboiron explicates, scale is not only a set of spatial, temporal, or quantitative relations, nor can it be reduced to a managing of such relations[20]. Relations across scales are not linear or scalable. Instead, scale functions as an epistemological conduit for approaching relationalities in a materially situated and differentiated manner.

In *phosphopraxis*, we consider different perspectives and the various registers that modulate phosphate, but the specific insights are not universally applicable. We aim to shift our focus from articulating phosphate runoff and heavy metal micro-traces as autonomous, supercomplex chemistry that causes harm (Figure 5), to instead discussing scales of colonial violence. In this sense, the relationship between harm and scale is one where harm is grounded in the "contravention of order at one scale and the reproduction of order at another"[21]. What the Moroccan state views as order produces harm to the Saharawi, repressing resistance, and to Palestinians through the military alliance with Israel, augmenting the latter's defense market, testing zone, and regional access. In other words, what might appear like a relevant strategy in one context can reveal itself to be genocidal in another. Obfuscating consideration across different scales can also be weaponized. In another example, recent nutrient neutrality

17 CIAM refers to the *Congrès Internationaux d'Architecture Moderne* [International Congresses of Modern Architecture].
18 Munadil, 2025
19 Kodjo-Grandvaux, 2019
20 Liboiron, 2021, p. 84
21 Liboiron et al, 2018, p. 335

schemes in the UK, which purport to ensure the protection of water bodies in conservation sites, offer offsetting options to developers that finance environmental protection projects elsewhere. While this may be beneficial to one location, it often exacerbates nutrient overload in another. Scale should therefore also be understood as cultural and political[22].



05 Intermediate and End Products, derived From Phosphate Rock and Their Industrial Uses; source: Waggaman, W. H., & Ruhlman, E. R. (1960). Phosphate rock. Part 2: Processing and utilization. U.S. Government Printing Office.

Viewing the issue solely through a technical lens risks overlooking deeper complexities that echo Vanessa Machado de Oliveira's[23] critique of modernity's misleading claim to universal solutions. The belief that a fix in one context can be applied everywhere reflects a problematic abstraction, ignoring the fact that knowledge is always shaped by its environment. Consequently, every solution is inherently limited in scope, and if applied without consideration of context, may unintentionally perpetuate the very issues it aims to resolve—or even generate new ones[24]. Or, as Machado de Oliveira aptly puts it, "modernity paradoxically creates the problems it tries to address"[25]. These reflections should fuel skepticism towards narratives that promise so-called innovative scalable solutions, which often conceal systemic violence. Phosphate rock is rooted in forms of violence that, beyond soil chemistry, move across scales and through the bodily, the domestic, the territorial, the geopolitical, and the infrastructural. It is therefore our contention that a critical raw enquiry into phosphate is only possible through the question of scale. Here, we define a "critical raw enquiry" as an art led enquiry that foregrounds the role of critical minerals in the construction of spaces and territories.

22 Ó Murchu, 2023, p. 6-11
23 Vanessa Machado de Oliveira, 2021
24 Idem, p. 27
25 Idem, p. 82

Scales operate across space as well as time, and as such, *phosphopraxis* inevitably considers the genealogies which contextualize the contemporary phosphate condition[26]. Certainly, this can never be exhaustive, and therefore inherently relies on the collaborative and the collective to further generate genealogical insights. Throughout this paper, we describe certain avenues which were explored, stemming from archival research, field research, and an organized walk through the English Midlands.

To glimpse the longue durée geostrategic importance of phosphate is to conjure decades of *marchandage politique* serving the long-term vision of the *Eurafrique* project[27]. France's post-war industrialization depended on continued access to resources in the Sahel, secured through the development of influential strategies in a post-colonial context. *Eurafrique* reflects enduring European ambitions in Africa today[28]. This unfolds largely through *marchandage politique*, loosely translated as political bargaining, an expression which underpins much of international trade relations. The Moroccan occupation of Western Sahara demands a fair amount of *marchandage politique* to have been able to continue contravening the UN Legal Counsel's mandate, which until its recent amendment in 2025 backed by the Trump administration, stated that the Saharawi have the right to self-determination. A contributing factor to the previously mentioned Israeli Moroccan alliance is also rooted in such negotiations, wherein the United States tacitly overlooks Morocco's territorial occupation in exchange for "certain strategic advantages"[29]. This long-standing liaison has grown with the 2020 Abraham Accords[30], where Morocco agrees to significant bilateralism with both the United States and Israel, and to cooperate on a number of sectors such as innovation and technology. The accord also states recognition of Morocco's sovereignty over Western Sahara. In addition to substantial military aid, the U.S. has largely assisted in the construction of a 2700km long berm dividing Western Sahara, cordoning off the "useful triangle" from the Saharawi and the Polisario–an area where the majority of the territory's mineral deposits lie[31]. The deepening US-backed military ties between Morocco and Israel are securing resources as much as a geopolitical "asset". It is not a coincidence that Israeli Prime Minister Benjamin Netanyahu further recognized Morocco's sovereignty over Western Sahara in a letter to King Mohammed VI on July 17, 2023. This is the *stuff* of political bargaining, and as it now supports a genocidal regime committing war crimes, its role can scarcely be overstated. For Morocco, and Spain before it, resource-rich Western Sahara is a profitable site to occupy, and the fact that it contains the world's most concentrated phosphate mine is central to this profitability. Western Sahara is also rich in sand, which is extracted and exported. The country has fisheries, among the richest in the world, largely exploited under the EU-Morocco Fisheries Partnership Agreement. Additionally, it is the site of massive solar and wind farms, as well as agricultural projects. However, in the context of *phosphopraxis*, we focus here on fertilizer, also because it has been of most historic importance together with fishing.

26 A nod to the Contemporary Condition Series edited by Geoff Cox and Jaco Lund which offers an inquiry into contemporaneity as a defining condition of the historical present. Here we draw a parallel between the aim of the series, which namely examines the planetary and politics of intrastructure and wider ecologies, and the capacity of phosphate to act as a material engquiry into such relationships.

27 *Eurafrique* refers to Eurafrica, a notion that germinated after WWI, where the unification of Europe was conceptualized and facilitated by the extraction of African resources. It did not however contain any bilateral provision for freedom of movement, but rather a curated designation of European settler colonies throughout the continent. For a critical overview, see our conversation with Peo Hansen and Stefan Jonsson in *The Contemporary Journal* (2021), and for an in-depth discussion, see their book by this title (2014).

28 Abderrahmane, 2025

29 Zunes, 1987, p. 423

30 U.S. Department of State, 2025

31 Zunes, 1987, p. 424

As gestured in *Eurafrique*, phosphate rock was also tantamount for the very foundation of Europe. First, it was part of Francois Mitterrand's Eurafrican France[32], and later for the institution of the European Economic Community (EEC). Phosphate is mentioned by the Spaak Committee in 1956, along with fossil fuels, metals, and hydropower, in a preamble to the Rome Treaty article–the one officially establishing the EEC:

"In addition to the mineral riches of all kinds and the agricultural and exotic products of the overseas countries, it is fair to mention as a concrete incentive, the results of very recent prospections in the petroliferous area carried out in connection with the systematic inventorying of the immense African reserves of metals, phosphates, and hydro-power"[33].

At the time, Western Sahara was a Spanish colony named *Sahara Occidental*, and its resources were instrumental to support Franco's fascisticised regime, which was otherwise girdled by international sanctions. And so, at a time when many African countries were claiming and transitioning towards independence, Spain refused to follow suit. It mobilized prospection efforts and, later, campaigns to sedentarize, through urban developments that would house the new workforce and bureaucracy of phosphate extraction. In parallel, many European states were scrambling to respond to the demands of decolonization, a delicate and often performative operation which distracted from the infrastructures being put in place to maintain access to resources, such as the CFA franc[34].

Phosphate, however, upset the balance that colonial administrators and architects sought to achieve with the housing projects in *Sahara Occidental*. The following quote published in *Viviendas en Africa* by Ramón Estalella, Chief of the Architecture service of the province of Sahara, reveals the way in which the Spanish regime was portraying the occupation as consensual, and even potentially mutually beneficial: "It was necessary to find the coherence between man, soil, climate and housing: a simultaneous agreement"[35].

HISTORIOGRAPHIC INVISIBILITY

Today, branded an economic and geostrategic security risk, access is restricted to the area surrounding the Bou-Craa phosphate deposits and to the Spanish state archives, which hold significant photographic and documentary material from the state's early involvement. This initiative was under the auspices of the state-owned industrial holding company, *Instituto Nacional de Industria* (INI), which promoted industrialization with the aim of achieving economic self-sufficiency. It created *Fosfatos de Bucraa* (Fos Bucraa), a company dedicated to exploiting the phosphate reserves in that zone. The company was founded in 1962, initially under the name *Empresa Nacional Minera del Sahara* (ENMINSA). Interestingly, as Spain slowly relinquished its shares in this company during its "handover" to Morocco, the intellectual property rights for many of the archival images were also progressively transferred, together with the company's ownership, to the Moroccan counterpart, *Office Chérifien de Phosphates* (OCP). In 1977, 65% of the shares were ceded, and the rest incrementally over the following decades, due to increasing political unrest over the occupation, until 2002, after which Spanish involvement was mainly limited to

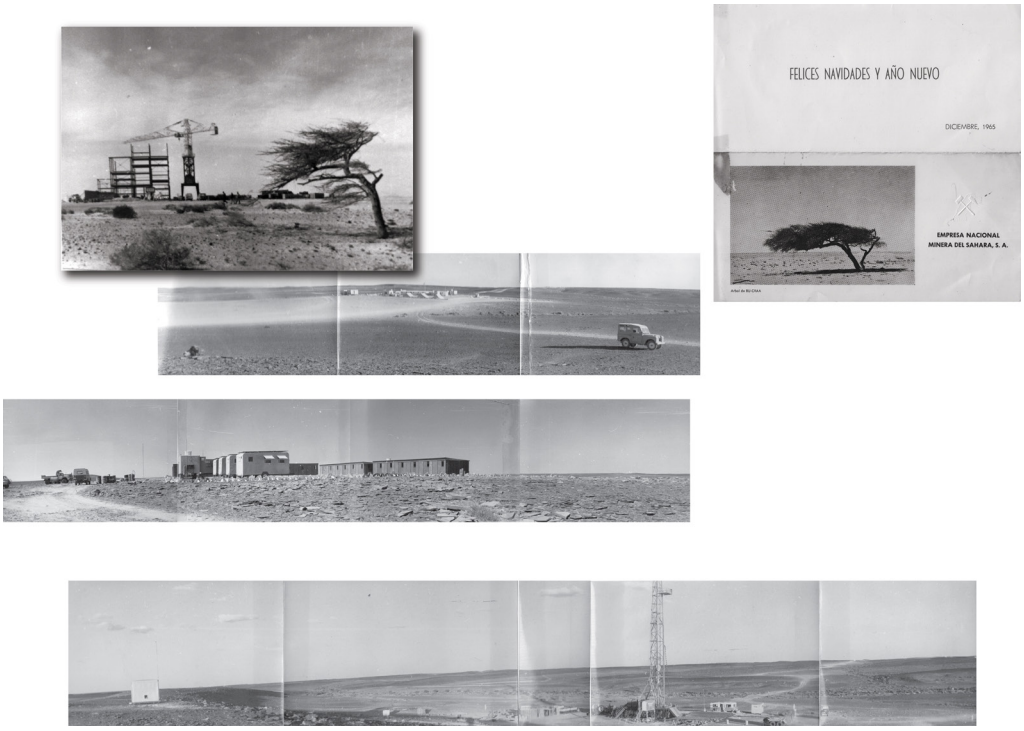
32 Hansen & Jonsson, 2014, p. 104
33 Ad Hoc Group for the Overseas Territories, 1956, as cited in Samson & Gallardo, 2021
34 Pigeaud & Sylla, 2018
35 Estalella, as cited in Rabasco, 2015, p. 316

participation in OCP's international advisory council. It is unclear when the intellectual property was precisely relinquished, and in conversation with Spanish state archives, we also learned that certain images, those, for example, produced by Fos Bucraa, should belong to OCP; however, others, produced by INI or a branch of it, probably do not. There is a distinct haziness around which images belong to whom, and at which point in time ownership may have been transferred. This creates an additional layer of inaccessibility, as uncertainty over intellectual property rights typically defaults to the impossibility of obtaining permission to use the images. Contemporary Spanish legislation curtailing access to foreign affairs and communications from high-ranking officials further exacerbates the tension between what is shared and what is obfuscated.

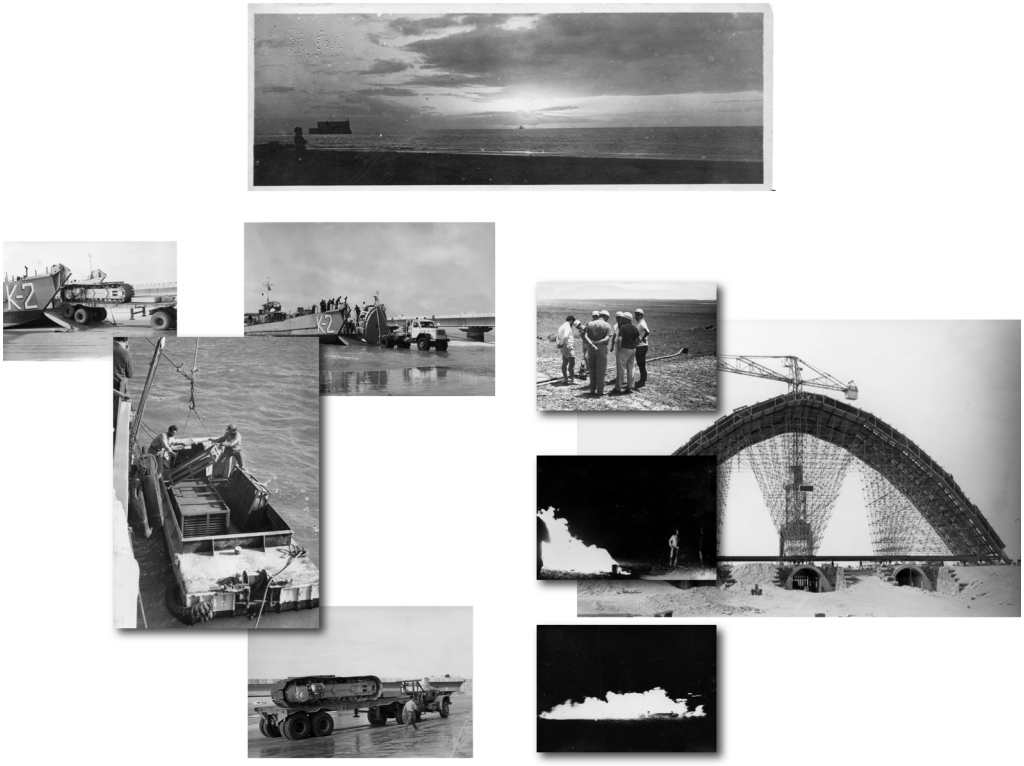
As a response to Spain's important role in the genealogy of phosphate futures, part of our *phosphopraxis* consisted of collecting archival documentation of Spain's initial prospection efforts in the area, including early modernist architectural experiments for housing projects built around the working of the mine. The following provides expanded contextual information on these montages of archival photographs and documents that depict Spain's actions in the area.

As mentioned, to retain its claim over Western Sahara on the international stage and to overcome the economic isolation imposed by the postwar international community, the prospecting campaigns initiated by the Spanish regime mobilized considerable resources for geophysical exploration. The photographs in Figures 6 & 7 depict several of these campaigns, with specialist equipment and large-scale machinery being offloaded from large vessels into amphibious military vehicles for transport to the shores of Saguia el-Hamra and Laâyoune. Initially, the Francoist regime focused on uranium prospection; however, as the presence of uranium in phosphate rock became increasingly well understood in the 1950s, strategic interests shifted toward the direct exploitation of phosphate deposits. This transition prompted systematic prospection efforts aimed at identifying high-concentration phosphate veins capable of supporting economically viable extraction. Probing also brings about unexpected collateral damage from poking and prodding the earth. A natural gas pocket is such an encounter, if rare, during drilling operations. For safety reasons, controlled ignition is required—an instance of this, which occurred in the Morcba region, near the Mauritanian border, is also shown in Figure 7.

In several archival documents, an Acacia tree is frequently depicted. The Acacia often stands solitary in the landscape, providing a useful navigational reference for nomadic groups. In Figure 6, the desert navigation tree, dubbed *el Árbol de Bu-Craa* [The Bou-Craa Tree], is re-appropriated into a Christmas greeting card, showing how cultural colonialism operated on many levels. In 1965, this card was sent to employees of ENMINSA, the National Mining Company of the Sahara, preceding Fos Bucraa, created three years earlier, exclusively for open-pit exploitation of phosphate in the Bou-Craa mine.



06 1965 Christmas card by the Empresa Nacional Mineral del Sahara S.A; Bou-Craa Tree with phosphate pilot plant in the background; Drilling well facilities, Bou-Craa camp; Panoramic view, Morcba camp. © 2025 SEPI, Images courtesy of SEPI, Madrid, Spain.



07 Photograph of a sunset on the Beaches of Cape Juby (1928), author unknown, image courtesy of FRAUD. Transportation of wheeled shovel machinery for exploitation testing on the beaches of Laâyoune; Unloading of scientific instruments, possibly around Cape Juby or Laayoune; Nighttime image of natural gas flaring at the Morcba camp drilling site. © 2025 SEPI, Images courtesy of SEPI, Madrid, Spain.

In June 1963, ENMINSA technicians drilled a well in the *hammada* [desert] near the pictured tree, following a series of unsuccessful prospection efforts in nearby areas pictured in Figure 6, including in Morcba, not far from Bou-Craa. They uncovered a phosphate vein of exceptionally high quality, located unusually close to the surface. Beneath the Bou-Craa tree lay one of the world's largest and richest phosphate reserves—estimated at 1.6 billion tons, with veins reaching up to 80 percent purity. This concentration far exceeded that of comparable deposits in Saudi Arabia, Algeria, or Finland. Now, in place of *el Árbol de Bu-Craa,* OCP's open-pit phosphate rock mining complex is situated.

36 Martínez Millán, 2007, p. 376

ENTER THE ARCHITECTS

"*Nuevas 'jaimas' de ladrillo y cemento, dotadas de todos los servicios, se alzan ahora en el desierto en zonas perfectamente urbanizadas. La civilización exige bases sedentarias.*"

[New 'tents' made of brick and mortar, equipped with all modern amenities, are now rising in the desert in perfectly urbanized areas. Civilization demands sedentary settlements.] (author's translation)

– Estalella, *Viviendas en Africa.*

"*Jamás sacamos de aquí el más mínimo beneficio material y os hemos dado en cambio cuando hemos podido*."

[We have never gotten the slightest material benefit from here, and in exchange, we have given you everything we could.] (author's translation)

– Carrero Blanco, *Acción de España en Sahara.*

The quote by Luis Carrero Blanco (Undersecretary Minister for the Government Presidency of Spain) during a 1966 visit to Laâyoune resonates with the preceding one by the previously introduced Ramón Estalella, a leading Spanish urbanist and architect of the period. Both encapsulate the masquerading of resource extraction (and occupation) under a thick veil of altruistic development. Carrero Blanco was known as Franco's right-hand man, and was far from enthusiastic about the decolonization process, having namely said that the Province of the Sahara was "as Spanish as the province of Cuenca is"[36]. His claims of generosity obfuscated the actual focus of the visit, which was to assert continued control over the region. Countering such narratives of colonial altruism, we denounce the large-scale public works and infrastructural efforts as a form of "historiographical invisibility" for Spanish African colonialism. In this context, this phrase refers to both the way it is depicted and what is left out of the picture, together with the invisibility of much of this material today. Clearly, the images portray developmental optimism, foregrounding the industrial sublime of machinery and infrastructural projects, and none of the dispossession that was a direct result of this. Also, the colonial genealogy of the current mining and urban infrastructure is usually not under-

stood from the perspective of the Spanish continuum. However, Spanish colonial architecture helps elucidate this perspective, demonstrating how the housing projects and urban planning aided and abetted the preservation of colonial tropes.

As such, under the pressure of rising decolonization, the regime initiated alternative modes of occupation to maintain the extraction of valuable resources such as phosphate and fisheries. The earliest efforts to assimilate nomadic populations involved forcibly evicting them from their traditional grazing grounds and trading routes, followed immediately by the aggressive promotion of sedentary settlements away from resource-rich areas. Echoing Liboiron, Spanish colonization required not just access to resources, it entailed the eradication of other types of relations that could pose a threat to that very access[20]. As part of this process, several strategies were employed, reinforced by the newly built environment. *Cabilas* [a Berber term that refers to both indigenous tribal organizations and their territory] were disbanded, and in parallel, the regime introduced passes which became mandatory for communities crossing the borders between the French and Spanish occupied regions. The carrying of regime-issued IDs also became compulsory. In addition, the French franc and the Spanish peseta were introduced as official currencies. This created a need to engage in labor-based economic relations in order to secure the means for tax payment—a model previously implemented by France in parts of Sub-Saharan Africa. As the *Impôt de capitation* [head tax] was payable only in cash, the scarcity of the latter often implied unescapable labor on public infrastructure projects and administrative buildings[37].

The imposition of administrative structures in Ifni and the greater Province of the Sahara was later compounded by the creation of experimental urban plans, the construction of harbors, airports, and markets (Figure 8). To further entice nomadic communities into sedentary settlements, newly established colonies expressly attempted to include a locally infused modernism through the adoption of spatial and decorative design. That is to say, the superficial and decontextualized nature of these ornaments rather became an element of dispossession. Espousing an "ethnological stance"[38] pioneered internationally by groups such as ATBAT-Afrique and CIAM-Alger[39], architect groups headed by Estalella, incorporated elaborate yet cheap lattices for climate control in Sidi-Ifni's housing projects, or center patios for livestock keeping, and local markets such as those incorporated in the experimental housing group *El Hexágono* in Laâyoune (Figure 8).

The spatial configuration of *El Hexágono* was characterized as being (dis) placed at the periphery and at arm's length from the urban center, which was dominated by the administrative and military corps. This was done, according to the architects, to preserve an imaginary way of life. Each unit had a center courtyard (intended for sheltering livestock during nighttime) with a wedge-shaped floor plan. This project, and according to Rabasco Pozuelo[40], reveals a striking resemblance to an earlier project, *Cité du Soleil* in Avignon, by the group Candilis, Josic and Woods. This project was part of a policy of racialized expulsion and re-settlement of Roma and/or traveler communities from city centers to the peripheries, in what

20 Liboiron, 2021, p. 96
37 Young, 1997, p. 173-174
38 Demerdash, 2015, p. 98
39 Avermaete, 2006
40 Pozuelo, 2013

became known in France as 'Roma cities.' In the *Cité du Soleil*, the architects mobilized a racist understanding of the inhabitants–the latter using tropes like *tribu* [tribe] as a social unit, in which the proposals respected 'millennia-old traditions' that included, among many others, sleeping on floors and the absence of personal items[41]. With many structural and design failures (such as the effective provision of sun and wind sheltering), these projects renewed, rather than solve, the conditions they purported to address.

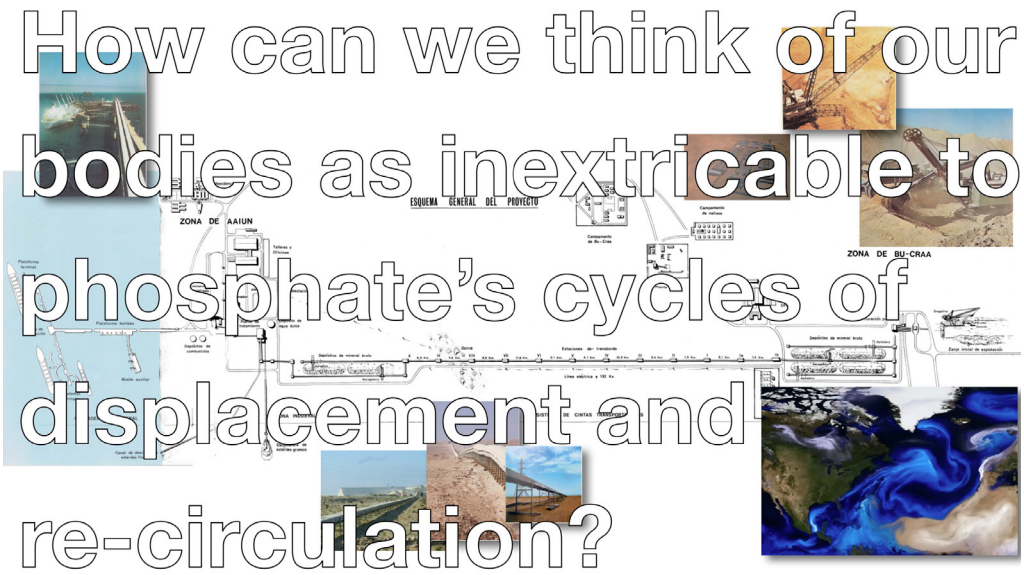
The failure was similar in Ifni, where, for the local nomadic population, it was rather an architecture of displacement. After all, tents and *jaimas* operate under different indoor/outdoor relations. The outdoor spaces included in such developments were based on sedentary land ownership models that fail to understand other forms of land use. As outlined in the film *DESERT PHOSfate* by Sahrawi artist Mohamed Sleiman Labat, which discusses life in camps along the Algerian border, the harsh climate demands significant movement across the terrain to obtain sustenance. As such, forced sedentariness in the camps has aggravated malnutrition.

08 Housing unit for military personnel in Villa Cisneros (Dakhla); Public square and fountain at the workers' quarters next to the Bou-Craa mine; Image of public market after works completed (1966) part of the 1962 Sidi Ifni neighbourhood (Plan General de Edificación de Ifni); Grand plaza for the *Hexágono* housing group in Laâyoune (El Aaiun), 1960-62; Mass and celebrations on December 4th in honour of Saint Barbara (patron saint of miners) for the workers of the Bou-Craa mine; Aerial view of the *Hexágono* housing unit in Laâyoune (El Aaiún), 1960–62. Aerial view of a complex of 12 terraced houses in Dakhla (Villa Cisneros), 1964–67, built for agricultural and industrial entrepreneurs. "La Paz" neighbourhood in Laâyoune (El Aaiun). Housing complex for military officers in Dakhla (Villa Cisneros), 1964-66. CC BY-NC-ND 4.0, 2025. Research repositories of the research group GAMUC and the University of Seville, Spain. Housing units for Fos Bucraa's engineers in Laâyoune; Terrace housing units in Villa Cisneros (Dakhla), most probably for military personnel. Source: Instituto de Estudios Africanos. (1971). La acción española en el Sáhara. Consejo Superior de Investigaciones Científicas. © 2025, Consejo Superior de Investigaciones Científicas, Madrid, Spain.

Sidni-Ifni's plans also reinforced segregation, as there was an extensive provision of public, rent-limited housing schemes; however, it benefited mostly military personnel, such as in Dakhla (Villa Cisneros), and in Laâyoune, settlers and locals were literally separated in the North and South of the city's center (Figure 8)[42]. Ultimately, Spain's African colonies provided mainland modernist architects and urbanists with a fertile ground for experimentation, one that was not granted so freely in the mainland. It is no accident that the first-ever Modern Spanish General Urban Plan by Pedro Muguruza—celebrated for being the first implementation of zoning laws and recognized in 2015 as National Heritage of Morocco—was not for the Spanish capital, but rather in Tetuan, in the

41 Mouchard, 2022
42 Carrascal Pérez et al., 2015

Spanish Protectorate of Morocco. Currently, as Western Sahara is one of the testing grounds for Israeli drone weapons, modernity, which was rooted in separation and scale, is now perpetuated through the spectral scales of unmanned aerial vehicles. Moving forward, how can we think of our infrastructures as inextricable to phosphate's past and current relationship to dispossession and occupation? But also, its cycles of displacement and re-circulation through land and water bodies (Figure 9)?



09 General plan for the Bu-Craa mine, from mine to port. Source: Instituto Nacional de Industria. (1972). The phosphate deposit of Bu-Craa. Fosfatos de Bu-Craa S.A. NASA's Goddard Earth Observing System (GEOS) picturing Hurricane Maria forming, which hit Puerto Rico in 2017. The weather system captures Saharan sand sea salt and other aerosols transporting them from the African to the American continent.

NUTRIENT NEUTRALITY

Dependence upon phosphate extraction continues to be actualized in the built environment through nutrient neutrality schemes. Stemming from what is known as the 'Dutch Nitrogen' case. In 2018, the Court of Justice of the EU established that projects with the potential to adversely affect protected sites must not be granted approval. This not only includes legislation which concerns the authorization of new developments, but also the introduction of measures which may include "the surveillance and monitoring of farms whose activities cause nitrogen deposition and the possibility of imposing penalties, up to and including the closure of those farms"[43]. Henceforth, the notion of appropriate assessment, how it is defined and measured, should become the object of scrutiny.

In the UK, because Habitat Regulations originated in EU law, which predated Brexit, interpretation must be in line with EU case law. This affects approval for new housing developments, with specific attention to the additional wastewater they produce and the extra nutrients they create in the catchment area. Nutrients refer to nitrogen and phosphorus; thus, according to the UK's House of Commons briefing, nutrient neutrality is achieved if the "proposed development will not result in any additional nitrates or phosphates being discharged to the catchment"[44]. The nutrient budget of a site is calculated by taking into account increased wastewater production resulting from additional population due to development, together with current and future land use and associated nutrient export levels[45].

43 Raad van State, 2019
44 Rankl, 2023
45 Ricardo & Natural England, 2022

This has spurred the development of mitigation schemes to counterbalance the supplemental nutrients in waterways. This includes offsetting measures such as restoring semi-natural habitats, creating treatment wetlands, upgrading treatment plants, or taking land out of use. In 2023, Natural England launched a nutrient mitigation scheme (NMS), which, much like the emissions trading system (ETS), made credits available. Developers who could invest in certain nutrient-reducing projects *elsewhere* could thereby offset the increase in nutrients in their own projects. But what does it mean for nutrients to be deemed "neutral"? To what extent does this budgetary exercise frame nutrient neutrality as a zero-sum paradigm? One that ultimately balances out in spreadsheets, rather than in waterways. Again, echoing Liboiron's concerns, does this form of offsetting also presume access to the areas meant to be "upgraded"? And, how can critical spatial practices address violence, rather than only harm? At what scales do phosphate relations work, and how do we address them at the same scale?

TRIPLE SUPERPHOSPATE

Here, we move from forms of nutrient calculations that exacerbate eutrophication to consider phosphate itself, a mineral that has the potential to problematize its continued extraction and gestures towards eliding the commodity market of exhaustion altogether. In doing so, we have taken Triple Superphosphate fertilizer as a material of enquiry, moving across the elemental, the infrastructural, and the territorial. Figure 10 shows a phosphorescent pigment produced from such fertilizer during a residency at RADAR Loughborough[46]. The pigment was synthesized with several apatites, one of which was doped with Europium. Mostly mined in Inner Mongolia, Europium, named after the European continent, is namely used as an anti-forgery measure in many currencies such as the Euro. The fertilizer used was obtained from a UK-based company which openly disclosed the use of Western Saharan phosphate, despite the fact that this constituted a violation of international law according to the UN Legal Counsel. The resulting pigment has a magenta glow under UV light. This highlights another important aspect of *phosphopraxis*, forms of material enquiry that are non-discursive and rooted in a desire to pay close attention to the mineral and its elemental qualities. Figure 10 also shows the safety datasheet for Superphosphate Triple fertilizer from Nutrien, a Canadian fertilizer company, one of the largest in the world, and the OCP Datasheet for phosphate rock mined in Bou-Craa, Western Sahara. The phosphate is derived from francolite, indicating its calcium and fluoride content, which is characteristic of sedimentary phosphate and points to the organogenic origins of the Bou-Craa deposit. Figure 11 shows a silkscreen print composed of some of the elements that informed our enquiry. The large-format print layers a scanning electron microscope (SEM) image[47] of a grain of Triple Superphosphate fertilizer with an archival photograph of the site where the phosphate was mined, depicting the landscape prior to the start of mining operations, with the *Árbol de Bu-Craa* as its central figure. Understanding how images represent the mineral across scale, whether as a scientific object at the nanoscale, as an archival document, as an infrastructural element, or as an instrument of cultural colonialism, is another facet of *phosphopraxis*, one through which the layered materiality of the silk screen process lends itself. That said, *phosphopraxis* remains promiscuous in its choice of medium explorations.

46 The pigment was synthesized with Dr. Kurt Lawson and Prof. Sandy Dann in the Chemistry Department at Loughborough University.

47 Courtesy of Loughborough University.

10 Bu-Craa Phosphate rock Safety Data Sheet © 2025, OCP. Image courtesy of Western Sahara Resource Watch, Brussels, Belgium. Simple Fertilizer Triple Superphosphate product sheet, Granulated. © 2025 Nutrien Europe S.A. Image of FRAUD's Triple Superphosphate pigment (2023) under ultraviolet light; Europium-doped, phosphorescent pigment; image courtesy of FRAUD and RADAR. Dr. Kurt Lawson is processing francolite phosphate fertilizer into pigment in the Chemistry Department at Loughborough University; image courtesy of FRAUD and RADAR.

11 Triplesuperphosphate, FRAUD, 2024. Four-layered silkscreen print on acid-free paper, approx. A1-format, edition of 30 SEM image courtesy: Loughborough University; archival image courtesy: Dr. Lino Camprubí, Instituto Geológico y Minero de España.

AFTERGLOW, SPECTRAL TRACES

We began by asking how we can make sense of the complexities of a site which unfold in relation to colonial genealogies, global supply chains, the commodities market, and policy. For FRAUD, *phosphopraxis* has been a research methodology that attempts to bridge British waterways and development sites with the wider network of trade, governance, and genealogies of extraction in which they are enmeshed. The modulation between site specificity and its broader framework of "dependencies" lies at the heart of *phosphopraxis*. It is our contention that scalable abstractions often reproduce and reinforce structural violence under the guise of efficiency and ever-popular *économies d'échelle* [economies of scale]. Consequently, *phosphopraxis* moves across scale without offering scalable solutions. We are advocating for multiscalar investigations into existing forms of structural violence to envision interventions that can occur at

scales that match and impact the various relationships drawn together in this essay. Only by doing so can the scales of problems and the scales of proposed interventions align without offsetting harm *elsewhere*.

As we have outlined, phosphate has recently gained increasing spotlight, being instrumentalized to create political divisions between farmers and *les écolos* [ecologists], in propelling the eutrophication of water bodies, and lying at the heart of the continued occupation of Western Sahara, to name a few. We argue that the current awareness being cultivated around the mineral, encompassing the stakes of its use, extraction, and exhaustion, should consider the specificity of the site examined in conjunction with the web of planetary relations in which phosphate exists. That is to say that the Moroccan occupation of the area cannot be understood without considering the global supply chain of fertilizer as well as the earlier Spanish occupation. In the same vein, the smooth drone remote-controlled surveillance made possible by the Israeli Moroccan partnership can only be made sense of in the context of gaining US support for the occupation. Here, the new technology of scalar violence is in operation. Like Gaza, Western Sahara has become a testing ground for military weapons, where the seamless drone capture across scales distracts from the political alliance and the suppression of self-determination. Considering the historiographical invisibility of earlier geographies and architectures of dispossession becomes equally paramount. Spain's colonial architecture in Western Sahara masked occupation and resource extraction under the guise of development. Urban planning and housing projects, often experimental and racially coded, displaced nomadic communities and reinforced control. These infrastructures, rooted in colonial logics, continue to shape the region's geopolitical landscape, linking past dispossession to present-day technologies of surveillance and extraction. Arguably, these logics of assumed access are reflected in nutrient neutrality schemes. By framing ecological harm in housing development impacts as a calculable offset, it exacerbates the commodification of resources.

Echoing Mi You[48], this commodification and these genealogies of extraction, we argue, can only be denaturalized by bridging scales of development, responding to concerns which are local as well as planetary. As such, the visual essay presented, through archival material and research documentation, attempts to re-contextualize the rich web of phosphate relations this mineral mobilizes. Or, as Matthew Fuller puts it: "to reach across compressed domains of reality to make connections"[49]. In this way, *phosphopraxis* proposes critical raw enquiries across scales, which are not scalable, but rather aim to provide opportunities to shape the epistemic commons. Michael Richardson argues that the artistic form has a unique capacity to address the problems of scale outlined in this essay, that it can "forge affective relations" between what can seem incommensurable[50], such as the concerns of land custodians and those of the commodities market. After all, knowledge is always shaped by its environment, and we therefore embrace respecting the specificity of the site within its context of wider complexities. Ultimately, *phosphopraxis* shines bright with multispecies respect and the universal right to self-determination.

48 You, 2025
49 Fuller, 2025, p. 17
50 Richardson, 2020, p. 341

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