

Mining and otherness: why a jonasian perspective is imperative for disaster prevention

Mineração e alteridade: como a perspectiva jonasiana é imperativa para a prevenção de desastres

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Abstract: The aim of this article is to analyze, from Hans Jonas's perspective, the impact of mineral extraction activities on groundwater resources and their consequences for human and non-human water supply, drawing on the German philosopher's theory of responsibility, particularly his concept of the "heuristics of fear". First, it seeks to expose the metaphysical foundations that led to the imposition of a way of relating to nature based on the dualism between human beings and nature, a view strongly criticized by Jonas. Furthermore, it situates the Jonasian critique of technology by using mineral exploration and extraction activities, together with their impacts on water bodies, as one of the clearest and most practical examples of the consequences of this dualism. It then discusses the possibility of ethically responsible mining, outlining the ethical limits of mining activities. In this sense, the article proposes an ethical imperative for rethinking economic activities so that they address not only the needs of present generations but also the survival needs of future generations.

Keywords: mining; water; Hans Jonas; theory of responsibility.

Resumo: O objetivo deste artigo é analisar, sob a ótica de Hans Jonas, o impacto das atividades de extração mineral sob corpos hídricos subterrâneos e suas consequências para o abastecimento humano e não-humano, utilizando-se da teoria da responsabilidade do filósofo alemão, sobretudo de seu conceito de "Heurística do temor". Primeiramente, busca-se expor os fundamentos metafísicos que levaram à imposição de um modo de relação do ser humano com a natureza, fundada no dualismo ser humano versus natureza, tão criticado por Jonas. A seguir, situa-se a crítica jonasiana à técnica, tomando como referência a exploração mineral e as atividades de extração mineral com seus impactos nos corpos hídricos como um dos exemplos mais firmes e práticos das consequências resultantes desse dualismo. A partir daí, discute-se a possibilidade de uma mineração eticamente responsável, delineando os limites éticos para a atividade minerária. Nesse sentido, será apontado um imperativo ético para que possamos pensar atividades econômicas em que caibam não somente as atuais gerações e suas necessidades, mas também as necessidades de sobrevivência das gerações futuras.

Palavras-chave: mineração; água; Hans Jonas; teoria da responsabilidade.

1 Mining and water scarcity: the consequences of mining technology

Mining and metallurgical activities require large volumes of water, which may contain colloids, chemical reagents, anions, dissolved heavy metals, suspended solids, among other substances (Rebouças et al., 2015). The

most frequent problems can be summarized through productive axes, namely mining, ore processing/beneficiation, and extractive metallurgy.

During the mining phase, soil and groundwater contamination may occur due to the use of oils in operating equipment for various purposes, including transport vehicles and pump lubricants, as well as glycerin-based explosives and, as previously mentioned, acid mine drainage. In the ore processing/beneficiation phase, pollution is more commonly associated with colloidal solid waste, organic compounds (including foaming agents, surfactants, and oils), as well as heavy metals and anions (Yue et al., 2017).

The environmental impacts of extractive metallurgy stem from liquid effluents containing heavy metals, anions, complex and toxic organic and metallic compounds, emulsified or non-emulsified oils, organic solvents, and sludge.

According to Rebouças,

Water treatment processes in the mining industry encompass not only the removal of impurities introduced during industrial operations (such as reagents and species dissolved in the ore), but also the pre-treatment of the water collected to meet the requirements of specific uses (Rebouças, 2015, p. 445, author's translation).

In this sense, in addition to efficient and properly monitored wastewater management, a comprehensive assessment of all possible scenarios is necessary, with particular attention to the worst-case scenario.

Pinheiro (2019) state that ecosystems are fundamentally life-support systems for the human species and all other forms of life. The biological need of human beings for food, water, clean air, shelter, and a relatively constant climate is basic and unalterable. Ecosystem services are indispensable for the well-being of all people, everywhere in the world.

Mining differs from the exploitation of most other natural resources in that it typically has a defined beginning and end. Mineral resources, within commercially and geographically viable limits, are finite. Other forms of natural resource use, such as agriculture, can continue indefinitely, provided that resources and inputs are properly managed. Mines are opened and closed as production demands fluctuate in response to changes in commodity prices and advances in technology. Globally, mineral resources are subject to volatile cycles of growth and decline. These can result in significant changes in mine operations, ranging from periods of expansion and increased production to periods when production is reduced or even interrupted. These variations, together with the dynamic nature of mining operations, make the development of a static model a major challenge (Lechner et al., 2017).

Planning for mineral extraction regions must accommodate mineral and energy resource extraction while ensuring coexistence with traditional land uses, such as agriculture and ecological conservation. Lechner et al. (2017) identify six aspects of planning in mining regions: the temporal

nature of mining operations; their spatial dimensions; their social dimensions and corporate responsibilities; the irreversible changes to post-mining landscapes; the cumulative nature of environmental impacts; and interdisciplinarity as an integrative tool for understanding these phenomena.

A pertinent question is: given the aforementioned market volatility, the fluctuations in mining activity and, consequently, in the operations of mining companies and conglomerates worldwide, how can we ensure that these actors remain permanently responsible for managing a specific contaminant if the continued existence of the company itself cannot be guaranteed? Given the temporal nature of mining activities, how can we manage consequences whose effects may extend far beyond the time horizon we are capable of anticipating?

2 Metaphysical foundations of the human–nature dualism

Traditionally, according to Valls (2002), ethics is understood as the study and reflection (whether scientific, philosophical, or even theological) on customs and human actions. Life itself may be considered ethical when it conforms to socially accepted norms of conduct. Ethics, then, is understood as the study of actions and customs, and may also refer to the very practice of a particular type of conduct. In addition to evaluating human behavior, ethics also includes the normative aspect, establishing a link between the factual and the normative, or between the real and the ideal.

According to Grün (2012), one of the main causes of environmental degradation is that we live under the aegis of an anthropocentric ethic. In the value system shaped by this ethic, human beings are placed at the center of all things. Everything else in the world exists solely for their benefit. Grün says:

Man is the center of the world. In fact, anthropocentric ethics is not as new as one might think, nor is it an exclusive creation of Descartes. The roots of anthropocentric ethics are already found in the Old Testament. (...) There is a passage in Genesis that is particularly enlightening regarding the cultural roots of anthropocentrism: “Then God said, ‘Let us make mankind in our image, in our likeness, so that they may rule over the fish in the sea and the birds in the sky, over the livestock and all the wild animals, and over all the creatures that move along the ground’” (Genesis 26:28). However, this ethic assumes a much broader scope in the philosophy of Descartes (Grün, 2012, p. 24, author’s translation).

Descartes’ philosophy represents a major philosophical milestone for understanding the modern human relationship with nature. During the transition from the medieval to the modern world, the emergence of classical humanism placed the human being, once regarded as subordinate to the divine, at the center of intellectual and cultural life. Within the

context of humanism, Western society underwent a transformation that extended beyond the philosophical sphere to the artistic, political, and even religious spheres. Grün continues:

The task of reorganizing the world requires this man to develop special abilities. *Virtù* is this capacity, now acquired by man, to choose the right occasions to transform the course of events. Man wants to leave his mark on the world. He is no longer content with the position relegated to him by medieval theology. This will lead to the modification of the logical spatiotemporal structure by which human beings perceive and explain the world. In this new logical structure, human beings will see themselves increasingly at the center of the universe (Grün, 2012, p. 25, author's translation).

These philosophical developments did not occur in isolation; we must consider the broader context in which they emerged. Socially, while the bourgeoisie consolidated its position as the dominant social force, the Reformation and the Counter-Reformation profoundly and irreversibly transformed the Church's relationship of power over society.

Grün (2012) further states that:

The epistemology of medieval theology, which had God as its nodal point and support, loses its credibility. (...) In this diffuse and disordered context, human beings search for a center. (...) Human beings, it seemed, were truly responsible for their own destiny, but this condition ended up generating a kind of uncertainty. (...) The transition to the modern world is characterized, above all, by a crisis of legitimacy (Grün, 2012, pp. 34-35, author's translation).

It is precisely in this context that Descartes emerges. In this diffuse environment, where the old order is fading but a new one has not yet emerged, philosophical thought unfolds within this vacuum. The foundational element of the order is no longer present, but the need for a foundation remains. It was therefore necessary to establish a new foundation capable of reuniting human beings under a new order. It is in this sense that Descartes is regarded as one of the "fathers of modernity".

Descartes believed that human reason itself could be the central point of reference. To grant reason the desired unity, he needed to overcome the following methodological problem: if reason is autonomous and unified, it is necessary to identify an object of reason that is neither unified nor divisible. In this search for the autonomy of reason, there was, therefore, the objectification of nature.

Given that reason is autonomous, it would then be impossible for nature to be autonomous. Therefore, nature needed to be dominated. According to Grün:

The question is simple: how can I dominate something of which I am a part? The answer is that I cannot; consequently, I cannot be part of nature. If I intend to dominate it, I need to situate myself outside of it. Descartes manages to legitimize the

unity of reason at the cost of the objectification of nature. It is on the basis of this radical division between subject and object that practically all subsequent scientific knowledge will be based. The subject is the *cogito* and the world, its object. It is on the basis of this dualism that we find the philosophical genesis of the modern ecological crisis, because from this division nature is nothing more than a passive object awaiting analytical intervention. Human beings withdraw from nature.

The distinction between subject and object will legitimize the entire methodological procedure of the natural sciences. (...) Cartesianism and Christianity combined laid the foundations for an ethics, and men became, in Descartes' own words, "masters and possessors of nature" (Grün, 2012, p. 37, author's translation).

Thus, the anthropocentric ethic upon which modernity is based was established. By positioning themselves "outside" nature, as subjects rather than objects, human beings become able to scrutinize and exploit nature in order to extract from it what they seek to discover and possess (Massenberg, 2019).

As a direct consequence of this philosophical model, based on the supposed real and objective separation between human beings and nature, body and mind, this way of conceiving the world prevents us from understanding other forms of perceiving existence, other cosmogonies, and other worldviews (once again, Bacon and his critique of Aristotelian teleological physics, among others). Therefore, prevailing production models were (and continue to be) highly destructive toward the environment (Massenberg, 2019).

This anthropocentrism in modern ethics has had disastrous consequences for the environment, with this metaphysical understanding being one of the reasons for the disregard of non-human nature, which has been reduced to the status of an object "without life or spirit". Hans Jonas was one of the names in ethics who first warned that nature had been considered ethically "neutral". Modern metaphysics has contributed to the serious environmental crisis we are currently experiencing by allowing the disregard of natural beings, which came to be seen as devoid of ethical dignity. It is in this context that ethics begins to incorporate concern for the moral dignity of non-human beings in an effort to address the serious environmental crisis that has affected humanity. Thus, from the 1970s onward, a branch of ethics known as environmental ethics emerged, proposing a new way of conceiving the relationship between human beings and nature through a more holistic perspective.

According to the *Stanford Encyclopedia of Philosophy* (2011), environmental ethics is the branch of philosophy that studies the moral relationship between human beings and nature, as well as the values and moral status attributed to human beings and other non-human entities.

Questions and discussions about the relationship between human beings and the environment reflected a widespread perception in the 1960s that the century would face a "population bomb" and a severe environmental crisis. Among the

accessible works that drew public attention to this sense of crisis, one can cite the book by scientist Rachel Carson, *Silent Spring* (1963), which drew attention to the use of pesticides in agriculture, showing how they could simultaneously affect the environment and public health, although environmental awareness also emerged from the economic and productive sphere. In this sense, the mineral extraction process, whose technologies are constantly advancing, also relies, like much of Western science, on the dualism stemming from anthropocentric ethics, in contexts where nature is harmed in the name of the widely promoted concept of “development”. The technologies currently used in mineral extraction clearly reflect the Cartesian dualism that paved the way for nature to be viewed as an object to be exploited without limits in the service of human interests and ends. At the end of this work, drawing on the discussions initiated by Hans Jonas and considering his principles, we intend to examine whether mining can be ethical and socially responsible. Hans Jonas’s ethical reflection will serve as a framework for analyzing the relationship between mining and water, allowing current levels of mining exploitation and their present and future consequences to be questioned in light of the moral dignity of nature and the responsibility of current generations toward future generations.

3 Hans Jonas and the critique of technology

Hans Jonas, a German philosopher who emigrated to Palestine, then to Canada, and finally to the United States due to Nazism, is an heir to the phenomenological tradition of Husserl and Heidegger. His concern, expressed in the book *The Imperative of Responsibility* (1979), is the preservation of life in all its dimensions. While ethically justifying the need to preserve humanity, he acknowledges that this is impossible unless the ecological conditions for its existence are also preserved (Hess, 2013).

From the perspective of the so-called philosophy of technology, Jonas has been classified among thinkers considered “dystopian” due to the negative projections they make regarding the risks of technological advancement when detached from ethics. Jonas rejects the view that technological advancement is, in itself, a destiny. For Jonas, technology is neither neutral nor a destiny in this restricted sense. Rather, for the author, it is a power and a vocation marked, in the modern era, by a magnitude and ambivalence that demand ethical reflection on its use, with the aim of altering this trajectory (Oliveira, 2014).

Regarding this critique of technology as humanity’s “vocation”, Jonas (2006) points out that:

Today, in the form of modern technology, *techne* has transformed itself into an infinite impulse of the species forward, its most significant undertaking. We are tempted to believe that the vocation of humankind lies in the continuous progress

of this undertaking, always surpassing itself. (...) In other words, even disregarding its objective works, technology assumes an ethical significance because of the central place it now occupies subjectively in the ends of human life (Jonas, 2006, p. 43, author's translation).

Jonas's concern is that, having assumed the role of an outsider in relation to nature and becoming its "master", humanity's success in this endeavor has led to interference in the lives of other human and non-human beings through the power of technology. Therefore, valuing all forms of life, as Jonas does, also means valuing the preservation of human life on Earth. Jonas says:

The presence of man in the world was a primary and indisputable fact from which all ideas of duty regarding human conduct stemmed: now, it has itself become an object of duty – that is, the duty to protect the basic premise of all duty, namely, precisely the presence of mere candidates for a moral universe in the physical world of the future; this means preserving this physical world so that the conditions for such a presence remain intact; and this means protecting its vulnerability in the face of a threat to these conditions (Jonas, 2006, p. 45, author's translation).

In line with Jonas's argument, Grün (2012) notes how important this dualistic break between nature and human beings, as well as the paradigm shift it promoted, was for philosophical thought to develop into its current form. Grün states:

Bacon's project was to transform (organic) nature into the New Atlantis. Thus, Bacon began to draw the modern dividing line between nature and culture. A line that would end up being strongly inscribed in history, irrevocably splitting human beings and nature. This division would take on the proportions of an abyss in subsequent centuries (Grün, 2012, p. 33, author's translation).

Grün further states that Baconian enthusiasm and optimism held that man should be the master of his own destiny, which, of course, implied that he should become the master and lord of all things in the world. Thus, the Baconian perspective of a new culture carried within it a radical form of anthropocentrism.

Bacon's "modern" project has failed, as demonstrated by the depletion of natural resources and the consequences of recent climate change, which threaten humanity's survival. Humanity has not become entirely free through science, as Bacon imagined. However, the other side of his project has prevailed in a surprising way, and anthropocentrism has become central to the conception of science in the modern era.

Oliveira (2014), a commentator and specialist in Jonas's ethics, points out that technology constitutes an ethical problem for five reasons: the ambivalence of its effects; the automaticity of its application; the new global dimensions of space and time; the rupture with anthropocentrism; and the approach to the metaphysical question.

The first reason highlights how futuristic technological projections can obscure the risks and threats of technological practice, with only a few consequences of these technologies being known, both by those who implement them and by those affected by them. Using the example of the interactions between water and mining, when mining areas are established in new regions, there is usually a general notion instilled in the population that these actions can generate employment and income, improving the quality of life of the population. But what would happen if the region's water resources were excessively consumed? And what about other productive activities also dependent on water, such as agriculture and small-scale livestock farming? Oliveira argues that if humanity were completely certain that its actions were always good, there would be no need to evaluate them ethically. The problem arises precisely when technology begins to dispense with ethical evaluation, creating a dangerous separation between technology and ethics.

As Lins (2015) states, the risk of water supply shortages is looming; in this sense, it will not be surprising if, due to the use of large volumes of water, part of the responsibility for this problem falls on the mining sector.

The critique of Jonas's technique also takes into account that, given the new scale of the technology, any use can lead to negative effects, inseparable from the positive ones:

Not only when technology is used with ill intent, that is, for harmful purposes, but also when good intentions are pursued for highly legitimate personal ends, does it have a threatening side that could have the last word in the long run. And the long term is, in some way, uncertain in the context of technological action (Jonas, 2013, p. 34, author's translation).

For Jonas, then, ethics must involve not only the isolated evaluation of intentions but also the evaluation of the consequences of human action. As alluded to, technology does not possess ethical neutrality, and serious consequences can arise from the risk it entails. Ethics can contribute to avoiding or mitigating these serious consequences, since it can guide human action toward the good by anticipating its future consequences.

The second reason is basically concerned with the possession of power and its use. While power and action were once largely distinct, this is no longer the case in modern society, given the constant drive for "updating" that imposes its own rhythm on technology.

According to Oliveira (2014), just as "being able to breathe and having to breathe" are the same thing, technology is marked by an automaticity of application that always occurs on a new and greater scale, as a "permanent vital need". It is precisely here that this second characteristic lies, through which technology has become an ethical problem: this dynamic marks an endless search for continuous advancement, making this movement blind to its potential risks and dispensing with ethical reflection.

The third reason takes into account the new global dimensions of space and time. The case of mining as it is currently conceived provides an excellent example to illustrate this point of criticism.

Mining activities involve large-scale engineering works, ranging from the installation of drainage systems and the lowering of groundwater levels to the construction of different types of containment or tailings dams, among other direct interventions. This activity causes irreversible changes in soil stratification and in the dynamics of water bodies downstream from these areas.

In Brazil, there are four constructed ore pipelines, three belonging to Samarco and one belonging to Anglo American (Observatório Lei.A, n.d.). Samarco's pipelines have been out of operation since the Mariana disaster in 2015, while Anglo American's pipeline resumed operation after a leak in Santo Antônio do Grama, where a pipeline rupture released 450 m³ of ore over 45 minutes, affecting the water supply (G1 MG, 2018).

It is important to consider that ruptures, leaks, and failures in pipeline transportation systems represent serious concerns for companies operating industrial pipelines. Since these risks can affect the integrity of the environment, nearby populations, and the facilities themselves, improving the reliability of these systems is urgent (Lopezlena & Sadovnychiy, 2019).

In this sense, would these companies be able to control the environmental consequences that failures along the route could cause? Would there be safety nets for communities that might eventually suffer from the consequences of the release of ore pulp in their territories? Do these companies consider all territorial specificities regarding biodiversity and the multiple mechanisms of solidarity and action that existed prior to the arrival of the pipeline?

In addition to the considerably high water consumption required for pulp formation, there will be an intense and constant vibratory effect involved in transporting this ore pulp to its final destination. How does this affect the lives of human and non-human animals, biodiversity, and the environment?

Considering also the characteristics of production processes inherent to mining, which, depending on environmental management and policy guidelines, can generate environmental problems for centuries to come, such as acid mine drainage, or lead to environmental crimes like those in Mariana and Brumadinho (which had no precedent in the country – in terms of similar cases and similar systems – and whose socio-environmental consequences are still being understood, if not completely unknown), it is possible to understand how technology has operated within a much broader temporal and spatial spectrum than previously thought.

Jonas states that:

This expansion of temporal and spatial dimensions shows that the new power may be too great for the size of the scenario in which it develops – the earth – and for the good of the actors – human beings. This is because its effects extend across the planet and into the future in a cumulative and probably very irreversible way (Jonas, 2013, p. 229, author's translation).

Oliveira adds that what we do while thinking only of ourselves, in the present and in a defined place, can end up affecting millions of people elsewhere and in the future. We mortgage our future lives in exchange for short-term advantages and needs, most of which are created by ourselves. Technology would contradict the idea of sustainability, since, in satisfying the supposed needs of present-day people, we would be compromising the conditions for the survival of future generations.

In this sense, Jonas argues that, given the power to affect future generations, ethics must confront the innovations brought about by technology. Furthermore, the ethical category demanded by this new scenario would be responsibility, whose requirements would grow proportionally to acts of power.

The fourth and final reason is connected to the third and to the others: with the rupture of anthropocentrism, since man is no longer the center of the ethics proposed by Jonas, but rather the self-expanding power of technology and its constant updating, human beings now hold new and unlimited dimensions of power in their hands.

It is the excess of power that imposes responsibility on man. This is because technology grants human beings that which only religion had previously granted them: the role of administrators or guardians of creation. Now, with the magnitude of technological power, human responsibility becomes cosmic: it is the threat to human life that introduces the most necessary dimension into the proposed ethics (Oliveira, 2014).

Jonas identifies in the modern world the signs that we are entering a danger zone, mainly because human beings have become subjects of technology. The danger stems from the excesses of techno-industrial civilization, fostered by the development of the natural sciences. What we call the Baconian program – that is, placing knowledge at the service of the domination of nature and using it to improve the condition of humanity – did not, from its origins and in its capitalist implementation, possess the rationality and rectitude that would have been appropriate to it; however, its dynamic of success, which necessarily leads to excesses of production and consumption, would have subjugated any society, given the short timescale of human objectives and the true unpredictability of the dimensions of success (Jonas, 2006).

Jonas also indicates that:

Power has become autonomous, while its promise has transformed into a threat and its prospect of salvation into apocalypse. It becomes necessary, now, unless catastrophe itself imposes a limit on us, a power over power – the overcoming of impotence in relation to the compulsion of power that feeds on itself to the extent of its exercise. (...) A power over all that power that no longer belongs to man, but to power itself, which dictates the rules of its use to its supposed user, transforming him into a mere involuntary executor of its capacity. Which, therefore, instead of liberating man, enslaves him (Jonas, 2006, pp. 236–237, author's translation).

From this perspective, it is possible to identify how the power of technology, combined with capitalist implementation, gives rise to phenomena that are identifiable (or not, depending on the temporal scope) and undesirable to those who, in theory, conceived the mining production process.

In the establishment of new mining areas, indigenous populations whose means of production and existence are linked to the land will invariably be harmed. While, in the initial phase of mining exploration in Brazil, the indigenous holocaust was a constant, today other forms of destruction of the way of life of inhabitants of regions not yet affected by mining occur, even with the legal support of the nation-state or under severe threats and the devastation of the basic conditions for these populations' survival (where water and soil are irreversibly contaminated) (Malerba, 2014).

Thus, the activity that should bring economic and social benefits ends up bringing devastation to entire populations. It is in this precise sense that Jonas believes that a power over technology (or a power over power) needs to be established through the Imperative of Responsibility, because, since ethics is the science of right and just action, it is in this capacity that it must confront the new technological scenario of modernity.

Now, ethics must not only examine the consequences and results of actions in order to judge them, but must also, above all, possess the capacity to foresee these actions in order to prevent them.

Jonas points out that, in the age of technological civilization, which has become "all-powerful" in terms of its destructive potential, the future of humanity constitutes the primary duty of collective human action. This future of humanity obviously includes the future of nature as a mandatory condition.

Jonas further notes that "society as a whole is affected above all by what technology releases into the world, and thus effectively by its progress, since it is a progress of results" (Jonas, 2006, p. 272).

And he concludes:

In technique [...] this success, with its stunning public visibility encompassing all domains of life – a veritable triumphal procession – causes the Promethean

adventure to shift, in the eyes of common consciousness, from the role of a mere means to that of an end, showing the “conquest of nature” as humanity’s vocation: *Homo faber* rises before *Homo sapiens* (who becomes its instrument), and external power appears as the supreme good – for the species, obviously not for individuals. Since there is no end to this activity, we would be facing a “utopia” that speaks of constant self-improvement on the way to an infinite goal (Jonas, 2006, p. 272, author’s translation).

The question is how nature will react to this intensified aggression. Both on the right and on the left, from Marxists to the liberal bourgeoisie, all economic theories carry within them a utopia that necessarily relies on abundance (a concept that can range from satisfactory frugality to exuberant opulence). According to Jonas, it is not a matter of knowing precisely what man is capable of doing, but how much nature is capable of enduring.

Jonas makes it clear that these tolerance limits, when compared with human ambitions, may fall far short of the limits imposed by the manipulation of nature. Such limits only become perceptible when the harmful effects of our interventions begin to undermine those gains and threaten to surpass them. For Jonas (2006), these limits are exceeded, perhaps irreversibly, when such unilateral efforts drag the entire system toward a catastrophe from the perspective of human goals. Jonas states:

It is a relatively recent discovery not only that such a thing can happen in principle, from the point of view of physical laws, but also that, for this strictly limited Earth, such a catastrophe could be the direct result of the aggressions that man may inflict upon it, or is already inflicting. This imposes a previously unknown buffer on the belief in progress, whether socialist or capitalist. We are dealing with the external nature of man, therefore, we can set aside all the differences in motivation of capitalist and socialist extrapolations in relation to technology: what interests us here is the purely neutral quantitative question. The question is: what are these “limits” and where are they? (...) Unfortunately, current science is not yet able to offer reliable results (Jonas, 2006, p. 301, author’s translation).

It is important to clarify that the ethics proposed by Hans Jonas are not intended to be technophobic, nor are they against any kind of economic and social development. What the author proposes is that natural boundaries be calculated and critical thresholds identified. Regarding current factors (such as the biochemical quality of soil and groundwater), such calculations need to be made well in advance, with the aim of anticipating these critical thresholds rather than waiting for them to be reached.

Jonas proposes an ethic that he believes is capable of addressing technological and scientific civilization and its problems, and of achieving universal acceptance in the face of the dangers that threaten the existence and essence of humanity and nature (Carrara, 2013).

Human responsibility toward nature is ultimately based on an

ontological solidarity between human beings and nature, a solidarity that the Cartesian-Baconian model supposedly destroyed. For Jonas, the simple fact of existing overrides non-existence; in other words, being prevails over non-being.

So how does Jonas understand ethical responsibility?

In traditional ethics, the focus has always revolved around the act, praxis, and proximity, since everything was considered from a short-term context. The first aspect of Jonas's reflection stems from a critique of the notion of responsibility restricted to past acts, in which the author becomes responsible for what he has done. (...) Jonas wants to raise a responsibility for the future of humanity, that is, for the survival of humanity. (...) If Criminal Law demands what we have already done, how can we impose on acquired power the awareness of duty? Responsibility is placed before the fragility of individuals and the world threatened in their continuity. In other words, it is the object that demands my action, or the "why" is outside the subject, although it imposes itself on my power, clamoring for protection or being threatened by it. It is not the idea of responsibility that leads me to engagement in favor of the object that demands my attention, but the recognition of the intrinsic good of the object (Carrara, 2013, p. 219, author's translation).

Just as the promises of scientific and technological progress and the construction of a strong state were the responses to the threat of violent death (Hobbes), the scarcity of resources and the threat of civil war (Locke), and even the fear of a possible apocalyptic future (the utopias of Bacon, More, and Campanella), the heuristics of fear seeks to awaken a sense of responsibility toward the future (Carrara, 2013).

Sganzerla et al. (2015) state that, in Jonas's thought, responsibility operates at different levels, namely care for the continuity of being and the preservation of the authenticity of human and extra-human life.

Thus, with regard to future generations, we must ensure not only their biological preservation, but also the preservation of the ontological conception of the human being. In Jonas's words, we are responsible "for the idea of man, whose mode of being demands the presence of his embodiment in the world" (Jonas, 2006).

For Jonas, overcoming the current ecological crisis also requires recognizing nature's inherent dignity and granting it autonomous ethical significance. The conception of responsibility proposed by Jonas differs from that of traditional ethics, which links responsibility to autonomy and the free exercise of the will, as well as to past acts and their consequences. It is a passive responsibility, imposed by otherness, whose foundation does not lie solely in the subject.

Carrara (2013) further states that:

Jonas's ethics are not limited to considering responsibility for the continuity of human existence, but teach that human existence is only possible through the coexistence of human and extra-human nature. If we understand his critique of

traditional ethics, accusing it of anthropocentrism, we understand why his ethics could not fall into the same error. Thus, in his ethics, nature gains its own dignity and demands a limit to the unlimited power that technology has conferred on humankind over it (Carrara, 2013, p. 222, author's translation).

Hans Jonas draws a parallel between parental responsibility and political responsibility. In parental responsibility, the focus is on the child as a whole and all their potential, not just their immediate needs. It is impossible for a newborn human to survive on their own; they need someone capable of providing basic necessities such as food, hygiene, and all subsequent care. Responsibility here lies in ensuring the child's continued survival.

In the political aspect of responsibility, the goal is also human development. However, unlike parental responsibility, which ends when a child becomes autonomous, political responsibility has no endpoint. Political responsibility encompasses not only the needs of a single individual, but also those of the entire community whose lives are affected by the decisions made by public officials. Beyond the immediate consequences of political action, Jonas argues that public officials are also responsible for the future consequences of their policies. In this sense, the moral imperative imposed upon them is...

(...) to do nothing that might prevent the emergence of their peers; that is, not to obstruct the indispensable, even unpredictable, source of spontaneity in the community, from which future public figures may be recruited. The principle is that all integral responsibility, with its set of particular tasks, is responsible not only for fulfilling itself, but for guaranteeing the possibility of responsible action in the future (Jonas, 2006, p. 201, author's translation).

Following this line of reasoning, the author proposes a new science capable of dealing with the complex web of existing interrelationships. Since there are no reliable projections – particularly in light of the irreversibility of many ongoing processes – Jonas argues that:

Prudence will be the better part of courage and certainly an imperative of responsibility; perhaps forever, if, for example, to assess the full range of our technical possibilities, that science has to capture all the data and then process them in their interrelations (Jonas, 2006, p. 307, author's translation).

One of the central features of the new ethics proposed by Jonas is the capacity for prediction, embodied in the concept of “comparative futurology”. This concept assigns to ethics the task of projecting, as accurately as possible, what initially appears as a hypothesis, so that future projections may serve as a stimulus or warning for present action, while acknowledging the possibility of error, since a negative prediction would benefit from a favorable unforeseen outcome – in other words, it would be desirable for the predicted event not to occur (Oliveira, 2014).

The aim is to connect ethical reflection with the knowledge provided by other disciplines in order to develop scientifically informed projections of the consequences of present human actions. Comparative futurology thus emerges as an ethical tool and one of the most important means of addressing the urgent challenges of our time.

For Jonas, responsibility is linked neither to the past nor to the minimum conditions of human action, but rather to humanity's obligation in relation to the consequences of its actions, regardless of the intentions, motives, or circumstances that gave rise to them. Therefore, for Jonas, where there is action, there is also responsibility. In this way, it becomes impossible to shift responsibility for our actions to another authority, and nothing exempts us from our responsibility and our duty to safeguard the continuity of being into the future (Sganzerla et al., 2015).

The defining feature of this projection into the future is its preference for negative prognoses. Here, Jonas introduces the "heuristics of fear", probably the most controversial concept in *The Imperative of Responsibility*. This is a negative projection that, in light of present threats, derives – or invents (*heuriskein*) – the principle from what ought to be avoided, giving greater weight to human fears than to desires, aspirations, or hopes.

Oliveira (2014) highlights that:

The ethics of responsibility, therefore, relies on futurology because it detects a change in the emergencies that generate values and identifies in the new technological times the urgency of a new value, the value of prediction. Unlike traditional ethics, which bases and proves its arguments on already known principles, the ethics of responsibility tracks and discovers those not yet known (Oliveira, 2014, p. 131, author's translation).

Jonas adds that it is through the preference for negative prognoses that we arrive at the ethical principle that we cannot gamble away the interests of future generations for the sake of the present, either in terms of their existence or the quality of that existence, given humanity's unconditional obligation to continue to exist.

The new imperative calls for coherence not in the act itself, but in its ultimate effects on the continuity of human activity into the future. It is, therefore, an obligation toward those who do not yet exist, who, by definition, cannot assert any claim to existence (Sganzerla et al., 2015).

This concept is a new version of the old value of prudence, now transformed into the moral core of our actions. This makes futurology a means of fostering awareness of the dangers and risks arising from the reckless use of technological power. It is also worth remembering that the heuristics of fear is not merely a theoretical concept, in the strict sense of the term, but above all an ethical procedure. Whereas the concept is merely a theoretical tool employed in intellectual argumentation, the practical

procedure forms part of an effort to provide moral guidance for human action (Sganzerla et al., 2015).

For Jonas, the utopian belief that technology can heal the wounds it creates through ever more advanced technology, in an endless cycle, represents the greatest danger of the ideal of technological progress. The Mariana environmental disaster, for example, illustrates that some wounds cannot be healed by technology and that technology itself may create forms of damage that it is incapable of preventing.

Sganzerla et al. (2015) point out that, whereas ethics traditionally focused on present human well-being, today there is a risk that future human well-being is threatened by uncertainty about whether there will be a future at all.

When considering responsibility beyond the idea of an action already performed, as in civil and criminal law, Jonas seeks a meaning that can ensure the right to authentic existence of those who do not yet exist. (...) The foundations of traditional ethics, that only those who exist have the right to claim, have become insufficient for the ethics of the future proposed by Jonas (Sganzerla et al., 2015, p. 141, author's translation).

It would then be the task of the ethics of responsibility "to preserve for man, in the persistent ambiguity of his freedom, that no change of circumstances can suppress his world and his essence against the abuses of his own power" (Jonas, 2006).

According to Oliveira (2014), in this context of optimistic yet dangerous technological development, fear emerges as an alternative to the utopian pursuit of technological progress. Its function is to assess the costs of technoscientific progress and, where possible, eliminate or mitigate its risks. According to Oliveira:

This involves giving preference to the negative prognosis, that is, imagining the future not through utopia, but through risk: if projecting the future as an ideal situation results in the confirmation of actions carried out in the present, causing a certain ethical apathy, the negative prognosis would call into question such actions in the present, with a view to altering and reorienting them. (...) Now, if the novelty of the scenario is the magnitude of the power of technology, that is, the serious possible consequences from a geographical and temporal point of view of this power, then it is certain that the need also grows for the assessment of potentialities to include and give preference to risks and dangers, in order to avoid them (Oliveira, 2014, pp. 128-140, author's translation).

In this sense, Sganzerla et al. (2015) argue that, whereas modern science has been concerned primarily with disseminating positive results while ignoring – or even concealing – errors, the ethics of the future should ensure that the alarming findings of scientific futurology are disseminated as widely as possible, since they embody the ontological imperative of

humanity's duty: not to think only of our own existence, but also of that of future humanity.

The 'comparative futurology' used by Jonas highlights the need to utilize the power of technological society for predictability, that is, to use the technique of prediction to prevail over the technique of action. Thus, by using futurology as a science of hypothetical prediction, Jonas seeks to combat the harmful effects of technology by resorting to a possibility present in technology itself. But this futurology can only be effective if humankind, in addition to knowing the causes of science and its effects, maintains autonomy in the face of technoscientific power, and also relies on a morality ("let there be a future") and an authentic image of the human being that it wishes to preserve (Sganzerla, 2015, p. 145, author's translation).

Specifically regarding mining, when considering its interactions with water, whether surface water or groundwater, it is crucial to remember that the high volumes of water consumed by this activity can lead to the depletion or reduction of this resource in existing springs and wells. Furthermore, it can compromise the volume of surface water bodies in general, affecting river flows and the water supply of entire communities; reducing water quality; lowering the water table below well pumping chambers, among other serious and well-documented consequences. This is one of the main points of Jonas's critique, considering that the known problems are already enormous, and there is a range of others that are still unknown due to a lack of predictive capacity.

However, it is worth remembering that environmental potential depends on so many limiting factors, including time, that it may become a concept used to serve specific, predetermined purposes without any actual scientific basis. Adapting this concept to their interests is what companies have been doing, and it is precisely the consequences that do not appear in environmental impact studies – that is, those we would not even have imagined existed – that we have been witnessing in practice.

What has been observed, and what Jonas had already predicted, is the prevalence of the economic interests of certain groups over those of the vast majority of populations, especially communities with fewer resources and greater dependence on the land taken from them. Not only does humankind dominate nature, but it also disregards the existence and interests of fellow human beings in decision-making processes, generating the perverse socio-environmental consequences we already know, as well as others that remain beyond our current ability to perceive.

In this sense, it is possible to clearly understand what Hans Jonas's theories can contribute to the idea of ethical mining. Up to this point, based on current knowledge and the experiences of mining in our territories, we can recognize that mining has not demonstrated ethical responsibility, nor does it incorporate a sustainable approach into its production processes,

since the ore extracted from an area cannot be replenished on a human timescale.

Despite this, the products of the mining process are widely used in the vast majority of global societies. Certainly, there would be no way to end mining activities worldwide today, given our dependence on their final products.

4 So what could we expect from ethical mining?

One of the strongest aspects of the ethics of responsibility, understood as an ethics of otherness, is its relationship with the Other, in this case, with future generations, calling for intergenerational concern. This Jonasian interpretation is also contemporary with the emergence of the concept of environmental sustainability, which presupposes respect for nature's capacity to replenish extracted raw materials. In the case of mining, the earth does not replenish the extracted ore that was formed during the planet's geological process. Consequently, concern arises regarding established patterns of consumption that render the planet incapable of replenishing what has been extracted from it.

It is therefore necessary to consider our responsibility toward human and non-human beings, as well as toward the integrity of the planet as a whole, thereby generating an authentic and dignified condition for human life in a shared future. To achieve this goal in the future, it would be necessary to adopt prudent and measured actions in the present, so that their consequences can be anticipated in sufficient time and the worst predictions do not become reality, as Jonas's heuristics of fear demands.

Here, we recognize that putting the Principle of Responsibility into practice, based on precaution, restraint, awareness, and sensitivity with a view to guaranteeing an authentic future, is not easy, because it runs counter to the desires of *homo faber* and the stimuli directed toward it by consumer society (Sganzerla et al., 2015).

Beyond the objective aspect of the "rational foundation of duty", Jonas also posits the "psychological foundation of the capacity to influence the will", that is, the subjective aspect. This means that the ethical appeal presupposes acceptance by the one who receives it; in other words, it requires a feeling capable of influencing the will. It is the object that calls us to responsibility before we have chosen it as the object of our responsibility. It is a feeling of responsibility that binds "this subject to that object", demanding a response to its appeal, such that this external call produces in us the necessary disposition to engage in the struggle for the existence of the threatened object.

Once this dimension of Jonas's concept of responsibility is understood, there would be no appropriation of territories belonging to indigenous

communities, no pollution of surface and groundwater bodies, nor the use of environmental assets as mere economic resources.

5 Ethics of Responsibility and EIA/RIMA: foundations for the protection of future generations

This article aims to demonstrate that there are multiple ways of understanding nature and the socio-environmental and economic phenomena resulting from interactions between human beings and the environment. Having inherited the Cartesian scientific model, the scientific perspective that shapes our reasoning is intrinsically linked to a dualistic notion that underlies the ways in which problems are perceived and directly affects the mechanisms through which solutions are sought.

Through the discussions presented here, it became possible to understand how a historical, social, political, and above all economic construction has enabled mining to operate, based on the modern model of development and technical knowledge, as a unique force over nature.

As noted throughout the text, technology cannot be understood as neutral, but rather as a tool that always embodies a particular vision, one that has not only physical but also subjective dimensions, and that can lead even to global tragedies if no power exists to regulate it.

It became clear that these concepts, although considered stable in our daily lives, were created and evolved through the ways in which we interact with them. They are not natural, they do not remain unchanged over time, nor should they be considered impossible to alter. What should be considered impossible is the idea that there is no other way for us to survive on the planet of which we are a part.

In this sense, the idea that the future holds nothing beyond conflicts between the financial system and ways of life – which, by definition, cannot peacefully coexist – should be considered impossible.

a. Are there solutions within the Western capitalist extractive model?

The ecological crisis may be leading to growing global concern for the environment. Companies whose practices harm the environment or fail to comply with relevant legislation risk becoming obsolete. Aware that mining is not inherently a sustainable activity and seeking mechanisms that can make it ethically responsible, the following section is presented. It is worth remembering that this work does not aim to provide a ready-made and definitive solution to the mining problem, given the complexity of the issue discussed here, which requires multiple approaches not only from the scientific field but also from the political and cultural fields, based on the assumption that solutions do exist.

b. Environmental impact assessments and decision-making processes

An ethics of responsibility, as proposed by Hans Jonas, would involve care for the preservation of human and non-human life on the planet. Based on the knowledge and techniques available to date, it would be possible, according to Jonas, to create tools for predicting the consequences of our actions. Using these tools, choosing the worst-case scenario would be the best way to prevent undesirable consequences of human activities for the environment.

Considering a scenario such as the one proposed by Jonas, it is possible to draw a comparison with Environmental Impact Assessment (EIA), an environmental policy instrument recognized in international treaties as a potentially effective mechanism for preventing environmental damage and promoting “sustainable development”.

The United States National Environmental Policy Act (NEPA) came into effect on January 1, 1970, requiring all federal government agencies to (Congress, 2025; author’s translation):

- (A) Utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man’s environment;
- (B) Identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations;
- (C) Include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on:
 - (i) the environmental impact of the proposed action,
 - (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
 - (iii) alternatives to the proposed action,
 - (iv) the relationship between local short-term uses of man’s environment and the maintenance and enhancement of long-term productivity, and
 - (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

The Environmental Impact Assessment (EIA) presents itself as an ideal tool for decision-making regarding environmental impacts from different perspectives. Its preparation relies on an interdisciplinary team, ensuring that technical quality standards are met and that established limits are not exceeded. It should highlight the environmental impacts of the process subject to authorization, indicating ways to reduce, mitigate, or even

eliminate them. In cases where the proposed action is not feasible or viable, it should present alternatives to the project under consideration.

Sánchez (2006) further states that the EIA aims to ensure that environmental considerations are explicitly addressed and incorporated into the decision-making process; to anticipate, avoid, minimize, or compensate for significant adverse biophysical, social, and other effects; to protect the productivity and carrying capacity of natural systems, as well as the ecological processes that sustain their functions; and to promote “sustainable development” while optimizing opportunities for the use and management of resources.

In theory, although it does not encompass human and extra-human well-being in its original formulation, the EIA would be the preventive instrument most closely aligned with the idea of responsibility toward people and territories proposed by Jonas.

When evaluating the Brazilian case, it is possible to identify the main elements of the Brazilian EIA process, which still uses CONAMA Resolution 1/86 as a reference. These include: screening, scope definition, preparation of the EIA¹ and RIMA², technical review of the EIA, public consultation, decision-making, and follow-up.

For an environmental impact assessment to be successful, the mere existence of the process is not sufficient; the steps listed above must be carried out with technical rigor and, above all, the drive for development must not come at the expense of environmental concerns.

Based on a power over technological power, as Jonas argued, and on an ethics that prioritizes a shared future, environmental impact assessment can be a useful instrument for ensuring a future for the planet and humanity.

6 Final considerations

We analyzed the socio-environmental consequences of the relationship between water and mining in light of theories of environmental ethics, especially Hans Jonas’s Theory of Responsibility. From the urgent need for an environmental ethic to Jonas’s ethics and his proposal for a science of action for the environment, this chapter sought to outline argumentative paths showing what can be expected from ethical mining.

Groundwater bodies play a crucial role in maintaining soil moisture and river flows. They are responsible for maintaining the perennial flow of watercourses during drought periods, as well as supporting the roots of many types of vegetation and supplying water to humans and non-human beings across the planet.

When waters deteriorate – whether rivers, streams, or reservoirs within

1 Environmental Impact Study

2 Environmental Impact Report

a watershed affected by pollution from substances leached or contained in mining effluents – life as it was understood before this great “development project” is transformed into an experience of intensified social suffering, in which peoples, cultures, and ways of life are completely disrupted to make way for the “progress” brought by large companies.

In this context, territories and land uses need to be better understood before activities of this kind are undertaken. It is necessary to ensure that populations who have always lived in surrounding areas do not have their heritage compromised in terms of quality or quantity, whether for agricultural use, subsistence, or local commerce. It is necessary to guarantee health, safety, and water sovereignty in the face of these projects, which exert such a powerful influence over social organization. Furthermore, it is necessary to ensure that vital water resources supplied by shallow groundwater wells, springs, and small streams – highly vulnerable water bodies – do not undergo significant alterations. For this to happen, we need to consider an ethics of responsibility in mining.

If it is the science of action – anthropocentric and technocentric – that sustains mining as it is currently conceived, then only through a profound transformation of these foundational paradigms of Baconian-Cartesian thought could we obtain different answers to the crises we face. Now, if we want different results, nothing is more certain than changing the way things are done.

Still from Jonas’s perspective, ethically responsible mining would be mining that considers not only the productive needs of current generations, but also care for the planet, human and non-human beings, and, above all, the future. Guaranteeing authentic human life, both today and in the future, will only be possible through an ethical perspective that recognizes responsibility as a non-negotiable value.

Therefore, in conclusion, ethical mining can be understood as mining in which responsibility toward human and non-human beings and toward the planet is a non-negotiable factor. Thus, conditions for an authentic and dignified human life could be created within a shared future. However, to achieve this goal in the future, it would be necessary to adopt prudent and measured actions in the present, so that their consequences can be anticipated in sufficient time and the worst predictions do not become reality, as Jonas’s heuristics of fear demands.

Water bodies, whether surface or groundwater bodies, as part of the nature preserved by this ethic, would thus be less subject to the impacts caused by human action. If our technocentric views could be broadened beyond their position as primary and exclusive frameworks, allowing for perspectives that encompass other cosmogonies and other ways of understanding the world, new forms of perceiving nature and caring for water could also become part of our actions.

It is urgent that, given the continued existence of mining, groundwater

and surface water bodies be viewed not only as resources but also as heritage, and that Jonas's ethics serve as a fundamental framework for developing an ethics of mining.

Since ethics is the science of action, it is necessary not only to establish new theoretical frameworks for such action, as proposed here through a reinterpretation of Jonas's precautionary principle, but also to link this science to practice so that humanity may indeed have a future.

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