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(Toxi)City of Steel: Steelmaking infrastructure and social contestation in a case of contamination by industrial waste[1]

Maria Raquel Passos Lima[a]

The article analyzes the case of contamination of the 'Volta Grande IV' neighborhood by industrial waste from National Steelworks Company (CSN), in the city of Volta Redonda, in the South of Rio de Janeiro State, Brazil. The notion of 'steelmaking infrastructure' is developed as a key concept that conceptually and ethnographically enables the integration of the invisible dimension of steel production, by focusing on the residual part of the infrastructure, characterized by toxicity. The focus is to understand the power relations and political dynamics engendered by toxic substances in the configuration of contentious arenas around their potential uses and effects. The ethnographic narrative proceeds by presenting four scenarios – contamination, scientific controversy, the legal process, and the environmental arena – and adopts time as a privileged object, discussing the ways in which divergent temporalities differentially traverse infrastructure and their political effects on the construction of corporate strategies and social contestation processes, that shape a 'resilient politics'.

Environmental justice, Toxic waste, Steel industry, Infrastructure, Time.

In this article, I propose the notion of 'steel infrastructure' as an ethnographic interpretive strategy to reflect on the case of industrial waste contamination of the neighborhood known as Volta Grande IV

a Professor of Anthropology, Department of Anthropology/ Institute of Social Science – Rio de Janeiro State University (ICS/ UERJ). Email: mariaraquel.passoslima@gmail.com.

Condominium in Volta Redonda by the National Steelworks Company (Companhia Siderúrgica Nacional – CSN), located in the municipality of Sul Fluminense (Rio de Janeiro State), as well as the political disputes surrounding this case. The fieldwork for this research was carried out during 2017 and the methodology consisted of attending a number of meetings and public events related to the case, as well as developing qualitative in-depth interviews with relevant actors, monitoring the case in the press and analyzing the documents that make up the judicial process.

In terms of its textual structure, the discussion begins with a theoretical-methodological introduction that justifies the infrastructural approach to the case, given its conceptual plasticity, its relational character, and the inscription of the anthropological discussion through the prism of materiality and (in)visibility. This allowed the incorporation of marginal elements into the ethnographic analysis, which were either located outside the field of vision, or in an obscure manner. The analysis proceeds with a figure-ground reversal game between regimes of visibility that are specific to toxic waste and their temporal dynamics, and is composed of the description of four scenarios, which expose different levels and dimensions that constitute the infrastructure of steelmaking. To begin with, the discussion presents the elements that make up its most visible part, from a brief historical narrative that contextualizes and qualifies multiple aspects and scales of the relationship between the company and urban space, pointing to specificities of the city of Volta Redonda. Then, in the first scenario, I present the contamination case of Volta Grande IV as an invisible or residual dimension of the steelmaking infrastructure, analytically situating the contamination as an inert part that, when it is brought to light, enables the explanation of latent relationships and agencings[2] that exist in the shadows. Connections between the production structure of CSN and urban spaces are traced from the characteristics of toxic substances and from a set of techno-political devices that run their complex management structure.

With this movement, the scope of the infrastructure expands and the analysis is extended to three further scenarios, which are: a scientific controversy that emerged from a study carried out in the neighborhood; a lawsuit involving the contamination of the location; and the mobilization of civil society in the environmental arena. From these three scenarios, it is possible to understand how power relations cross the infrastructure and also the ways in which the contamination and its effects are managed by actors located in different areas in an arena of dispute around security/ risk and potential damage to the local population in terms of environmental health. Within this context, which points to profound asymmetries in the power relations between the various agents involved, the study adopts time as the focus of the analysis and the privileged object for understanding the politics around the toxicity of the steelmaking infrastructure. It discusses the appropriations and effects of divergent temporalities in corporate strategies and the processes of social contestation in the examined context, which emerges as a 'resilient politics'.

Infrastructural approach: conceptual and ethnographic plasticities and (in)visibilities

Since the introduction of the notion of infrastructure in the anthropologic discussion, which is progressively becoming part of the ethnographic perspective (Star 1999), many debates have begun in a continuously renewing process (Anand *et al* 2018; Grahan & Mcfarlane 2015; Hetherington 2019; Larkin 2013; Murphy 2013; Venkatesan *et al* 2018), which demonstrate the diversity and plasticity of methods to conceive of and analyze infrastructures, as well as the effectiveness to aid the understanding of complex phenomena surrounding urban life in contemporary times.

In such plasticity lies not only the wealth but also the difficulty that the notion of infrastructure presents, which is expressed through a conceptual unruliness that stems from the characteristics of its very ontology, given that infrastructures contain the duality of being

not only just things, but also the "relation between things" (Larkin 2013:329). This relational quality (Star 1999; Larkin 2013) inherent to infrastructures is what refers directly to the methodological dimension which constitutes it. This is because, if infrastructures are not things that are simply 'there', given as a principle, but are relational and heterogeneous networks in proliferation, crossed by different scales and being operated in different levels simultaneously, the question of their composition, frontiers, and limits becomes unavoidable.

When stating that the discussion of an infrastructure is always a categorical act, Larkin (2013) brings the debate into the theoretical-methodological approach, emphasizing its definition as a work that presupposes a cultural analysis, epistemological and political commitments, and that it, therefore, depends on choices, focus, and framework. As an "interpretive tactic" (Hetherington 2019:6), the aspects and levels of the heterogeneous composition of the infrastructures being addressed will need to be factored in to any choices made, making it clear what will be ignored, in so far as the adoption of what is conceived as infrastructural will inevitably leave out other relational possibilities.

The (in)visible dimension of the infrastructure and its inclusion in specific regimes of visibility is a sensitive point of the discussion. The excessive emphasis on the invisible condition of the infrastructures which was assumed from the start (Star 1999; Graham & Marvin 2001) was criticized and problematized, leading to the formulation that it is not a matter of affirming invisibility or visibility as an inherent condition, but of understanding invisibility as an aspect that lies at the very end of a range of visibilities that move across a continuum, in which what matters is "to examine how (in)visibility is mobilized and why" (Larkin 2013:336). Thus, infrastructures always have an exposed and visible dimension, leaving others in the shade, which, without clarity, cease to be the object of appreciation, which in turn causes their exclusion from the field of political disputes, at the same time surreptitiously mobilizing power.

The material, spatial, and technological dimension of infrastructure, and its relationship with the urban environment, as a rule, constitute its most spectacular and visible part and forms the basis for the management of life in cities in its most concrete dimension. However, many less evident aspects, such as the poetics, papers, bureaucracy are also relevant to understanding the dynamics that give agency to and cross the infrastructures, especially for the understanding of their political and environmental dimensions, insofar as infrastructures radically change and materially reconstruct the environment, while differentiating populations and subjects through subordination, colonization, racialization, and a series of violent practices (Anand 2018:5).

The 'steel city': the urban space as steelmaking infrastructure

The creation of the National Steelworks Company (CSN) in the 1940s corresponds to the origin of the Volta Redonda municipality, which was built specifically for, and around, the steel plant, and is therefore popularly known as the 'steel city'. In this context, the construction of the company was part of the national-developmental plan forged during the Estado Novo period, and was a central element of the national industry's development strategy. The establishment of the Company had significant consequences for the development of the entire South Fluminense region (Ramalho & Fortes 2012), thereby making Volta Redonda one of the most emblematic industrial cities in the country, as the enterprise was loaded with symbolic meaning.

The history and development of Volta Redonda were marked by the expansion cycles promoted by CSN since its creation (Lima 2013). The character of 'city-company' (Piquet 2012) has brought implications to the ways in which the municipality has developed and been conditioned to conform to the needs of the Company. The power relationship between the company and the city was also expressed through the conformation of the urban space. The latter was structured by vertical ties (Ramalho *et al* 2013: 180), which "confused in-

dustrial ties with the domination over the worker and his spheres of reproduction" (Lima 2012:205). Such control spread to the territory of the city, where this disciplined principle was applied to residential quarters and the types of housing, which separated categories of workers and social classes from the arrangement of houses in the urban space (Lima 2012).

Composed from a tutelary dimension, this influence over workers was also expressed through the allowance of social benefits, which made it possible for CSN to intervene, in practice, in all levels of the lives of the workers, ranging from technical training, to leisure spaces, as well as basic services (Veiga & Fonseca 1990; Lima 2010:38).

This socio-political configuration points to a historical relationship of control and dependence which the Company held over the population and other local agents, including the public authorities and their possibilities and spheres of action, with the company exerting influence over municipal governments through the recommendation of former staff to be appointed to the city administration (Lima 2012:206).

From the 1980s, when faced with a situation of increased mobilization of civil society and organized social movements, it is possible to sense a change in the hegemony driven by the company in the city. It is important to highlight the role of the metalworkers' union and, above all, the pastoral activity of the local Catholic Church, under the leadership of Bishop Dom Waldyr Calheiros, which has a history of supporting popular causes and workers in Volta Redonda (Costa *et al* 2001). The emergence of a more articulated popular and trade union movement provided an associative fabric "capable of questioning the influence of CSN on the development of the city" (Lima 2012:206).

During the 1990s, the Company went through a controversial privatization process, which was due to the adoption of new corporate strategies and a different productive logic being put into operation. In addition, this process imposed new contours on local development with significant economic and political impact. If, until then, the Company was characterized by its national performance, after the

privatization it began to operate within an international production network. However, it still kept its main unit, the Presidente Vargas Steelworks (UPV), that had been inaugurated in Volta Redonda in 1946 with a portfolio that was the "most complete and diverse of flat steel in Latin America" (Ramalho *et al* 2013:179).

The effects of the privatization process were acute for the municipality, and were reflected in the loss of thousands of jobs, outsourcing, and severe unemployment that led to a social crisis. While this process distanced the company from the city (Ramalho 2012:237; Ramalho *et al* 2013:180), the relationship of domination and control historically exercised by the Company has continued to be maintained even after organizational changes from its transformation into a business conglomerate, (Lima 2013), entered into global production networks (Santos 2015).

On the other hand, the post-privatization scenario in Volta Redonda was marked by a set of mobilizations in which different local agents organized themselves in unprecedented initiatives in the region, with the aim of reversing the socially damaging effects caused by the changes in CSN's business strategies (Lima 2012; Ramalho 2012; Ramalho *et al* 2013). In the 2000s, the gap between CSN and the city widened with the announcement of a cohort of new layoffs at the Volta Redonda unit (Lima 2012:2019). This movement led to a new mobilization, called Zero Dismissal Forum (Fórum Zero Demissão) (Lima 2010), whose organization and discussions in turn led to the creation, in 2009, of the Southern Environmental Commission (Comissão Ambiental Sul).

As a civil society authority, the Commission seeks to discuss and propose strategies for action, constituting a "field of social struggles and collective action to resist the company's policies and attitudes" (Ramalho *et al* 2013:183), regarding the protection of human and environmental rights. Hence, from another perspective, the environmental theme resumes CSN's relationship with the locality, exposing the problems of this relationship.

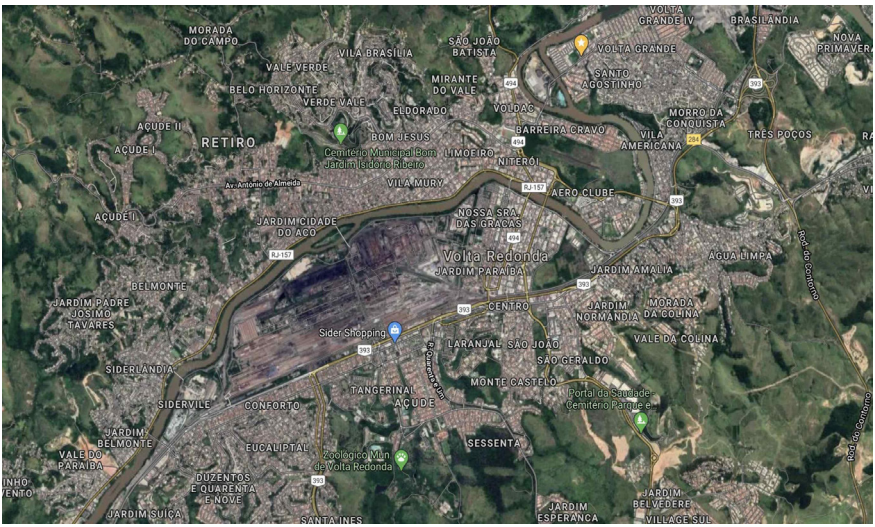

Figure 1: Satellite image of the Companhia Siderúrgica Nacional in the urban center of Volta Redonda city.

The mining-steel industry requires the intense exploration of natural resources in its productive and extractive processes, in addition to generating numerous pollutants (Milanez & Porto 2008:11), which makes these sectors and corporations particularly subject to social dispute. The description of the Volta Grande IV contamination case will operate what Bowker (1994) called "infrastructural inversion", bringing the discussion of the residual side and the less visible relations of the steelmaking infrastructure to center-stage to the analysis of the power relations that cross it.

The latency of contamination: steel toxicities

The Volta Grande IV condominium or housing complex is located in the Santo Agostinho neighborhood, on the east side of Volta Redonda municipality. Its relationship with CSN has spanned its history since its origin until the present day.[3] In the early 1990s, the

Company donated land to the Steelworkers' Union of the South Fluminense for the construction of houses for company employees. In 1998, the condominium, which today has approximately 827 properties, was built by the national bank Caixa Econômica Federal.

Between 1986 and 1999, CSN used an area of the neighborhood as a deposit for industrial waste from the Presidente Vargas Steelworks steel production. This area was divided into two waste storage cells, which were placed inside a company, which in turn was situated next to the land used to construct the condominium. The Harsco Company provides services to CSN, and is responsible for the operation of its steel waste, storage and processing of steel slag, used in civil and road construction.

CSN ran the hazardous waste landfill in the area without setting out any requirements regarding the control of operations, such as what type of waste was deposited and how it was to be monitored. Without monitoring, there was a leakage of industrial waste due to a failure in the piping of the percolated wells, which had been built to monitor and drain the cells.

One of these wells was situated under four houses belonging to the condominium. These houses were expropriated by CSN and demolished. A multisport court was subsequently built on the site. In 2003, cracks and strong-smelling liquids started to appear on the floor of the houses and residents expressed concern over the potential risks. A committee of condominium residents, which had originally been created to claim permissions for construction and outstanding balance on the houses, then starts to follow up the case and acts upon it.

By considering the contamination of the Volta Grande IV condominium as possibly the "greatest environmental disaster in the recent history of Volta Redonda" (Ramalho *et al* 2013:183), the contamination and waste are elected as the key for the theoretical and methodological analysis to qualify and develop the notion of steelmaking infrastructure. Waste, pollution, and toxicity are not "externalities" (Liboiron *et al* 2018:334), "collateral damage" (De Angelis 2004:77), or "unintentional by-products" (Ofrias 2017:16) of productive sys-

tems, but a constitutive dimension of industrial capitalism and business organization in global networks of production and destruction (Liboiron *et al* 2018; Ofrias 2017; De Angelis 2004; Dicken 2011; Gille 2010; Mcgrath-Champ *et al* 2015, Herod *et al* 2014), which produce inequalities and 'sacrifice zones' (Lerner 2010), affecting bodies, communities, and territories in different ways.

Toxicity constitutes structures of power, producing "invisible opportunities for capital accumulation" (Ofrias 2017:16), not based on an involuntary effect, but on a "conscious imposition of power over a particular group of people" (Ofrias 2017:2; De Angelis 2004:77).

Thinking of industrial waste as part of the steelmaking infrastructure is, therefore, a strategy to recover analytically the links between company and territory that work at the opaque pole of the regimes of visibility, and the power relations and political disputes that they engender. This article started by restoring what lies on the margins as part of a broader totality, analytically incorporating several spaces in the city, and a set of devices and elements that run its management, into the production structure of the company. To this end, the industrial waste management apparatus and its arrangement in the urban space were retraced. In addition to the industrial structure of the Presidente Vargas Steelworks, the entire logistics and railway transport structure also includes the illegally operated (MPF 2012:13) maintenance of several industrial waste landfills spread throughout the city, such as Márcia I, Márcia II, Márcia III, Márcia IV, Wandir I and Wandir II (Panco), as well as the landfill in the VGIV neighborhood, since many plots in the municipality are owned by CSN.

However, in addition to the physical structure that makes up the material apparatus for waste management and disposal, it is also necessary to consider the materiality of the industrial waste substances themselves and their characteristics. By investigating the life of toxic substances and their agencing, we make the residual, inert, and latent side of the steelmaking infrastructure visible and conceptually profitable. Hence, its toxic dimension, the toxicity of steel, is revealed.

Figure 2: Presidente Vargas Steelworks (CSN) installations.

Figure 3: Railway transport system for the supply and disposal of steel production.

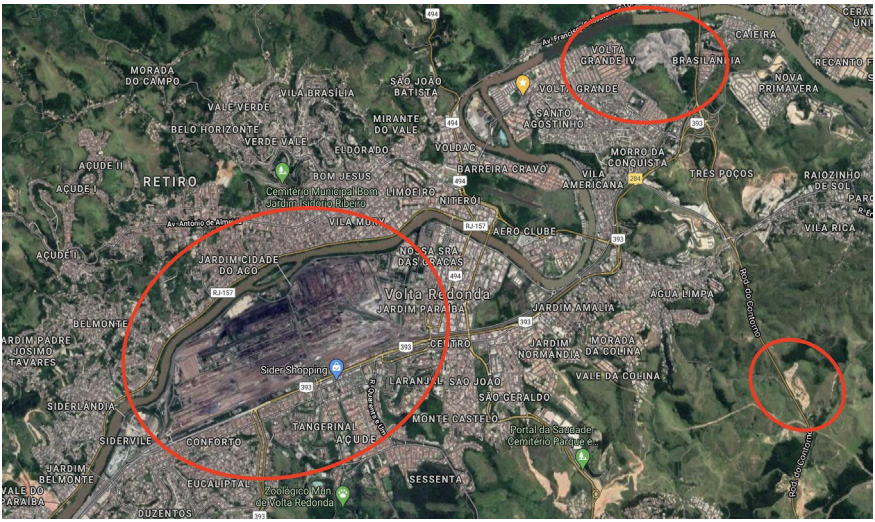

Figure 4: Installation of the Presidente Vargas Steelworks (UPV) and two CSN waste landfills in the city, one in the Volta Grande IV neighborhood, which make up the Steelmaking Infrastructure.

In this sense, it is in relation to time that the characterization of the steelmaking infrastructure can incorporate contamination, waste and toxicity, to the extent that these depend on specific temporalities for the effect of the agency of its materiality in the world to enter the domain of the sensible and, gaining visibility, also the political arena. To frame the scope, scale and toxicity effects of steelmaking infrastructure, I rely on Murphy's notion of 'chemical infrastructure', which defines them as

> "The spatial and temporal distributions of industrially producing chemicals as they are produced, consumed, become mobile in the atmosphere, settle into landscapes, travel in waterways, leach from commodities, are regulated (or not) by states, monitored by experts, engineered by industries, absorbed by bodies, metabolized physiologically, bio-accumulate in food changes, break down over time or persist. Chemical infrastructures are regulated and ignored, studied and yet filled with uncertainties" (Murphy 2013:105).

Understanding contamination and waste as part of the steel infrastructure is to investigate the relationship between time and toxics, as time, in particular its slowness, persistence, increasing accumulation, and latency, has a productive impact on regimes of visibility and configurations of power relations, insofar as the infrastructure and its toxicity unequally and materially shape human and non-human life in time and space.

The centrality of waste and toxic contamination in the reproduction of the production systems of industrialism and global capitalism leads to the formation of 'toxic landscapes' that would require the investigation of their toxic accumulation in bodies and the environment. Stewart (2017) advocates an archeology of toxicity to analyze the persistence of substances over time, capturing their lengthy duration, given that it projects the future in a non-deterministic way. The biological lives of intoxicants vary widely, while some last for hours, others can survive for decades, as well as their agency with bodies and organisms, which can quickly kill or accumulate in the body through long-term exposure.

The specificity of the temporality of toxic contamination, the slow pace of its existential rhythm and the updating of its harmful effects, led to the concept of 'slow violence' by Rob Nixon (2011). Due to the fact it occurs "gradually and out of sight", it is a violence "of delayed destruction that is dispersed across time and space", which is not normally seen as violence, because it is neither instantaneous nor spectacular (2011:2). Its deleterious effects occur in various timescales and its relative invisibility poses representational, narrative, and strategic challenges.

The production of waste and the toxic condition inherent to industrial development are therefore followed by the manufacture and proliferation of risks that threaten the health of the population and the environment, creating situations of profound uncertainty about the safety of everyday life. As the representative of the residents of the Volta Grande IV condominium committee said: "We need to be

sure that our children will be able to live in that community without getting sick. [...] Because, regardless of whether the soil is contaminated or not, we are bombarded with doubt all the time. Doubt is our biggest problem" (Public event – I Environmental Forum of VR 02/22/2017).

In view of the uncertainty generated by the presence of toxics and the lack of definition surrounding the risks and damages caused by chemical contamination, issues related to sanitary, environmental and health problems became public controversies. The invisible, latent and insidious condition of intoxicants makes science the necessary mediation capable of shedding light on these substances and making them intelligible, allowing the assessment of the dangers and hence, providing the preventive or palliative measures necessary in the face of situations of contamination. Knowledge is "essential in the identification and characterization of toxicants as well as the public legitimation of different policies" (Boudia & Jas 2014:2).

However, as a social process, science is also imbued with power relations, subject to controversies and political uses. When starting to research the contamination in Volta Grande IV, the case had become a public controversy in which scientific knowledge entered the political arena, based on 'definitional struggles' (Beck 2010) over the extent, degree, and urgency of the risks and the recognition and possible forms of action around toxicity. Science and regulation are "obligatory passage points", as they "define toxicity in dominant discourses" and thus "must be accounted for when evoking or challenging these dominant notions of toxicity" (Liboiron *et al* 2018:336). However, as Auyero & Swistun (2008) showed, toxic uncertainty is a social process also constructed by the actions of the media, companies, and public officials.

The prolongation of science: the controversy about the safety of the neighborhood

In February 2017, I attended a meeting of the Southern Environmental Commission, in which one of the participants reported his astonishment when he had seen a CSN advertisement in the city media,

entitled Volta Grande IV, a safe neighborhood. In it, the company invited readers to a meeting to present the results of environmental studies in the condominium. The group discussed hypotheses about the meanings of advertising and possible actions related to it, with one of the decisions being the drafting of an official letter to the attorney of the Federal Public Ministry (MPF).

One day later, news circulated that the Federal Court had accepted the request of the Public Ministry to suspend the meeting, which would unilaterally be promoted by the Companhia Siderúrgica Nacional (CSN) in the Volta Grande IV neighborhood the following day. The main reasons raised were that 1) the meeting would confuse the population, as there was an ongoing study about the contamination of the neighborhood being carried out by Fiocruz[4]; 2) the event was scheduled without the consultation of those involved; 3) the diffusion of the image of a safe neighborhood conveyed by the advertisement was irresponsible in view of the history of the local contamination.

Due to the suspension, the MPF decided to hold a meeting in the neighborhood, encouraging a conversation between all the social actors, including the company, to provide the necessary technical clarifications of the case, and to present the studies being developed by Fiocruz in agreement with Volta Redonda City Hall whose aim was to assess the health impacts on the population. At the public hearing, the prosecutor stated "the only certainty we have is uncertainty". The representative of the State Environmental Institute (Instituto Estadual do Ambiente – INEA) categorically affirmed that he did not agree with the neighborhood's environmental security. He stated that several studies had yet to be carried out, and that he did not corroborate the CSN position. The researchers of Fiocruz presented the research proposal, which was in its initial phase, highlighting the complexity of the process and that the interest was to assess the health of the population in the face of exposure to contaminants.

Days later, CSN finally presented the results of its study on the VGIV neighborhood to the local population, which had been carried

out by the North-American company NewFields. The time spent highlighting the qualities and excellence of this company, their labs and clients, drew attention because it took over half of the presentation. Repeatedly emphasizing its "independent" character, representatives of the consultancy firm concluded that none of the sample results revealed chemical compounds in quantities or in places that could cause damage to the health of the residents, and that the contamination in the neighborhood provided no risks.

For the purposes of this text, it is worth mentioning the radically opposed understandings of toxic substances and their risks, which were presented by the representatives of the two institutions. The studies from NewFields forged certainties that resulted, in practice, in a process of social production of toxic uncertainty (Auyero & Swistun 2008), providing, in view of specific objectives, information that would be contested by other actors, which contributed to a situation of insecurity. If the results that were released managed to reassure a part of the residents who attended the meeting, the effect on the group of more mobilized residents who made up the VGIV commission was a deepening of mistrust and uncertainty.

As compensation, these residents, members of the commission, were reassured with guarantees that the Fiocruz research would definitely be carried out, which they saw as a victory for them. They were enthusiastic about the prospect of obtaining a reliable report, which would be the result of a process they recognized as legitimate. "This is our fight. What we wanted to do was bring a respected body to investigate this for us. Today, we did it. Thank God" (Interview granted on 25/01/2107).

Due to a set of factors specific to the requirements and conditions of the development of any scientific research, but, in particular, those focused on the area of health in countries characterized by political and economic instabilities such as Brazil, the Fiocruz study ran over time, was continuously extended and, by the beginning of 2020, only partial results had been released to the residents, still leaving samples

to analyze whose results the researchers were waiting for. Next, I reconstitute the development of the research, based on my field experience and the work of Gilmara Silva (2019).

The research was set up as a partnership between Fiocruz and the Municipal Health Department of Volta Redonda. Fiocruz was responsible for the analysis of the material, while the collection would be the responsibility of the health department, carried out, therefore, by the technicians of the local basic health unit in the Volta Grande neighborhood. The analyses consisted of biological analyses (of blood and urine), environmental analysis (of water, soil, and air), in addition to the completion of four long questionnaires (on environmental exposure, sleep assessment, clinical, and nutritional assessment) and clinical examination (anamnesis). To collect the analyses, health agents visited people's homes, but to fill out the questionnaires the residents had to be taken to the health unit.

For the sampling to be representative, the survey would need at least 400 participants, whose houses were randomly selected in a draw. In November 2018, two years after the pilot project, only 228 residents had donated blood and urine. An even smaller number of questionnaires had been completed, and an equivalent number of biological samples and questionnaires was required for comparison, so that the various variables could be correlated.

Many other factors had an impact on the production of the research, contributing to the prolongation of its timescale, such as: the dependence on the economic resources of the Municipal Health Department, conditioned to the temporality of the processing of municipal bureaucracy; the decrease of resources transferred to Fiocruz with the economic retraction and the disinvestment in the financing of science and research due to the instability in the national political context; the turnover of health agents and the need to restart the specific training necessary to carry out the work; the agent's interaction with the neighborhood population who did not have the habit of attending local health units, because they paid for private health insurance.

The combination of all these factors generated a slow dynamic to the research, the effect of which was disbelief on the part of the residents and a certain discrediting in the process in view of the delay and non-materialization of the results on the health effects of the population. The low adherence of residents to the study was a challenge that had been present since the beginning, which concerned the researchers and was not reversed during the process. However, this disbelief on the part of the affected population was a reflection not only of the slow temporality of the scientific research in question, but of a temporality that came from a more distant past, and extended to other scenarios and levels of the steelmaking infrastructure for which political disputes over toxicities extended, encompassing a long judicial process.

The delay of the courts: environmental (de)regulation and bureaucracy

The studies and the question of the definition of the effects of contamination on the health of the neighborhood population are part of a broader context, which is the bureaucratic framework. This is constituted by environmental legislation, by the regulatory devices of potentially polluting activities, and by the court apparatus mobilized around the infractions and actions that differ from legal procedures. Both the science, and the studies and reports produced, as well as the regulatory framework and the legal-judicial apparatus, are systems that make up the steelmaking infrastructure network and that involve the life of CSN's toxic waste and its consequences for the environment and population.

Infrastructures are networks with an extension within which heterogeneous systems can be incorporated. Among them, bureaucracy, the legal system and its regulatory apparatus interact, and form an "amalgam of technical, administrative and financial information" (Larkin 2013:330). In order to analyze how they are positioned in the steelmaking infrastructure and the ways in which the issue of temporality involves the bureaucratic fabric, the regulatory devices, and the

mobilization of the judiciary (in an attempt to adapt and repair the situation), I will briefly return to the history of the case.[5] From this, the role of time in the corporate strategies as well as in the processes of social contestation against the polluting company are examined.

First, it must be emphasized that the production of pollution and the process of slow contamination of the city have been occurring since the inauguration of the steel company in the 1940s, in the plane of invisibility. At least since the 1970s, the area adjacent to Volta Grande IV already existed as a CSN waste field (MPF 2018; Silva 2019). Consequently, when the legal and institutional apparatus related to the environmental issue was created in Brazil, CSN had already been operating for almost three decades.

The creation of the environment secretariat took place in 1972 and the establishment of the National Environment Policy and creation of the National Environment System (SISNAMA) date from 1981. With the end of the Military Regime in 1985, Volta Redonda was no longer an Area of National Security, and FEEMA, the environmental agency responsible at the time, started to take part in the inspection, initiating some environmental controls related to CSN residues. In 1986, the steelworks uses the Santo Agostinho neighborhood as a waste deposit, installed illegally, without an environmental license and without an operating license (MPF 2012:4).

An Environmental Impact Study (Estudo de Impacto Ambiental – RIMA) was not required for the construction of these hazardous waste deposits, because the resolution that made it mandatory, as a requirement for granting the license, was instituted after the environmental license was issued for the installation of the project. The granting of the installation license by FEEMA took place subject to conditions that it would be a provisional deposit, for a maximum of four years, and that all waste disposed on the site should be removed within up to eighteen months (MPF 2012:3). Only in 1989 was the first environmental license for the enterprise issued. In 1994, CSN was privatized, which started discussions about the company's

environmental liabilities, and FEEMA signed a Conduct Adjustment Term (Termo de Ajuste de Conduta – TAC) in which the company was committed to monitoring the cells through the installation of four wells in the surroundings (MPF 2012:5).

Between 1998 and 2000, the condominium houses were built and sold. In 2000, CSN hired studies from the company Hidroplan on the area and the contamination of the water in the monitoring wells is verified. FEEMA signs another TAC and the VGIV residents' committee is created. In 2004, the first complaints from residents to the state Public Ministry are made. Another study by the company Nickol, commissioned by CSN confirms the contamination of groundwater and soil. In 2005, a third licensing takes place, and since then, several studies and technical opinions have been contracted.

Figure 5: A court-order sign on the street of the condominium indicating restrictions on land us.

In 2012, a public civil action is filed by the Federal Public Ministry and the Rio de Janeiro State Public Ministry, and, in a public hearing, CSN presents a study that proves the expansion of contamination in other areas unconsidered until then. In 2013, INEA fines CSN 35 million reais for the contamination. The Prosecutor's Office requires epidemiological studies and informs the research by Fiocruz in partnership with SMS. INEA becomes a defendant in the process and the case goes to federal court for threatening the Paraíba do Sul River water table.

Figure 6: The leisure area within the condominium, with the slagheap in the background.

In 2016, Fiocruz starts the research pilot. In 2017, CSN announces the results of the NewFields study, proving that there is no contamination or risk to the health of the population. In 2018, a new complaint by AHOMAR (Guanabara Bay Men and Women of the Sea

Association) generates notifications from INEA to CSN and Harsco, which leads to the execution of Public Civil Inquiries by the Federal Public Ministry and the Rio de Janeiro State Public Ministry on the slag deposit. In 2019, new fines are imposed on CSN for non-compliance with injunctions in relation to mitigation and remediation measures to regularize the environmental licensing of the waste deposit managed by Harsco, whose waste is increasing, worsening the contamination situation in the area.

Since the time the waste-storage cells were illegally installed in the 1980s, the deposit has received about 6,700m^3 of materials, such as acid dregs, tar dregs, oily dregs, mud from the UPV Chemical Effluent Treatment Station, waste from coke ovens, contaminated soil, plastic materials contaminated with chromium and laboratory waste, among others not identified due to the absence of a record of substance control, which were launched in the area by CSN.

Figure 7: Internal area of the condominium where the leak and expropriation of houses occurred, transformed into a sports area.

In the topsoil of the VGIV condominium, Carcinogenic and toxic compounds were found in concentrations above those acceptable by CETESB (Environmental Sanitation Technology Company) and the Ministry of Health, such as hexachlorobenzene, PCBs, dioxins and furans. There were also dark and purple colored residues present and a high concentration of contaminants in leisure areas and inside homes. An epidemiological study carried out in the condominium in 2004 pointed to a considerable incidence of abortions and leukopenia in the resident population (MPF 2012:6).

Used for decades by CSN to dump its industrial waste directly on the ground, Harsco's processing yard is in the permanent preservation area of the Paraíba do Sul River, next to an integral protection conservation unit. The site receives about 80,000 tons of waste per month, totaling five million tons of CSN slag (MPF 2018:4, 6). The sale of the processed material reaches a volume well below, around 30,000 tons, therefore, the amount of steel residues containing toxic substances continues to increase progressively.

Figure 8: Satellite image highlighting the area of the condominium, the location of the well spills, transformed into a leisure area, the slagheap identifiable within the environmental protection area and the banks of the Paraíba do Sul River.

Thus, CSN's intensive activity at the center of the steelmaking infrastructure resulted in the production of 'toxic landscapes' (Stewart 2017). The accumulation of thousands of tons of waste in the area bordering the condominium resulted in the formation of gigantic slag mountains, the contamination of which spreads from various agencings in the environment, reaching not only the soil, but the air, groundwater, organisms, with differing effects over time.

It is important to point out that, throughout this whole process, there has been a problem from the very beginning: the fact that the company started operating before the existence of the legal and regulatory apparatus, having acted without environmental control, generating contaminants that acted invisibly. This original problem gives rise to numerous attempts at subsequent adjustments and repairs, which are never completed and which extend indefinitely in time and in court, without, however, having an effect on concrete changes in the way the company operates, with remediation of damages, compensation for those affected, prevention of new contaminations, and reversal of those already in existence.

In the Brazilian context, anthropological studies on the regulatory apparatus and environmental bureaucracy, such as those by Andrea Zhouri *et al* (2017) and Debora Bronz (2016), highlight their objective, or at least their practical effect, of making the construction or the operation of large industrial enterprises viable. In relation to the Volta Grande IV case, Silva (2019:124) also underlined the role of the state and its institutions in promoting enterprises, environmental injustices, and the vulnerability of populations.

If, as Goldstein suggested, "it is the unseen nature of toxicity that allows the state to authorize its existence" (2017:321), following Hecht we understand that when a residue becomes visible, along with this comes 'new demands for its governance' (2018). It defines 'residual governance' as one that approaches the problem narrowly, isolating 'a small piece of the problem and ignoring its broader implications', as an afterthought, which ends up treating people as waste.

In fact, ethnographic research in contexts of contamination and slow violence (Nixon 2011) points to regulatory and compensatory systems as mechanisms that work not to curb actions and safeguard populations, but to allow corporate practices that produce pollution. "The state and its related systems are part of the structure of toxicity that allows the ubiquity and tonnage of toxicants to be produced and circulate in the first place" (Liboiron *et al* 2018:336), and by establishing legal limit-values for the toxic damage, intoxicants end up being "systematically and legally allowed in water, environments and bodies via regulatory structures" (Liboiron *et al* 2018:335), exposing bodies and ecosystems, and offering risks and damages to territories and populations (Murphy 2013; Hecht 2018; Liboiron *et al* 2018; Boudia & Jas 2014).

Time in the environmental arena: corporate strategies and social contestation

The dispute over contamination and its toxicity converts the steelmaking infrastructure into a political arena, in which the environmental issue gains relevance, having heterogeneous groups that confront each other and use different tactics and repertoires of action in order to reach their interests, given the unequal resources and degrees of influence and power they have.

In the four scenarios analyzed, contamination, scientific controversy, the judicial process, and the environmental arena, time proved to be a central element, differentially crossing the infrastructure, used and appropriated by the actors, and configuring situations and relationships with different political effects from specific agencings.

The slow temporality of contamination in the formation of the 'toxic landscape' of the city, which is born with and due to CSN, makes it difficult for the population to perceive pollution, given its generalized condition in the city. Davies identifies the slow build-up of intoxicants as the factor that allows them to be "ubiquitous yet unrecognized, accruing harm over time and also making it more difficult to epidemiologically and geographically locate blame" (2018:1538).

Ayuero & Swistun speak of "temporal dispersion of contamination" (2008:360) to characterize this process of normalizing pollution, which produces misperceptions about toxicity and its risks. They analyze the case of a community where, despite decades of slow incubation of pollution in the environment, no event was able to break the daily routine leading to mobilization in the face of the risks of toxic exposure, with no shared knowledge or common understanding about toxicity.

The Volta Grande IV case seems to fit into a specific configuration, mixing two paradigms. On the one hand, there is an event that interrupts the perception of the development of daily life, when cracks and strong-smelling liquids appeared on house floors in the condominium in 2003, raising concerns among residents (MPF 2012). On the other, the population of Volta Redonda lives in a context of long exposure to pollution and intoxicants due to the history of the city that emerged with CSN. For this reason, experts and local activists see a process of "naturalization of pollution" (Silva 2019:121; Brígida 2015), which takes on political meanings because it works as cognitive shielding in that it does not mobilize them for the fight, favoring the continuity of exposure to contaminants and legitimizing its progressive increase.

In this sense, there is no homogeneity in the residents' perceptions about contamination in the condominium, and it is necessary to identify the bases, relationships, belongings, feelings, and logics that support this rift, how they influence perceptions about toxicity and its political implications. A part of the residents is made up of CSN employees, which restricts political engagement and critical reflection on toxic exposure for fear of company retaliation and consequent job loss. Another part of the residents remains immersed in their routines and their practical questions, maintaining interest in the case less for the possible damage to health that toxicity offers than for the impacts (of recognition) of this toxicity in the (de)valuation of their properties, as they demonstrate in their interventions at public meetings.

Others, more mobilized, are part of the residents' committee and carry out the political groundwork of demanding the safety of the health of their families and the environment in which they live from the company actions. They participate in meetings and hearings, which characterizes the practice of activism. It is going back to life history that we can understand the fundamentals and meanings of this political engagement. The biographical example of one of the members of the commission is illustrative:

> My father came to Volta Redonda because of CSN, to work. He wanted his children to study at the technical school to, automatically, work at CSN. My older brother got in, my middle brother and me too. [...] My involvement with the Youth Ministry (Pastoral da Juventude) was very strong. So, I started to rebel against the company, due to its attitude towards employees. Because I joined CSN in the post-privatization period. [...] I have always been linked to grassroots ecclesial movements, to Youth Ministry. And what does it end up stimulating? Our activism". (Interview granted on 01/18/2017).

The testimony goes back to the associative fabric that characterized the city, especially after the privatization of CSN, and points to the importance of expanding the scale of analysis, incorporating the temporalities linked to the historical and political formation of Volta Redonda in order to understand the conditions of possibility of the social contestation processes against the company in the case studied.

The territories encompassed by the CSN mining and steel global production networks, such as Congonhas (MG) and Volta Redonda (RJ), have shown innovative potential in terms of the creation of forms of social contestation and political confrontation, especially bringing together guidelines and social actors who have traditionally been divided, such as labor and environmental issues (Ramalho *et al* 2013:189). It is in the mapping of this political dynamic that the present analysis is located in the case of Volta Grande IV.

As we have seen, the complexity of the processes for determining toxicity and its effects, and the local and national social and politi-

cal conditions for carrying out research that involve them, make the production of science a slow activity, continuously delayed, which extends over time. Incorporated into the lawsuits, studies for the identification of environmental and health damages are put into in the legal arena, which also has its own temporality.

Studies such as that of NewFields, released to the community as a spectacle similar to a marketing pitch, in addition to the political dimension of performativity, gain meaning when seen through the framework of the involvement of the company in the legal dispute. By the polluter pays principle, the company was urged to prove that its activity did not entail potential risks or damage to the environment, with the establishment of the inversion of the burden of proof (MPF 2018:43). The method of involving the courts and delaying a resolution is a time-saving device used by CSN. This prolongs non-compliance and postpones the adequate operations and effective measures to repair and remedy the situation of contamination.

In this sense, the ineffectiveness of laws, regulations, sanctions, and other mechanisms of environmental bureaucracy in preventing the continuing damage to the environment and health, and in carrying out its reparation, allows us to consider how the legal apparatus is appropriated by the company as a corporate strategy, thus becoming a resource enabling it to continue its ventures and avoid the costs of effective and fair compensation and reparations.

On the other hand, the environmental issue, which was transformed into a political agenda, and the existence of the legal apparatus related to the environment led to a process of social contestation against the company in the city. The leak in the monitoring wells triggered a process of making the effects of the company's activity visible, which until then had acted in invisibility, putting this into the public debate, with the formation of a critical coalition in opposition to the steel industry in the city.

The strategies employed by the actors in this critical coalition rely on the capacity to bring to light the dangers and risks of industrial

manufacturing, thus placing them in the field of the visible, inscribing them in the political dispute. In this way, toxic waste is no longer inert material. It begins to be politically managed and becomes a mediator in the environmental arena of steelmaking infrastructure.

On the one hand, the legal apparatus of environmental bureaucracy is manipulated and becomes a resource that produces time, in the sense that it prolongs and extends processes that delay effective solutions for populations and territories and worsen their vulnerabilities and violence by favoring action and value capture from economic agents. On the other hand, environmental legislation and its regulatory devices are also appropriated by social actors, becoming resources capable of producing socio-political networks and mobilizing agents in the formation of coalitions critical of the company.

Over time, the case that began with a discovery of contaminated soil in the houses due to the leakage in the wells, shifts the attention and actions of the affected residents, the environmentalists, and the agents of the courts to the mountain of slag in the open air that constitutes the steel residue deposit. Upon becoming the focus of attention, discourse, and action, the slag heap materializes the entanglement of relations between humans and non-humans in the steelmaking infrastructure, expanding the 'perception of the environment' (Ingold 2000) of the subjects involved for the multiple assemblages of slag toxicity in the air, water, soil, and human bodies.

In addition to soil contamination, and, above all, the mountain of slag, concern with the effects of steelmaking activity now includes the visual, the atmospheric, water pollution, given the lack of control of atmospheric emissions, of leaching into the water table, and the risk of collapse into the Paraíba do Sul River, announced in the media as an impending tragedy similar to that of Mariana (MG).[6] The toxic particles of the slag are dispersed in the air and residents report increased dust in their homes (Silva 2019:119), whose inhalation causes respiratory diseases. The engagement of various actors around the environment issue forms a coalition that involves a residents' commit-

tee, Southern Environmental Commission, Fiocruz, Public Prosecutor's Office, and NGOs, in a network with potential for expansion. The result of this mobilization process initiated the creation, in 2018, of the Movement of those Affected by the Dust from CSN, boosting and strengthening the contestation.

A resilient politics: a way of conclusion

In this article, we conceptually developed the notion of 'steelmaking infrastructure' as a prism of analysis capable of integrating and placing the invisible or opaque dimensions that constitute the production activity of the steel industry in Volta Redonda into the focus of the discussion. This was done by taking as a case in point the contamination of the Volta Grande IV condominium, an area in which the company dumped its toxic waste for more than four decades. As the municipality had become known as the 'Steel City' because of the steel company, the article focused on the analysis of toxics and their agencings as a way of exploring the political dynamics and effects that they produce, in order to reveal the 'Steel *toxic*ity' in the residual side of the steelmaking infrastructure.

As Liboiron and others pointed out, toxicity concerns the way in which life forms and the relationships that constitute them are enabled, restricted, or brought to extinction within broader systems of power. As such, toxicity is part of these systems, but nevertheless it also has the potential to create alternative political relationships. "The precariousness of toxic worlds enables the formation of resistances, coalitions and practices that expand the inventory of what politics means and does in late industrialism" (2018:341).

The ethnographic analysis of the toxicity politics unfolded in four scenarios of the steelmaking infrastructure. Time was the variable that allowed us to understand the agents' strategies and agencings in shaping the political dynamics around the toxics, as temporalities crossed several levels and dimensions of the infrastructure, producing differing effects. In this sense, time has allowed us to understand power

relationships, map injustices, reveal constraints and violence, as well as identify resistance and potentialities.

Recent anthropological research has given attention to time as an ethnographic object, focusing especially on the temporalities of living and its political dimensions (Martínez 2019). Ozolina (2019) describes 'waiting' as a form of neoliberal governmentality, providing an important contribution to contemporary discussions on the temporality of what is politically invisible, whereas Bandak & Janeja (2018) point to waiting as a political tool, capable of wielding power, to produce particular structures of feeling and to shape forms of resistance and micropolitics.

In the steelmaking infrastructure scenarios examined, time assumes an ambiguous role, acting differently on the actors. If, on the one hand, the slow temporality of contamination, science, and justice is given agency and appropriated as a resource for the steelworks, constituting its corporate strategy and exhausting those affected, forcing their withdrawal or feeling of hopelessness, on the other, the dispute processes of contestation and the mobilization strategies of the actors, through waiting, foment the constitution of a politics of resilience.

As one member of the residents' committee stated: "Because CSN, I think they expected our exhaustion to arrive sooner. I think they don't even know that we are tired" (Interview given on 18/01/17). Founded in 2004, the voluntary committee of condominium residents once had a headquarters with about 350 members today has only a few representatives with the most obstinate left, for whom politics comes with an underlying sense of ethics and is not dissociated from a sense of justice.

The disputes and power relations in the steelmaking infrastructure are inscribed not only in a formal context, but in the quotidian, that of the experiences, in which the perceptions, affections, and actions of the actors are definers of the strategies and potentialities present in an unjust and unequal power game. However, it is a place where giving up is not seen as an option, since its continuity is fused

with the material existences of the subjects and of the moral, ethical senses which the persistent engagement gives them.

In this sense, a resilient politics to toxicity comes close to the idea of a "slow activism" (Liboiron et al 2018:341), in which the effects of its actions take time to appear, do not necessarily involve system change, and nor are they defined by efficiency, but by ethics. In view of the persistence of contamination, uncertainty, injustice and violence, defiantly continuing to exist, waiting for change, is a political action. As a member of the neighborhood residents' commission said: "Today, we are known as 'a resistance group'" (Interview given on 25/01/17).

Notes:

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[2] TN: Despite the common use of 'assemblage' in English as the translation for the French concept of *'agencement'*, the Portuguese equivalent term *'agenciamento'* has been translated in this article as 'agencing', following Franck Cochoy's (2014) discussion of the concept in translation. Cochoy points out the limitations of the use of 'assemblage' and 'assembling' in English, and affirms, from his discussion of Michel Callon's theory of agencing, that "the meaning of agencing is deeper than what might be expected. What Callon shows is that organizational and economic processes are aimed at 'agencing' the world [see his last and detailed contribution on the 'market agencement' notion in Callon 2013]. This means both arranging it [agencing as producing specific agencements] and putting it in motion [agencing as 'giving agency', i.e. converting some people, non-human entities, or 'hybrid collectifs' (Callon & Law 1995) into agents, or rather actors]" (Cochoy 2014:117).

[3] The description of the case in this section is based on the work of Irinéa Brígida (2015), one of the main references on the case, and on the Public Civil Action taken by the Public Ministry (*Ação Civil Pública*) (2012).

[4] The Oswaldo Cruz Foundation (Fiocruz) is a biological sciences research and development institution. It is considered one of the main research centers in public health in Brazil and internationally.

[5] The historical account is based on two reference works about the case: Brígida 2015 and Silva 2019, and on the pieces of the judicial action and inquiries of the Public Ministries both on the federal and on the state level (MPF 2012, 2018).

[6]https://odia.ig.com.br/rio-de-janeiro/2018/06/5549776-rio-paraiba-do-sul-esta-ameacado-de-sofrer-desastre-ambiental.html?fbclid=IwAR2n4nqrQEB4HpOYNsRCs16IBZRb2intsA-H4bIHPg1Eox0XmHUZt4wMEA#foto=1.

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Resumo: O artigo analisa o caso de contaminação do 'condomínio Volta Grande IV' por resíduos industriais da Companhia Siderúrgica Nacional (CSN), em Volta Redonda no Sul Fluminense (RJ). A noção de 'infraestrutura siderúrgica' é desenvolvida como chave de análise capaz de restituir conceitual e etnograficamente a dimensão invisível da produção

siderúrgica, ao enfocar o lado residual da infraestrutura, caracterizado pela toxicidade. O objetivo do artigo é compreender as relações de poder e dinâmicas políticas engendradas pelas substâncias tóxicas na configuração de arenas de disputa em torno de seus potenciais usos e efeitos. A partir da apresentação de quatro cenários a contaminação, a controvérsia científica, o processo judicial e a arena ambiental a narrativa etnográfica adota o tempo como objeto privilegiado, discutindo as formas como temporalidades divergentes atravessam diferencialmente a infraestrutura e seus efeitos políticos na construção de estratégias corporativas e processos de contestação social, que terminam por conformar uma 'política resiliente'.

Palavras-chave: Justiça ambiental, Resíduos tóxicos, Siderurgia, Infraestrutura, Tempo.

Tradução: Patrick William Bushell

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