

‘THE BAY OF ALL BEAUTIES’:
STATE AND ENVIRONMENT IN GUANABARA BAY,
RIO DE JANEIRO, BRAZIL, 1875-1975

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THE BAY OF ALL BEAUTIES

Talk not of Bahia de Todos os Santos--the Bay of All Saints; for though that be a glorious haven, yet Rio is the Bay of all Rivers—the Bay of all Delights—the Bay of all Beauties. From circumjacent hill-sides, untiring summer hangs perpetually in terraces of vivid verdure; and, embossed with old mosses, convent and castle nestle in valley and glen.”

Herman Melville, *White Jacket*

Abstract

This dissertation is a history of Guanabara Bay, in Rio de Janeiro, Brazil, and of the institutions that managed its environment between 1875 and 1975. It illustrates the birth of environmental agencies in Brazil, and how administrative, scientific and military institutions resisted or integrated environmental concepts into their activities. It explores the interplay of the urban environment and the natural environment in Guanabara Bay against a continuously shifting political and legal background. Regime change, international pressure, personal networks and demographic growth add to the complexity of this century-long investigation of one of the most celebrated landscapes of Latin America. The dissertation contributes to the development of environmental history in Latin America by combining an environmental approach with more traditional concepts of urban history and history of technology.

By focusing on the practices that defined environmental management—transformation, monitoring, regulation and law enforcement—I identify four institutions closely connected to changes in Guanabara Bay: municipal administration, the Navy, the Hydrobiology Station belonging to Oswaldo Cruz Institute and the Institute of Sanitary Engineering. These institutions shared a preference for top-down intervention, taking little account of the preferences of a growing human population that was as much a part of Guanabara Bay as the shoreline and the waters. Nevertheless, in spite of these limitations, this knit together an evolving concept and practice of environmental management. Chronologically, the chapters overlap rather than succeed each other; diachronically, they delineate a network of individuals who interacted with each other, even when their institutions failed to do so.

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Note

Translations from French, Portuguese and Spanish into English are my own, unless otherwise noted.

Currency conversions from mil-réis (1\$000), contos de réis (1:000\$000) or cruzeiros (Cr\$1,00) into US dollars until 1937 are based on John Wirth's conversion tables, in John D. Wirth, *Minas Gerais in the Brazilian Federation, 1889-1937* (Stanford, CA: Stanford University Press, 1977), page 263. From 1938 on, the exchange rates were obtained at the Economic History Services website, section by Lawrence H. Officer, "Exchange rate between the United States dollar and forty other countries, 1913 -1999," *Economic History Services* (EH.Net, 2002, available at <http://www.eh.net/hmit/exchangerates/>).

Table of Contents

Abstract	v
Acknowledgements	vi
Table of Contents	xiii
List of Graphs	xiv
List of Figures	xv
Introduction	1
Chapter 1 Placing Guanabara Bay	30
The Physical Bay	32
Brazil, Rio de Janeiro and Guanabara Bay	39
Two States and One Bay	45
From the Dictatorship to the Merger of the States	48
Demography and Municipalities	53
Chapter 2 Engineering Modernity: An Uneven Landscape	62
Urban Bay, Rural Bay	66
Engineers, Politics and Beauty	72
Public Works, Health, and Sanitation	85
Sewage, Garbage and Beaches	86
Miasmas, Vectors, and the Dredging of Swamps	93
Frustrating Modernity: the Sanitation of the Fluminense Baixada	99
Chapter 3 To Protect and Defend: The Navy	111
Place: Guanabara Bay as Headquarters	115
Staking a Claim in Guanabara Bay: Beyond Defense	122
Oil, Water and Diplomacy	135
Chapter 4 Scientists, Mangroves and Pollution, 1937-1973	154
The Oswaldo Cruz Institute and the Formation of its Scientists	156
The Pinheiro Island	165
From Hydrobiology Station to Monitoring Pollution	184
Developing Biological Indicators	191
The Station and the Island Lose their Places	201
Chapter 5 Pollution Control: From Public Health to Public Environment	211
Legal Environment	216
Sanitary Engineering: Uniting Sewage and Waters	222
Defining and Addressing Pollution in Guanabara Bay	230
From Sanitary Engineering to Environmental Engineering	253
Conclusion	268
Appendix A - Municipalities in Guanabara Bay	276
Appendix B - Mayors of Rio de Janeiro, 1987-1930	278
Appendix C - Officers of the Port Captaincy of Rio de Janeiro	279
Appendix D - Six Degrees of Pollution	281
Glossary/Abbreviations	282
Bibliography	284

List of Tables

1 - Comparison of maps of Guanabara Bay	25
2 - Population for Rio de Janeiro and Brazil.....	56
3 - Demographic map of Guanabara Bay, 1872-1970	58
4 - Annual estimates of benefits for main water uses, 1974	240

List of Graphs

1 - Populational growth, 1872-1970 (Brazil, state and city of Rio de Janeiro)	56
2 - Population growth in Guanabara Bay, 1872-1970	60
3 - Population distribution in Guanabara Bay.....	61

List of Figures

1 - Projected highway system for Guanabara Bay, 1915.....	26
2 - Hydrographic map of the Rio de Janeiro harbour, 1810.	27
3 - Sample collection in Guanabara Bay, 1948.....	28
4 - Location of main discharge points of pollutants, 1974	29
5 - Landsat-7 satellite image, 2000.....	34
6 - Geographic and administrative microrregions for Rio de Janeiro state, 2002	59
7 - Guanabara basin.	70
8 – Map of the Neutral District (detail), 1880	72
9 - Landfills in Guanabara's shoreline.	80
10 - The Passos Reform in progress, 1905	82
11 - Fish corral, Guanabara Bay, 2000	131
12 - Palafitte dwelling in Praia de Ramos, 1970.....	145
13 - Facilities at Pinheiro Island, 1952	162
14 - Pinheiro Island, 1921	166
15 – Changes in Pinheiro Island, 1937-1957	170
16 - Favela da Maré (Slum of the Tide), 1951.....	177
17 - Healthy mangrove, Guapimirim, Guanabara Bay, 2000	192
18 - Water use zoning in Guanabara Bay.	246
19 - Grid used for mathematical models.....	247
20 - Proposed goals for water quality.	248

Introduction

In 1992, Rio de Janeiro hosted the United Nations Conference on Environment and Development. Delegates from member countries and concerned environmental organizations came from all over the world to Rio de Janeiro's Galeão Airport (built mostly on land reclaimed from Guanabara Bay), then drove on the Red Line highway (built especially for the occasion, also on reclaimed land) to reach Rio de Janeiro's downtown. While official delegates met in the suburbs of Rio, representatives from non-profit organizations gathered at the Global Forum, a Woodstock-like environmental conference held in the exquisite Flamengo Park—another huge landscaped area reclaimed from the bay in the 1960s. One of the products of the UN conference was a large project for the cleansing of Guanabara Bay (PDBG-Programa de Despoluição da Baía de Guanabara). The plan had a budget of US\$800 million for its first ten-year plan, and was coordinated by the government of Rio de Janeiro state, the Inter-American Development Bank, the Japan International Cooperation Agency, and the Overseas Cooperation Fund.¹ The plan was welcomed by Rio's residents as salvation of their beloved Guanabara Bay. From the most conservative politician to savvy street vendors, all were familiar with words such as despoluição (cleansing), meio ambiente

¹ Celebrated as a turning point for the Bay, the program proved disappointing, and its first ten year phase, budgeted at US\$800 million, fell short of the expectations. Although much has been done on sewage treatment and industrial pollution control, the program fell short for chemical, biological and social indicators of sustainability. For a evaluation of the PDBG, see Guilherme Malaquias dos Santos Neto, "Avaliação do Programa de Despoluição da Baía de Guanabara e do Programa Nova Baixada para o Saneamento Básico na Baixada Fluminense." (Master's thesis, Universidade Federal Fluminense, 2002); David Zee, "Baía da Guanabara: Dossiê Sócio-Ambiental," in *Sustainable Management of the Guanabara Bay: International Seminar*, ed. Centro Internacional de Desenvolvimento Sustentável (Rio de Janeiro: Fundação Getúlio Vargas, 2000). Current comprehensive evaluations are in process.

(environment), and discussing the condition of Guanabara Bay was as popular as deciding who was to be the national soccer coach.

The environment was not always such a popular topic, but its management has a longer history. Long before such concepts as environmental protection became politically fashionable, Guanabara Bay and its resources, waters, and beauty had been important elements in the government's agenda. From the mouth of the Bay, with the fortresses of Santa Cruz, São João and Lage, to its back where the protected wetlands of Guapimirim resisted oil pollution, Guanabara shows the signs of centuries of human intervention, of careless and other times deliberate environmental management, understood as the use of the bay to meet human needs. Today's bay with its polluted waters, altered shoreline, parks, airports, roads, and favelas (slums) built on landfills is the result of these centuries of action. The environmental management of Guanabara Bay can also be seen in the existence of the Galeão Airport and the Flamengo Park—land reclamation projects that encapsulated this idea that the bay is “civilization in potential,” or raw material to be transformed according to society's goals.

Needs change over time, and so have uses of Guanabara Bay. The landscape bears the marks of past use. The strategic geography of the bay's mouth was quickly noticed and utilized by a defense-minded population in the sixteenth century, and the Fortresses of São João, Santa Cruz and Lage were lined up to take watch at the mouth of Guanabara. Today, the fortresses are no more than picturesque tourist spots, their defense value largely diminished. Likewise, the Area of Environmental Protection Guapimirim sits on land claimed back by mangrove forests from orange orchards that were abandoned when economic decline struck the Guanabara lowlands in the late nineteenth century. One

hundred years later, an environmentally conscious public needed protected areas more than they needed orchards.

Environmental management in the sense I propose here is a broader term than its current usage allows. Societies have always regulated access to their own natural resources and have defined acceptable usages of such resources. States seek to control access to clean water, invent ways to eliminate waste and sewage, define rights to fisheries, navigation and control land reclamation--all practices that require management of the environment, even before environment was an explicit concept on the political agenda. Modern ideas of environmental management imply awareness of the direct and indirect impacts of human practices on nature, and it must include concepts such as sustainable development, environmental justice, and carrying capacity. Yet environmental awareness is not a precondition for states to exercise the above-mentioned practices that, *de facto*, constitute environmental management. Thus, what is discussed in this dissertation is a looser idea of environmental management that comprises all state practices that transform nature and regulate the interaction between society and nature, regardless of whether such practices are perceived as environmental management. Rather, the concept of environmental management exists in a continuum in which we can identify different levels of understanding of the rippling impact of these state practices and policies. This continuum was not necessarily progressive or uniform over time--some state institutions, such as scientific research centers, adopted environmental considerations and discourses earlier than others--but the process of regulating nature and coping with increasing deterioration of the environment did lead to the development of what is now understood as environmental management.

This dissertation is an environmental history of Guanabara Bay, in Rio de Janeiro, Brazil, from 1875 to 1975, and the institutions that managed its resources. It is also the history of how ad hoc and sometimes unplanned policies for Guanabara Bay evolved into planned environmental management. The dissertation explores how a loose set of practices that transformed Guanabara Bay, regulated and monitored its natural resources, and enforced such regulations: These practices that could be placed at one end of the environmental management continuum—gradually progresses toward comprehensive state policies that focus on the conservation and administration of the natural environment, at the other end of the continuum. In this process, practices that were implicit in the daily routine of diverse state agencies were brought forward and clearly highlighted for their impact on the environment of Guanabara Bay. The process runs parallel to the changes in the perceptions of nature by the different institutions involved in environmental management, changes that are also connected to a larger background of history of science and the status of scientists/technical staff within the state bureaucracy.

This particular narrative of Guanabara Bay contributes to an understanding of the birth of environmental agencies in Brazil. One of the most famous and beautiful harbors in the world, Guanabara Bay was the first body of water to prompt Brazilian governmental action in relation to water quality, aesthetic aspects, biota, and fisheries production. The bay was after all home to Rio de Janeiro city, the Brazilian capital until 1960, the postcard-symbol of Brazil, and one of the world's great cities by the end of the twentieth century. Concerns over the rational use of the Bay's resources date back to colonial regulations, or to warnings in 1790 by José Bonifácio de Andrada, one of Brazil's founding fathers, that wasteful and ignorant whaling as it was practiced in

Guanabara Bay would soon doom the industry.² Scientific, technological and urban projects in Guanabara Bay attained immediate national visibility and were often emulated in other regions of the country. Hence, the management of Guanabara Bay's natural resources is a fundamental case study of the history of water resources of modern Brazil. Yet, because of the shifting political circumstances—the transfer of the federal capital, the evolution of cities into states, and the merger of competing states, it is also a challenging and unique case.

Chronologically, the dissertation begins in 1875, when the Imperial Commission for Improvements in Rio de Janeiro presented its plans for expansion and reform of the imperial capital, settled down the parameters for sewage projects by The City Improvements Company, and inaugurated a cycle of many and extensive land reclamation projects.³ The dissertation closes one hundred years later, when in 1975 the new State of Rio de Janeiro created the State Foundation for Environmental Engineering (Fundação Estadual de Engenharia do Meio Ambiente-FEEMA), the first explicit environmental management agency in the country, largely influenced by another UN conference on the environment, held in Stockholm in 1972. If 1875 was the beginning of a cycle, then 1975 closes another, for this was also the year when the States of Rio de Janeiro and Guanabara were merged into a single state. With the merger, Guanabara Bay was again unified under a single state administration, as was 150 years earlier.

² José Augusto Pádua, *Um Sopro de Destruição: Pensamento Político e Crítica Ambiental no Brasil Escravista, 1786-1888* (Rio de Janeiro: Jorge Zahar Editor, 2002), 135.

³ Among its members, the commission counted with young engineer Pereira Passos, whose name would later become a symbol for urban reform. Many of his future projects were initially discussed within the commission. Jaime Larry Benchimol, *Pereira Passos, um Haussmann Tropical: A Renovação Urbana da Cidade do Rio de Janeiro no Início do Século XX*, Biblioteca Carioca (Rio de Janeiro Brazil: Secretaria Municipal de Cultura, Turismo e Esportes, Departamento Geral de Documentação e Informação Cultural, Divisão de Editoração, 1990), 45.

States mainly manage their territories through institutions, and therefore institutions tend to be the leading actors in the history of environmental management.⁴ During the period under study, a number of state institutions staked their claim to Guanabara Bay. Government agencies competed for or shared jurisdiction over the many different functions related to the bay: military defense, recreation, housing, fisheries, transportation, scientific research, sewage and garbage disposal, and aesthetic value. In this narrative, administrative, scientific and military institutions resisted or integrated environmental concepts in their traditional activities of landscape-building, monitoring, law enforcement, and regulation. Over the same period, the population living on the shores of Guanabara Bay increased almost twenty times, while the bay's water regime, biota, and shoreline were radically transformed. The physical bay and the institutional bay changed together—not as in a careful blueprint, but rather as a messy patchwork.

Thus, following the practices of environmental management, more than the explicit concept, I sought to place Guanabara Bay in a long-term perspective. In the next pages, I will first point out the persistence of certain elements that emerge from this bird's-eye view of the bay. I then analyze how Guanabara Bay has been discussed in the literature, and which are the problems and contributions that this study offers to this historiography. Finally, I discuss the available sources and how they guided the organization of this dissertation. The emphasis on the practices of environmental management led me to explore disciplinary discourses as they were proposed by different

⁴ For the goals of this dissertation, “institutions” refer to well-defined organizations, and I am particularly interested in governmental organizations. The concept of “institutions” as a set of well-established practices within a society or culture does not apply.

institutions. The result is a multiple image of Guanabara Bay, in the many ways it was perceived and represented by those who monitored, regulated and transformed it.

Environmental management practices from regulation and law enforcement to monitoring were not coordinated among agencies until late in the twentieth century. Institutions reacted—sometimes with perplexity, sometimes with political acumen—rather than planned to the changes they perceived in Guanabara Bay and the country. This fragmentation and ad hoc policies, the rapid pace of the twentieth century, and the demographic trends that outpaced any possible urban planning, contributed not only to the deterioration of Guanabara Bay's environmental conditions, but also to the institutional weakness of the environmental management agencies eventually created in the late 1970s.

These characteristics were not exclusive to the Brazilian government: John McNeill's recent book on world environmental history argues that crisis management and rampant urbanization were widespread challenges for state planning in the twentieth century.⁵ In Brazil however, these challenges were aggravated by the political crises and administrative reformulations that Brazil experienced during these hundred years. There was little collaboration among the agencies, or even within each agency. Long-term initiatives for Guanabara Bay often resulted only from the personal interest of individuals within these institutions.

In the case of Guanabara Bay, personal networks, rather than institutional commitment, were particularly influential in determining the success or failure of such

⁵ John R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (London, New York: W.W. Norton & Company, 2000).

initiatives. If institutions are the leading actors in this narrative, individuals are the supporting actors, and it was usually individuals who carried the day. The same names emerge over and over again in the primary sources, names associated with initiatives of environmental management when agencies all but shunned the concept. In the process of understanding a nature that kept changing, individuals were often more flexible than institutions to adapt to new conditions.

Historians are often tempted to recall Fernand Braudel's beautiful tripartite scheme for the sixteenth-century Mediterranean world, in which he describes a time of nature, "the almost immobile history of man's relation with the milieu surrounding him," a time of institutions, "a slow rhythmic history ... of groups and groupings", and a time of individuals, short-lived, fast and eventful.⁶ Yet, twentieth-century Guanabara Bay is as far from the sixteenth-century Mediterranean as a bay is different from an interior sea, and in Guanabara Bay, the Braudelian times seem to be upside down. The natural landscape changed faster than institutions could adapt to new political and environmental conditions; individuals often outlived institutions, pushing their personal projects forward from institution to institution and providing the most enduring features in the development of environmental management of the Bay.

Long-term perspectives are dear to environmentalists; Aldo Leopold's advice that "we should think as a mountain" certainly calls for a similar concept.⁷ Nevertheless, the argument here is that in certain times and places, far from Philippe II's Mediterranean world, the relation between humans and nature is anything but "almost immobile." And

⁶ Fernand Braudel and Richard Lawrence Ollard, *The Mediterranean and the Mediterranean World in the Age of Philip II*, abridged ed. (New York, NY: HarperCollins, 1992), xiv.

⁷ Aldo Leopold, Charles Walsh Schwartz, and River Round, *A Sand County Almanac. With Other Essays on Conservation from Round River* (New York: Oxford University Press, 1966), 46.

this very mobile relation transforms institutions and societies, in the ways in which we think about nature, and the individuals who witness the changes. Nature, in these moments, is as eventful as the life of the King of Spain.

In the fast, eventful times of the twentieth century, the history of Guanabara Bay weaves a complex tapestry of ecological transformation, institutional formation and individual actions. As this interplay of nature, institutions and individuals shaped Guanabara Bay, it also helped to shape how the Brazilian state would perceive nature in the late twentieth-century, with all its short-comings and successes. No less important, the most visible result of this three-angled relationship was FEEMA, and as an institution, FEEMA would become the model for future environmental agencies in Brazil and the main channel through which the populations of Rio de Janeiro negotiated with the State over their relationship to nature.

The dissertation contributes to the development of environmental history in Latin America, a field that is still little explored in Brazilian historiography, by combining the environmental approach with more traditional concepts of urban history and the history of science and technology. Further studies of this kind are still needed in Latin America. A review of titles on environmental history in Brazil reveals that most studies tend to focus on rural areas, forests or frontier areas such as the Amazon or Atlantic Rainforest.⁸

⁸ See for example the classic Warren Dean, *With Broadax and Firebrand: The Destruction of the Brazilian Atlantic Forest* (Berkeley & Los Angeles, CA; London: University of California Press, 1997); Marianne Schmink and Charles H. Wood, *Frontier Expansion in Amazonia* (Gainesville, FL: University of Florida Press, 1984). For a bibliography on environmental history of Latin America, see John D. Wirth, Lise Fernanda Sedrez, and José Drummond, *Online Bibliography on Environmental History of Latin America* [Internet Resource; Computer File] (s.n., January 24, 2004 1990 [cited May 29, 2004]; available from <http://www.stanford.edu/group/LAEH/index.html>). See also a discussion on the strengths and weakness of the field in Lise Fernanda Sedrez, "Historia Ambiental de América Latina: Orígenes, Principales Interrogantes y Lagunas," in *Repensando la Naturaleza: Encuentros y Desencuentros Disciplinarios en torno a lo Ambiental*, ed. Germán Palácio Márquez and Astrid Ulloa (Bogotá D.C., Colombia: Universidad

There is a major gap with respect to urban environmental studies, even though over 80% of the Brazilian population lives in cities.

The study of bays has only recently begun to develop within the literature of environmental history. Bays often shelter very productive ecosystems, and their easily defensible geography attracted Europeans since their arrival to the Western hemisphere. Cities located on bays often had their growth limited by the shoreline, and new studies have focused on how bay cities developed creative ways to face this challenge. Water management, sewage disposal, tideland transformation, and land reclamation are some of the topics that emerged from these studies, and there is a remarkable echo of them in the history of Guanabara Bay.⁹

Recent literature on Guanabara Bay is heavily influenced by the contemporary environmental debate. Popular assessments of environmental conditions of Guanabara Bay tend to be very critical, with harsh denunciations of gross mismanagement of the region. This perspective is not unfounded. In the last century, Guanabara Bay lost about 20% of its water surface. Islands, beaches, small internal bays, lakes and rivers were filled up, drastically altering water flows. Less than thirty percent of the original

Nacional de Colombia-Sede Leticia; Instituto Amazónico de Investigaciones Imani, Instituto Colombiano de Antropología e Historia, Colciencias, 2002).

⁹ Recent bay/city studies include Philip D. Curtin, Grace Somers Brush, and George Wescott Fisher, *Discovering the Chesapeake: The History of an Ecosystem* (Baltimore, MD: Johns Hopkins University Press, 2001); Sarah S. Elkind, *Bay Cities and Water Politics: The Battle for Resources in Boston and Oakland*, Development of Western Resources (Lawrence, KS: University Press of Kansas, 1998); Lynette McLoughlin, "Shaping Sydney Harbour: Sedimentation, Dredging and Reclamation 1788-1990s," *Australian Geographer* 31, no. 2 (2000). See also the ongoing doctoral dissertation on San Francisco Bay, by Matthew Booker, at Stanford University. Although it focus on an estuary, not so much on a bay, Ari Kelmans's environmental history of New Orleans also offers intriguing questions to water and shoreline management in a landscape dominated by a powerful, modernizing city. See Ari Kelman, *A River and Its City: The Nature of Landscape in New Orleans* (Berkeley: University of California Press, 2003). Water management has been an important theme in Environmental History since the first definitions of the field, and this new works derived from those research inquiries. See John Opie, *Ogallala: Water for a Dry Land*, Our Sustainable Future (Lincoln, NB: University of Nebraska Press, 1993); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West*, 1st ed. (New York: Pantheon Books, 1985).

mangroves remain today, and this undermines the Bay's ability to filter organic waste and to offer protection to the reproduction of its fauna.¹⁰ The impact of this loss on Guanabara's fisheries has yet to be assessed. In addition, the population within the Bay basin increased from roughly 400,000 in 1875 to over 7,000,000 by 1975, resulting in the incredible rate of 465 tons of mostly untreated sewage being discharged daily into the Bay by 1999.¹¹ A spill of 1.3 million liters of crude oil in March 2000 generated a wave of protests by the public, as well as intense press attention regarding the Bay. The spill also raised questions on the environmental costs of urbanization and industrialization in the Bay, and questions on the process that led to the current situation.

In the most significant and thorough work by one of these critical voices, historical geographer Elmo Amador claims the Brazilian state is the main culprit responsible for the degradation of Guanabara Bay. In a classic activist/declensionist narrative, Amador argues that the state is almost absolutely identified with, or worse, at service of, the interest of the industrial and real estate capital, with grave consequences for the integrity of Guanabara Bay.¹² Amador's work is a groundbreaking study of five hundred years of European/Brazilian occupation of Guanabara Bay, and in many ways, it inspired the basic questions for this dissertation. However, even if Amador is correct that most of the large interventions in the bay were sponsored, sanctioned and carried out by the state, the Brazilian state itself is more fragmented and diverse than his narrative allows. Instead of a unified front of disregard for Guanabara Bay while encouraging its occupation by industrial and real estate capitalists, the state sponsored ambiguous and

¹⁰ Elmo da Silva Amador, *Baía de Guanabara e Ecossistemas Periféricos: Homem e Natureza* (Rio de Janeiro: E.S. Amador, 1997), 385.

¹¹ Zee, "Baía da Guanabara," 32.

¹² Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 256.

contradictory projects for Guanabara Bay in which some sectors promoted large scale interventions, while others resisted and criticized this approach or were concerned with its implications. Likewise, the decision-making process was more complex than an automatic identification with powerful interest groups. Governments, both at the federal and state levels, did consider scientific input in their decisions, sometimes frustrating the interests of their constituencies. National security concerns, that is, the defense of the federal capital, were also important, especially in the earlier periods of the republic.

On the other hand, Amador is correct when he points to the lack of democratic practices in the State's management of Guanabara Bay. In this regard, the rise of environmental politics in Brazil is quite different from what Samuel Hays described for the United States. Hays saw an increase in the population's awareness of environmental degradation after World War II and he argues the creation of environmental institutions were the result of political pressures from this population.¹³ In Guanabara Bay, and by extension Brazil, the masses and the population are conspicuously absent in environmental politics, at least until the 1970s. Environmental policies were more the result of elite concern, including politicians and bureaucrats, and they were never really sure what to do with the population. In the elite's perspective, the growing population, particularly the growing poor population crammed in favelas in appalling sanitary conditions, did strain the resources of Guanabara Bay, while land reclamation, wetlands draining, and industrialization did not.

¹³ Samuel P. Hays and Barbara D. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985*, Studies in Environment and History (New York: Cambridge University Press, 1987).

By selecting Guanabara Bay as the unit of analysis, the delimitations of natural and urban environment are conveniently blurred. Although Rio de Janeiro city dominates the landscape, as did Chicago in William Cronon's *Nature's Metropolis*, the transactions and debates that took place in the city had an impact on the environment far beyond the urban limits, transforming the entire Guanabara Bay basin.¹⁴ In the case of Guanabara Bay, the environmental history approach translates the institutional world of urban projects, scientific research and public bureaucracy into a physical world of sewage, palafitte slums, cherished landscapes, fisheries, and people. It also exposes the paradox of the success story of these institutions, and how they became more integrated and environmentally oriented, parallel to the declensionist narrative of environmental conditions in Guanabara Bay, where pollution, siltation, and ecological loss increased over the century.

Although Rio de Janeiro city is probably the most studied place in Brazilian historiography, Guanabara Bay itself is surprisingly understudied. Most of the studies in the region have focused on the city because of its national importance, dismissing the physical environment in which the city is set.¹⁵ Regional historians of the state of Rio de Janeiro on the other hand have concentrated their attention on the Paraíba Valley, or the northern region of Campos dos Goytacazes, or more specifically, the coffee and sugar

¹⁴ William Cronon, *Nature's Metropolis: Chicago and the Great West*, 1st ed. (New York: W. W. Norton, 1991). In US environmental history, the focus on urban environments has yielded some remarkable studies, such as Martin Melosi's, *The Sanitary City*, and Joel Tarr's, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*. In both works, the management of water resources plays a crucial role in the development of urban landscapes. Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore & London: The John Hopkins University Press, 2000); Joel A. Tarr, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, 1st ed., *Technology and the Environment* (Akron, Ohio: University of Akron Press, 1996).

¹⁵ A 1990 bibliography on Rio de Janeiro Studies listed over 400 works. Maria Luiza Villela de Andrade, Maria Isabel Gomes de Sant'Anna, and Iara Moussatché, *Cidade do Rio de Janeiro: uma Bibliografia* (Rio de Janeiro: Museu da República, 1990).

economy.¹⁶ Only recently has the University Federal Fluminense established a center for regional historical studies with a focus on the relations between Niterói and Rio de Janeiro's city. Guanabara Bay will hopefully inspire more needed historical studies. One remarkable exception for this neglect of Guanabara Bay in the historiography is a 1998 unpublished master's thesis on the sanitation of the Fluminense Lowlands by Jefferson Fernandes. Beautifully illustrated, Fernandes's thesis contains exhaustive analyses on the actions of the Department of Sanitation and Public Works in the 1930s in Guanabara Bay, and the impact it had on the environment and population.¹⁷ Fernandes argues that the 1930s sanitation project dramatically altered the fluvial regime in Guanabara Bay, shaped the settlement patterns in region for the twentieth century, and created a large reserve labor force for the fledging industrialization in the lowlands.

Historical geographers have been more generous to Guanabara Bay. Written in the 1940s and 1950s, Alberto Lamago and Lysia Bernardes's works are still powerful references in the field. Lamago's *O Homem e a Guanabara* (The Man and the Guanabara) is part of a trilogy in which he explores (and celebrates) the close interaction between civilization and landscape, while Lysia Bernardes's *Rio de Janeiro: Cidade e região* (Rio de Janeiro: City and region) diligently demonstrates the vivid relationship between Rio de Janeiro and the hinterland, including a large part of the Guanabara Bay region. More

¹⁶ See Marieta de Moraes Ferreira and Sérgio T. N. Lamarão, "Fontes para o Estudo da História do Estado do Rio de Janeiro na Primeira República," *Boletim informativo e bibliográfico de ciências sociais BIB*, no. 20 (1985). Brazilian regional history gained new momentum in the mid 1970s, with the publications of seminal works by Brazilianist John Wirth, Robert Levine and Joseph Love. These works, focused on the states of São Paulo, Rio Grande do Sul, Minas Gerais and Pernambuco, privilege a political and economical understanding of the regions, and their spatial range overlaps with the political border of these states. Other regional historians have followed this model, and economic and political units, more than biogeographic ones, have dominated the literature. (include references for the three books).

¹⁷ Leonardo Jefferson Fernandes, "O Remédio Amargo: As Obras de Saneamento na Baixada Fluminense 1890-1950" (Master's thesis, Universidade Federal Rural do Rio de Janeiro, 1998).

recently, Maurício de Abreu wrote and inspired some excellent works on urban historical geography of Rio de Janeiro city with a strong emphasis on environmental considerations in Guanabara Bay.¹⁸ This dissertation builds on these studies to capture changes in the political institutions over time and their relationship to the bay as a physical and ecological entity.

Because environmental history thrives with long-term approaches, it also provides a privileged perspective of a long-term overview of the Brazilian state. The state apparatus in the Republic has yet to be comprehensively studied, in contrast to what happened during the colonial and imperial eras.¹⁹ Because of the state's relative political instability during the Republic (when compared to the previous periods), most studies of the state concentrate on chronological segments defined by traditional landmarks, for example, the Vargas Era, or the military dictatorship. Moreover, studies on the state also tend to focus on national and regional leadership and politics, the more visible face of the state, while the long-term development of a national bureaucracy and technical staff has received relatively little emphasis.²⁰

¹⁸ As a matter of fact, Abreu was the doctorate adviser for Elmo Amador. See Maurício de Almeida Abreu, *Evolução Urbana do Rio de Janeiro* (Rio de Janeiro: IplanRIO, 1997); Maurício de Almeida Abreu, *Natureza e Sociedade no Rio de Janeiro* (Rio de Janeiro: Prefeitura da Cidade do Rio de Janeiro/Secretaria Municipal de Cultura, Turismo e Esportes, 1992); Lysia Maria Cavalcanti Bernardes and Maria Therezinha de Segadas Soares, *Rio de Janeiro Cidade e Região*, Biblioteca Carioca (Rio de Janeiro: Prefeitura da Cidade do Rio de Janeiro, Secretaria Municipal de Cultura, Departamento Geral de Documentação e Informação Cultural, 1987); Alberto Ribeiro Lamego, *O Homem e a Guanabara*, Biblioteca Geográfica Brasileira: His Setores da Evolução Fluminense, 3 (Rio de Janeiro: Serviço Gráfico do Instituto Brasileiro de Geografia e Estatística, 1948).

¹⁹ See, for instance, Dauril Alden, *Royal Government in Colonial Brazil; with Special Reference to the Administration of the Marquis of Lavradio, Viceroy, 1769-1779* (Berkeley: University of California Press, 1968); Roderick J. Barman, *Brazil: The Forging of a Nation, 1798-1852* (Stanford, Calif.: Stanford University Press, 1988). For a discussion of the current research on the Brazilian state, see Ruth Leacock, "JFK, Business, and Brazil," *Hispanic American Historical Review* 59, no. 4 (1979).

²⁰ As an example of excellent, but traditional in their focus on political elites, studies on the Brazilian state, see José Murilo de Carvalho, *Teatro de Sombras: A Política Imperial* (Rio de Janeiro: Editora UFRJ, Relume Dumará, 1996); Raymundo Faoro, *Os Donos do Poder: Formação do Patronato Político Brasileiro*, 2 ed. (Porto Alegre: Editora Globo, 1975); Steven Topik, *State and Economy: Brazil under the*

This dissertation addresses some of these issues. By combining environmental and institutional histories, it invites the reader to view the state, not only from a long-term perspective, but also from the perspective of less celebrated layers of the state. The focus is not so much on high-level politicians and state ministers, but mainly on the technical staff on which these governmental institutions depended, and through which the necessary practices that constitute environmental management were made: intervention (in the form of public works), environmental monitoring, regulation, and law-enforcement. This research raises questions about the consequences of the continuities and discontinuities of governance in Brazil and proposes a new approach for a study of the Brazilian state.

By using the bay as the unit of analysis, we uncover a state that rarely made the headlines or the history books, a state that was fragmented because its institutions were fragmented, but which nevertheless continued to exist through revolutions, new constitutions, and radical political re-structuring. This state was composed of middle-level bureaucrats who carried on policies defined by political elites, but also pushed forward their own understanding of these policies. There were also those who saw the changes on the ground, the increase in pollution and siltation, and the plans for the aggrandizement of Brazil. Moreover, as their role as scientific experts gained legitimacy within the administration, state technicians were called to inform and promote state policies.

Empire and the Republic, Technical Papers Series 47 (Austin, TX: Office for Public Sector Studies, Institute of Latin American Studies, University of Texas at Austin, 1985). Some long-term studies of the state apparatus, remarkable in their exceptionality, are Thomas H. Holloway, *Policing Rio de Janeiro: Repression and Resistance in a 19th-Century City* (Stanford, CA: Stanford University Press, 1993); Simon Schwartzman, *A Space for Science: The Development of the Scientific Community in Brazil* (University Park, Pennsylvania: The Pennsylvania State University Press, 1991).

In this latter instance, analyzes of reports and internal memoranda on the environmental management of Guanabara Bay shed some light on the practice of state-sponsored science in twentieth-century Brazil. History of science is a burgeoning field in Latin America. In particular, the research center Fundação Casa Oswaldo Cruz in Rio de Janeiro, has made remarkable contributions to the history of science in Brazil in the twentieth century by studying the work of naturalists, botanists, and health experts.²¹ However, the center favors studies of public health and medicine, while this dissertation argues that other scientific disciplines (engineering and hydrography for instance) also had a strong influence on Guanabara Bay. Among other constituencies, governmental officials seriously took into account the input from scientific institutions and their concepts of public health, urban planning, resource management, and later, environmental health. If the Guanabara Bay's landscape changed over time, so did the disciplines that measured, evaluated, foretold, and eventually inspired governmental policies for the Bay. Disciplinary borders were as flexible as the Bay's shoreline. Scientific disciplines encapsulated concepts of nature that resulted from the historical practices of these sciences. Therefore, to understand the environmental management of

²¹ The Fundação publishes a quarterly journal, *Manguinhos, History, Health and Science* that is one of the most important publications on History of Science in Latin America, and it has published several articles on Environmental History. Only recently, however, the English literature in Latin America has been more receptive to see Latin America as a center of production of science. The American Historical Association recently published an article on fingerprints in Argentina by Julia Rodrigues. See Julia Rodriguez, "South Atlantic Crossings: Fingerprints, Science, and the State in Turn-of-the-Century Argentina," *The American historical review* 109, no. 2 (2004). Stuart McCook's book on science and environmental history in the sugarcane production in the nineteenth century, and Jorge Cañizares-Esguerra's work on the scientific identity of early-modern Spanish America, received very enthusiastic reviews. See Jorge Cañizares-Esguerra, *How to Write the History of the New World: Histories, Epistemologies, and Identities in the Eighteenth-Century Atlantic World*, Cultural Sitings (Stanford University Press, 2001); Stuart George McCook, *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940*, 1st ed. (University of Texas Press, 2002).

Guanabara Bay, it is important to understand these shifting concepts of nature in the equally shifting scientific fields.

* * * * * s

Focusing on the practices that defined environmental management—transformation, monitoring, regulation and law enforcement—it was necessary to locate the institutions/individuals that carried on these practices in Guanabara Bay between 1875 and 1975. Four different types of institutions emerged as closely connected to changes in Guanabara Bay. The first institution was the administration of the municipalities, where engineers played a central role. They planned the new developments for Guanabara Bay, created the laws that made these plans possible, and executed public works. Within the public administration, they not only altered the shoreline of Guanabara Bay, but also created a template for future interventions in the bay. While Chapter One offers an overview of the political background of Guanabara Bay and its close link to the larger national history, Chapter Two investigates the engineers at work on Guanabara Bay between 1875 and 1930, their empowerment within the Brazilian bureaucracy and the modernization projects that they advocated in which beauty and sanitation constituted two faces of the same modernity. Modernity as advocated by engineers created a new map for the Bay through embankments and river canalization that reclaimed thirty percent of Guanabara Bay's surface, and through the uneven access to capital and political power.

Chapter Three explores the role of the Navy in Guanabara Bay and how it shifted from its role of national defense to the guardian of national waters. From early in the twentieth century, the Navy had a vested interest in the fate of fisheries, fishermen, and navigation. Closely linked to Guanabara Bay where its main military port was located, the Navy also defended its claim over the Bay from civil administrations that promoted embankments in sensitive areas, encroaching upon navigation. Although some of its officers individually warned about the implications of water pollution in Guanabara Bay, it was only later in the century as oil pollution increased in the seas that the Navy responded to international pressure by taking the initiative domestically rather than allowing external interference. The Navy then brokered agreements among state agencies to regulate and monitor pollution, or simply to enforce existing laws. In this context, Guanabara Bay was the Navy's most visible field of action.

Chapter Four examines the development of a Hydrobiology Station at Guanabara Bay where two scientists, husband and wife, recorded the biological changes in the Bay ecosystem from 1937 to 1973. Affiliated with one of the most important scientific institutions in Brazil, the Oswaldo Cruz Institute, the couple redefined their laboratory from a center for hydrobiology studies into a center for studies on sea pollution. During this transformation, the couple succeeded in connecting with people in other governmental agencies who were equally interested in pollution at Guanabara Bay, and yet they failed to obtain support from their own institute of origin. The laboratory was eventually closed, but the studies and networks it initiated provided the basis for many pollution control policies in future years.

Finally, Chapter Five focuses on how the civil administration coped with pollution in Guanabara Bay. Picking up from where Chapter Two left off, this chapter analyzes how state institutions framed water pollution not only as a public health problem, but also as a political and legal concern. Against a complicated backdrop of regime change and the changing political map of Guanabara Bay, a new generation of sanitary engineers sought to create an autonomous technical agency that would manage Guanabara's waters with the best available knowledge. In contrast to earlier aspirations to emulate Europe and the developed countries, the new engineers sought to adapt international pollution standards within a national reality of competing urban needs. The evolution of pollution control brought together institutions and people depicted in the previous chapters, and built on the experiences and knowledge accumulated by those individuals, to create the first modern environmental agency in Brazil.

Together, these chapters show that institutions shared a preference for top-down intervention, taking little account of the dynamics of a growing human population that was as much a part of Guanabara Bay as the shoreline and the waters, fisheries, and mangroves. Chronologically, the chapters overlap rather than succeed each other; diachronically, they delineate a network of individuals who interacted with each other over the fate of Guanabara Bay, even when their institutions failed to do so. Some of these individuals include Paulo Moreira da Silva, a naval officer and one of the most important names in Brazilian oceanography; Lejeune de Oliveira, scientist and director at the Hydrobiology Station in Pinheiro Island; and Fausto Guimarães, health expert at the Waters Department and one of the creators of the Institute of Sanitary Engineering. The

careers of these three individuals interlinked to form one of many informal networks in the 1950s and 1960s, that presaged more official networks in the 1970s and 1980s.

In searching for the voices of the institutions that employed the civil and sanitary engineers, naval officers, biologists and health experts that studied, worked and defined Guanabara Bay as a political object, Rio de Janeiro city is a privileged location. The city hosts the country's National Archive, as well as a State and a Municipal Archives.

Brazilian law defines the National Archive as the legal depository of documentation generated by all federal governmental agencies, and similar legislation provides for the State and Municipal Archives. Unfortunately, even with the immense levels of paperwork generated in the second half of the twentieth century, many of the technical reports and internal memoranda never made it to the official archives. When these documents did, they often received a lower priority than other kinds of documents, taking years before they were classified and opened to the public.

Institutional archives may be more useful, in particular for more recent years. The Navy's Service of Documentation keeps a very thorough archive, as does the Oswaldo Cruz Institute and the State Foundation for Environmental Engineering (FEEMA-Fundação Estadual de Engenharia do Meio Ambiente), the last thanks to the efforts of Fausto Guimarães. As in the official archives however, staff and space limitations prioritize some types of documents over others, and as technical reports age and are updated, their earlier versions may be discarded. Political changes within the institution, administrative restructuring, and new political agendas also influence which documents are preserved and which are forgotten. Overall, unless a case can be made for their

contemporary usefulness, document preservation is seldom a priority in Brazilian institutions, which often suffer from a lack of funding for ordinary functions.

To compensate for such gaps in the documentation, I relied on interviews with individuals who worked in these institutions. Oral history is sometimes challenging, as today's values color the memories of yesterday. The environment is more valued today and wide-spread as a political concern than it was forty years ago, and the interviewees often interpret their recollections according to this new, modern filter. Yet, interviews with Naval officers, state engineers, biologists and health offered a guide to the labyrinth of personal careers and institutional options that helped to interpret the colder scientific reports and these perspectives ultimately shaped this dissertation for the better. No less important, personal contacts with those who helped build the management of Guanabara Bay opened the doors to precious personal archives.

Personal archives proved invaluable, most of all access to the private documents of Lejeune de Oliveira, the biologist and physician who worked at the Oswaldo Cruz Institute's hydrobiology station. Lejeune died in 1982, but his wife and colleague, Luiza Krau, kept his rather extensive archives, which contained his personal journals, publications and photographs of the hydrobiology station since the 1930s. While Lejeune's most recent reports can be found in the institutional archives, many more survived in his personal records. His archives also contain copies of many governmental documents that eluded the official archives, despite their relevance at the time.²²

²² For instance, the 1961 report on pollution in Guanabara Bay, produced by a working group at the Ministry of Transportation and Public Works, was referenced in Navy and state documents, but I could not find a copy in any of the institutional or official archives. Eventually, a copy of it emerged among biology journal articles and research diaries in Lejeune's personal archive. The document is Eduardo Secades, "Relatório do Grupo de Trabalho para Estudo da Poluição da Baía da Guanabara," (Brasília, DF: Ministério de Viação e Obras Públicas, 1962).

Likewise, collected newspaper clippings on Guanabara Bay, forgotten reports on fisheries, or earlier analyzes of the presence of bacteria in Rio de Janeiro's beaches fared better in the personal archives than in the institutional ones, and these were all generously shared with the author.

Reaching these primary documents was just the initial challenge. Scientific and technical reports not only belong to their disciplines, but they also echo their institutional discourses. The reports present the reader, and in particular the historian, with hurdles and promises. On the one hand, these unique primary sources require the reader to understand and learn discipline-specific terms without being trapped in their a-historical appearance. Scientific reports may be based on the most advanced research, and they argue from the viewpoint of this incontestable authority that it is the best science available. But sciences have a history and change over time: what was unquestionable in the reports at the time they were written may be challenged by more modern research. For the historian, understanding the terms of the reports is important, but it is equally important to place scientific knowledge in perspective, and to look for disputes in interpretation, for discordant voices in the scientific community. On the other hand, the combination of scientific, military, political and technical reports promises a view of the environment of Guanabara Bay that is remarkably interdisciplinary. Each institution had a different perception of Guanabara Bay, of the landscape, and of what Guanabara Bay should become, and these differences were reflected in their reports.

The different ways in which these institutions graphically represented Guanabara Bay illustrate their diversity. Allowing for some simplification, a 1915 project from a member of the Club of Engineers, Fig. 1 provides a projected circuit of highways for the

Guanabara Bay region, where the Bay was represented for what it had the potential to become. In other words, the bay is pliable material for engineering creativity. Fig. 2, an early nineteenth-century hydrographic map of Guanabara Bay produced by the Navy, highlights the underwater relief of the bay, the composition of its bottom soil, all of which ignored the political division between the municipalities above. More modern versions of this chart also include contemporary regulations for fisheries and navigation. The third map, Fig. 3, composed by Lejeune de Oliveira in 1948, marked his field trips to different areas of Guanabara Bay, the type of soil in these areas (sand, mud, or stone), sometimes salinity, and the currents. Finally, Fig. 4 illustrates the chief concern for the Institute of Sanitary Engineering and its successor institution FEEMA: sources of pollution in Guanabara Bay.

As it can be seen in these maps, Guanabara Bay was perceived, measured and represented in different languages, through different indicators, and under different agendas. Understanding the environmental management of Guanabara Bay demands more than simply putting these maps together; it requires an understanding of how they fit together, how they influenced each other, how they translated the Bay to each other, and how they could finally communicate. Even if these maps all refer to different institutional spaces, they still must co-exist in the same place, Guanabara Bay, with its waters, mangroves, sewage, and people.

Table 1 - Comparison of maps of Guanabara Bay



Fig. 1

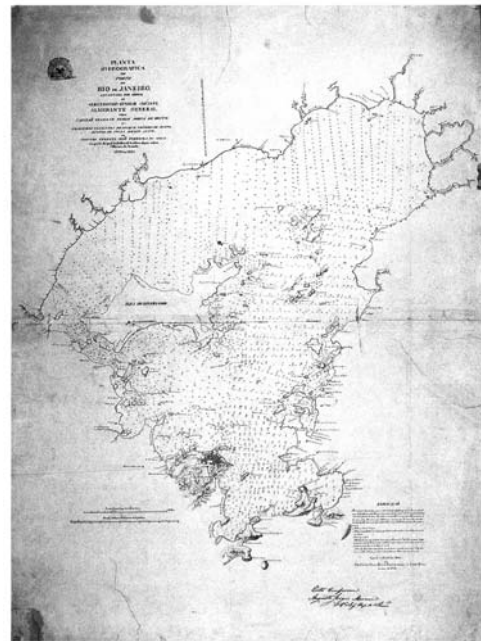


Fig. 2

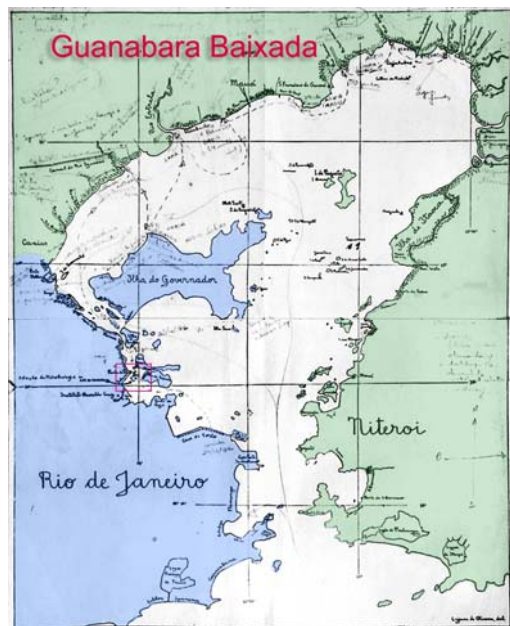


Fig. 3

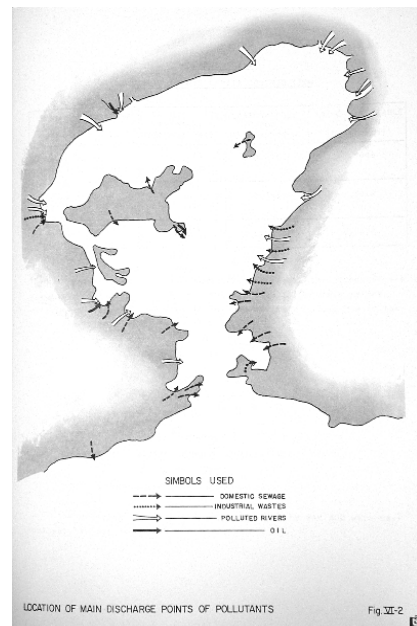
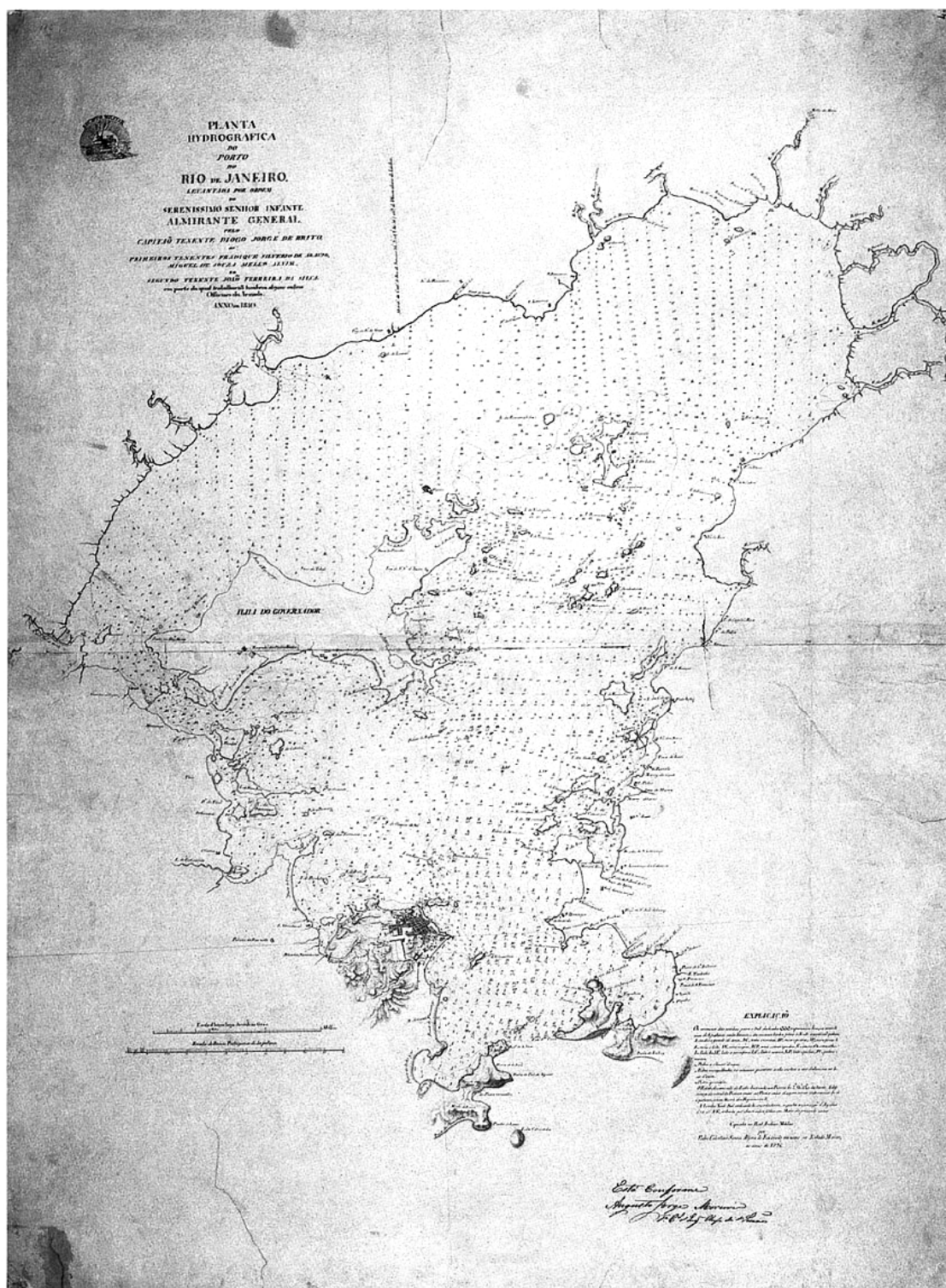


Fig. 4

[illegible]

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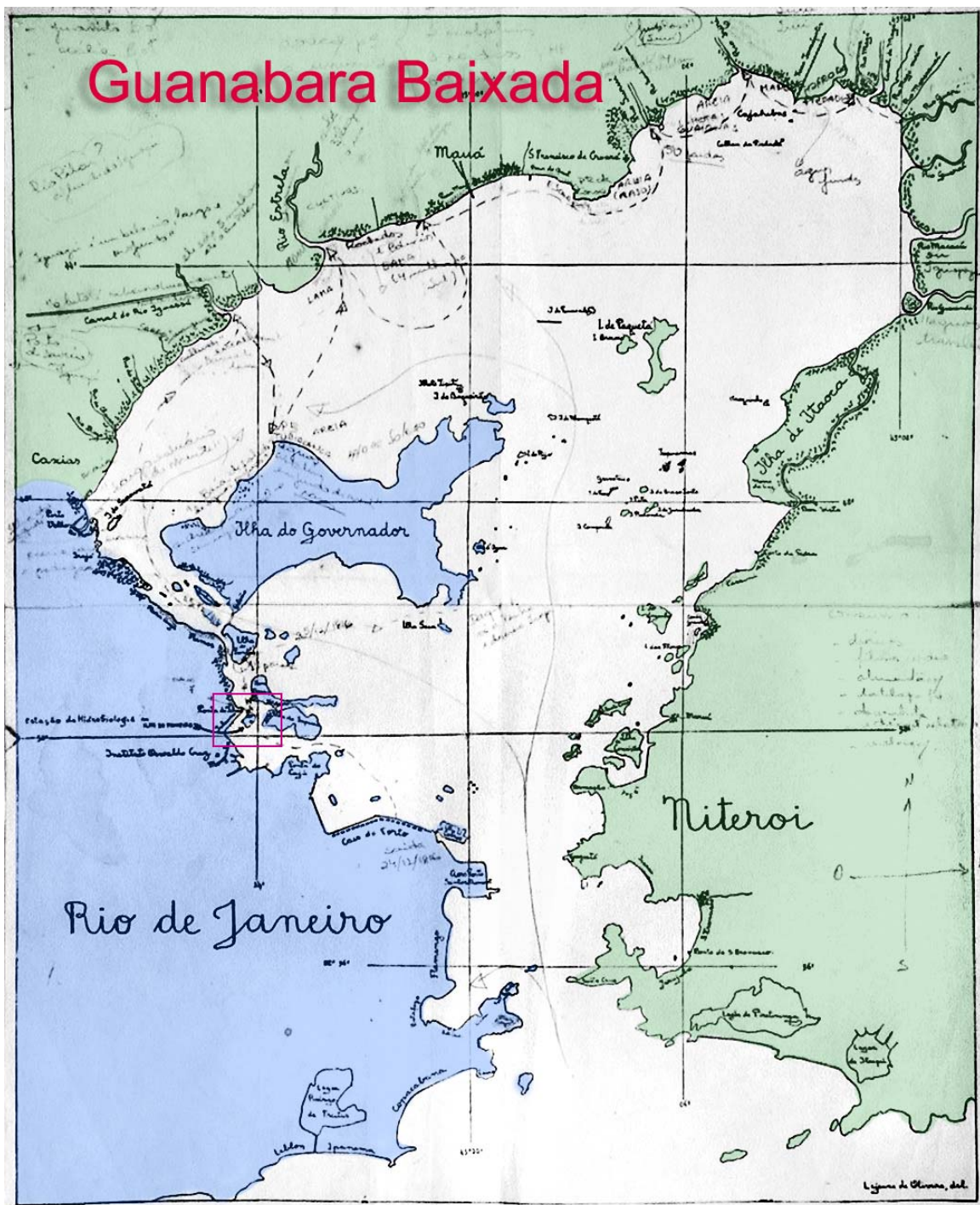


Fig. 3 - Sample collection in Guanabara Bay, 1948. Adapted from a map from Lejeune de Oliveira, 1948.



Fig. 4 - Location of main discharge points of pollutants, 1974. Illustration in Hydroscience Inc. 1977, 54.

Chapter 1

Placing Guanabara Bay

Rio de Janeiro (“River of January”), is a misnomer for Guanabara Bay. In 1503, a Portuguese fleet sailed along the Brazilian coast with a mission to chart the new territory. Charting territory was a necessary step in taking possession of the land, and it required giving names to capes, bays, rivers, thus transforming them into places for the Portuguese Crown. Under the leadership of Captain André Gonçalves, the fleet arrived at what the resident population (mostly Tupinambás or Tamoios), called Guanabara on January 1st, 1502.¹ The bay’s narrow entrance, with its strong current, could have been easily mistaken as a river. Gonçalves baptized the supposed river as “River of January,” collected some exotic birds, and left the site to continue on his mission.²

All but neglected by the Crown, the bay nevertheless appeared in the royal maps of 1534, when Portuguese America was divided into twelve independent and hereditary captaincies, or domains.³ By simply drawing parallel lines on the map, the Crown created

¹ Guanabara in Tupi translates as “the breast of the sea.”

² Gastão Cruls argues that Lemos was well aware that it was a bay, instead of river, and that the word “river” in sixteenth-century Portuguese referred rather to any strong current than to the distinction between river or bay. Portuguese explorers named new places according to the saint of the day: therefore the Cape of Saint Thomas (December 21) follows the Bay of All Saints (November 1), as one follows the coast from North to South. In the map created by Gonçalves, Rio de Janeiro sounds oddly secular. Cruls also sustains that that Gonçalves departed from the namesake tradition because January 1 celebrated the presentation of Jesus to the Temple, and no saint of Portuguese devotion. Gastão Cruls, *Aparência do Rio de Janeiro: Notícia Histórica e Descritiva da Cidade* (Rio de Janeiro: Jose Olympio, 1949), 23. See also Patricia Seed, *Ceremonies of Possession in Europe's Conquest of the New World: 1492-1640* (Cambridge: Cambridge Press University, 1998), 25-35.

³ Sometimes Guanabara Bay appeared the named Baía do Rio de Janeiro (Bay of the River of January) and sometimes simply River of January, especially in foreign maps. It was only in the twentieth century that the cartographers rescued its indigenous name. In the literature, however, Guanabara has always always present. In the literature, however, “Guanabara” was never abandoned: Jean de Léry, for instance, wrote his letters from the “baie de Guanabara” in 1550. Jorge Czajkowski and Fernando Sendyk, *Do Cosmógrafo*

the Hereditary Captaincy of Rio de Janeiro, a strip of land named after the same bay still believed to be a river. In the centuries to follow, the coastal portion of that territory would become the Province of Rio de Janeiro (late colonial period and Empire) and then the State of Rio de Janeiro (in the Republican period). The captaincy was little more than an abstraction for both the Portuguese Crown and the captaincy's grantee (donatário) Martin Afonso de Souza. The Crown was more focused on the northern captaincies or its domains in Asia and Africa, while Afonso de Souza concentrated his administrative efforts on the more promising Captaincy of São Vicente.⁴ The Captaincy of Rio de Janeiro not even an abstraction to the Tamoio inhabitants of Guanabara, who negotiated and warred with European visitors, with little thought to their status under Portugal. Another thirty years would pass by before Mem de Sá, then general-governor of the Brazilian captaincies, fought a war to evict French settlers and their newly installed France Antartique from the Bay of Rio de Janeiro.⁵ Under Mem de Sá's command, his nephew Estácio de Sá founded the Very Heroic City of Saint Sebastian of Rio de Janeiro—or Rio de Janeiro city—in 1565. To reward his allies—the Temiminós, a Tupinambá minority branch who fought with the Portuguese against Frenchmen and Tamoios—Mem de Sá gave the Temiminós chief Araribóia the land just across the bay,

ao Satélite: Mapas da Cidade do Rio de Janeiro (Rio de Janeiro: Centro de Arquitetura e Urbanismo do Rio de Janeiro, 2000); Jean de Léry, *History of a Voyage to the Land of Brazil, Otherwise Called America*, Latin American Literature and Culture (Berkeley: University of California Press, 1990), 23.

⁴ Armelle Enders, *A História do Rio de Janeiro* (Rio de Janeiro: Gryphus, 2002), 23.

⁵ *France Antartique* was part of an initiative by France to assert its rights to some part of America. At the eve of the sixteenth-century religious wars, the project mobilized Huguenots, Calvinists and Catholics into a join effort to create a viable colony in Guanabara Bay. Religious internal conflict, as much as the Portuguese attacks, brought the experience to an end. The war between French and Portuguese mobilized also several Tupinambá groups, as well as the first Jesuits arrived in Brazil. Léry, *History of a Voyage to the Land of Brazil*.

on the eastern shore, where the village of Niterói was founded, already subordinate to Rio de Janeiro city.

Bay, province/state, and city shared the name of a non-existent river. Despite their common name, bay, state and city were defined into existence by different political events and by their different purposes as spaces.⁶ The bay for instance existed as a physical space, with potential resources for defense and subsistence. The province on the other hand struggled to find its role in the larger mosaic that was Brazil, while the city constituted a political space of negotiation and conflict, and often overlapped with the conflicts and challenges of the country, particularly after the city became the capital in 1763. Yet, these very diverse produced spaces shared not only a name, but also a place—the waters, shores, and ecosystem of Guanabara Bay.

To comprehend the changes that took place in the bay in the twentieth century and the formation of the institutions with jurisdiction over the bay, it is important to understand the transformations in political and geographic spaces over time. Moreover, it is necessary to understand how these physical and political spaces of the bay are intertwined. This chapter serves as a guide on the political background for the place called Guanabara Bay, particularly the period from 1875 to 1975.

The Physical Bay

Guanabara Bay was originally an estuary created by the marine drowning of a complex Pleistocene fluvial system. A single inlet, approximately 56.7 meters deep,

⁶ I am borrowing liberally from Henri Lefebvre's concepts of place and production of space, as discussed by Henri Lefebvre, "The Production of Space," (Oxford: Basil Blackwell, 1991), 46. There is an extensive literature on the concepts of place and space; for a good overview on the use of these terms in Lefebvre, see Andrew Merrifield, "Place and Space: A Lefebvrian Reconciliation," *Transactions - Institute of British Geographers* 18, no. 2 (1993).

opens Guanabara to the sea. The deep underwater channel allows remarkable water exchange between the sea and the bay, and Guanabara was a favorite resting point for whales until the eighteenth century.⁷ Except for some foothills mainly in the city of Rio de Janeiro, the bay is surrounded by a vast lowland (Baixada Fluminense or Guanabara Baixada), punctuated by small half-moon hills, and confined by the mountain range of Serra do Mar (Coastal Mountains). Fifty-two rivers constitute the Guanabara Basin, running fast and steep as they fall down from the hills and mountains. When they reach the lowlands, the rivers slow down significantly before they reach the bay, creating a meandering pattern, while of feeding swamps and marshes. It is estimated that by the sixteenth century when the first Europeans arrived in the region, mangrove swamps covered 260 square kilometers, more than half of the bay's water surface of 468 km.⁸ (See Fig. 5.)

⁷ Overhunting was certainly a reason for the disappearance of whales in Guanabara Bay—a danger well foreseen by José Bonifácio de Andrada, one of Brazil's founding fathers. But so was the increase in sea traffic after the arrival of the Portuguese Royal Family in 1808, when the port of Rio de Janeiro was opened to friendly nations. Pádua, *Um Sopro de Destruição*, 35.

⁸ Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 24. In its maximum expansion, circa 5,100 years ago, the bay's waters occupied almost the entire Baixada, or about 800 square kilometers.



Fig. 5 - Landsat-7 satellite image, 2000. Image by NCE/UFRJ and Threetek in Czajkowski and Sendyk 2000, 36.

Mangroves are a type of tropical tidal vegetation. There are relatively few species of mangrove trees in Rio de Janeiro (three to seven at most) and they recover easily if disturbed. What does not recover as quickly is the ecosystem the mangroves support. The wetland fauna includes a complex group of resident, semi-resident and visiting animals: crabs, oysters, fish (especially young fish), shrimp, turtles, caymans, capybara, tapirs, as

well as an incredible number of birds.⁹ Mangroves have also been an important source of food and fuel for Indians, European fishermen, and other nearby populations. Even before the Tupinambá occupation in the twelfth century, the presence of Indians on these shores is evident by the clear vestiges of their modifications of Guanabara's shoreline: the sambaquis (human made hills of shells), date back to the tenth or twelfth century. Archeologists still debate whether the Indians built them to avoid erosion, for burial sites, or as garbage landfills.

Colonial authorities consistently tried to protect and reserve mangrove resources—shellfish and fuelwood—for the poor.¹⁰ The lime industry was the first industry to systematically disturb the Guanabara mangroves in the seventeenth century. Lime producers needed the shells that could only be found in the mangroves for the production of shell-lime. The ceramic industry followed with its need for fuelwood. Soon, very few sambaquis remained, and only the more insalubrious mangroves had not been ransacked. By the early nineteenth century, the virtual disappearances of whales and the deforestation of the most accessible mangroves were the most visible signs of the European presence in Guanabara Bay.

A Political Map of the Guanabara Bay

In the sixteenth century, Mem de Sá founded the city of Rio de Janeiro with the primary purpose of the defending the bay against invaders. The loss of Guanabara Bay, located half-way between the sugar-wealthy captaincies in the North and some promising

⁹ Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 149.

¹⁰ Shawn William Miller, "Fuelwood in Colonial Brazil: The Economic Consequences of Fuel Depletion for the Bahian Reconcavo, 1549-1820," in *Agriculture, Resource Exploitation, and Environmental Change*, ed. Helen Wheatley (Brookfield, VT: Variorum, 1997), 140.

settlements in São Vicente to the South, would result in a potential split of the colony, something the Portuguese Crown could not risk. But two centuries later, the situation had changed dramatically. Gold mines in the province of Minas Gerais, a couple of hundred miles inland from Rio de Janeiro city, required more reliable ports safe from smugglers to ship the new wealth to Europe. The favored port and the colony's capital, Salvador, was too far away. Guanabara Bay, however, seemed to fit the needs of the colonial government. The city already owed its name to the bay; now it also owed to Guanabara Bay its position of colonial capital.

Rio de Janeiro's rise as the Brazilian capital in 1763—which would last through the Empire and the better part of the twentieth century, until the creation of the new capital Brasília, in 1960—was a watershed for the city and for the whole region, including the bay. The city of Rio hosted the highest levels of the colonial administration, as well as the administration of the province of Rio de Janeiro. As the capital, many local government functions were in fact carried out by national agencies. And these administrative bodies often forgot that there was more to Brazil than Rio de Janeiro. A visibly well-done job in the city could go a long way to excusing a bureaucrat's total indifference to the needs of far away provinces.

The ascendancy of Rio de Janeiro increased with the arrival of the Portuguese Royal family in 1808. The city then became not only the political center of Brazil, but of the entire Portuguese Empire. Independence from Portugal in 1822 confirmed this position. However, by 1836, the city needed a unique status that corresponded to its role in the new Brazilian Empire: it was severed from the province of Rio de Janeiro, becoming the Município Neutro (Neutral District), or the Court. Niterói, which had by

now left its Tupinambá roots far behind, became the capital of the Province of Rio de Janeiro, a wealthy sugar and coffee producing province, relying heavily on slave labor, and enjoying its close relationship with the Court.¹¹ Guanabara Bay thus was now split into two jurisdictions—and three distinguishable regions: an urban and sophisticated city on the western shore; a less brilliant but still active city on the eastern shore, and a large rural region in the Baixada Fluminense. The unification of Guanabara Bay under a single administration would not occur for the following 150 years.

Symbolically, there was no doubt as to where Guanabara Bay was centered. To visit the capital of the Empire, travelers had to pass the majestic Sugar Loaf rock and enter Guanabara Bay. The disappearance of whales and mangroves did not diminish the impression made by Guanabara Bay on a first-time visitor. In the nineteenth century, Guanabara was probably the most celebrated landscape in Latin America. It combined the exotic New World tropics and the charm of an Imperial court. It was beautiful.

Augusto Souza Fausto, a member of the Brazilian History and Geography Institute (Instituto Histórico-Geográfico Brasileiro), in 1881 compiled the comments of the most renowned visitors to Guanabara Bay. The list was long. Herman Melville called the bay the, “Bay of All Beauties.” Sir Richard Burton said that, “nothing was comparable” to Guanabara Bay. James Cook thought he “had never seen a similar variety of fish as in this bay.” The naturalist Auguste de Saint-Hilarie asked himself, “who could depict the beauty presented by the Rio de Janeiro Bay, a bay that, according to one of our

¹¹ A limited provincial census coordinated by Paulino J. Soares de Souza, Viscount of Uruguay, in 1840, estimated the province population at 402,192, with 183,180 freemen and 224,012 slaves. In the 1872 national census, sixteen years before the end of slavery, the province still counted 292,637 slaves for 490,087 free people; in comparison, Brazil had a total of 1.5 million slaves for 8.4 million free, and Rio de Janeiro city had only 48,939 slaves compared to its 226,033 free. *Industria e Commercio Brazil*. Ministério da Agricultura, *Synopse do Recenseamento Realizado em 1 de Setembro de 1920* (Rio de Janeiro: Typographia da Estatística, 1925), 414.

more knowledgeable admirals, could contain all ports of Europe.” Rev. Daniel Kidder, an American who visited Brazil several times from 1845 to 1860, waxed poetic about Guanabara. “The first time one enters this bay,” wrote Kidder in 1845, “should mark a new phase in one’s life, because one must be totally insensitive not to enjoy such a sublime landscape, in which thrives the beauty and variety of nature, as well as the high concept of the Creator’s grandeur and power.”¹²

It was Charles Darwin who provided one of the most interesting insights on Guanabara Bay. In a letter to his sister Caroline, dated April 5 1832, Darwin wrote that the ship, “lay [outside the bay] during last night, as the Captain was determined we should see the harbor of Rio & be ourselves seen in broad daylight.”¹³ The Beagle’s

¹² Augusto Fausto Souza, “A Baía do Rio de Janeiro,” *Revista do Instituto Histórico-Geográfico Brasileiro* 44, no. 63 (1881): 35-70. The Englishman John Luccock, who lived in Rio from 1808 to 1824, was less poetic but more descriptive about his first impressions: “In proportion as the Sugar Loaf draws to the northward of the ship the gorge opens and through it is beheld the calm expanse of what is generally deemed the finest bay in the world. The entrance is about a mile wide, and fenced on either side by solid masses of granite, one entire stone without a chink; that on the West is nearly six hundred feet high, commonly estimated at much more; its neighbor on the other side, rears its head to a somewhat higher elevation and is topped with a signal staff, from which the first notice is given to the city of approaching vessels... Proceeding up the harbor, the waters expand on either side. On the left opens the bay of Bota-Foga [sic], skirted by inaccessible and verdant mountains, guarded by the Sugar Loaf and the fort of St. John on one side, and a smooth mass of granite on the other. On the right is the Sacco, or as the British call it, Five-Fathom Bay, surrounded by gentle and fertile woody slopes, verdant grass bands, and a yellow sandy beach, the whole enclosed by numerous peaks. Its fine expanse, not less than three miles in diameter, is broken and adorned by a singularly irregular mass of rock, the abode of sea fowl. The gorge of this bay, on the southern side, is flanked by a lofty cone of smooth granite rock; on the northern, by the small island of Boa-Viagem [sic] about a hundred feet high, with perpendicular sides, composed in part of grey and brown stones, in part of red clay. The intermixture of these colours, all glowing in the sun, broken into patches by the rich verdure, which descends from the summit, and occupies every spot, where nature can fix a root, together with the small white church, which surmounts the whole like a crest, is one of the finest objects, which the most fertile imagination can conceive.” John Luccock, *Notes on Rio de Janeiro, and the Southern Parts of Brazil; Taken During a Residence of Ten Years in That Country, from 1808 to 1818* (London: S. Leight, 1820), 32-33.

¹³ Darwin described also to Caroline that “The view is magnificent & will improve on acquaintance; it is at present rather too novel to behold Mountains as rugged as those of Wales clothed in an evergreen vegetation, & tops ornamented by the light form of the Palm.-- The city, gaudy with its towers & Cathedrals is situated at the base of these hills, & command a vast bay, studded with men of war the flags of which bespeak every nation.” We are cut short of a more complete expression of the naturalist’s first thoughts on Guanabara Bay because the mail ship arrived with letters from England to Darwin and the Beagle’s crew. After few seconds of hesitation, Darwin sent “wood & water, Palms & Cathedrals to old Nick & away I rushed bellow [to read about you all]”. Charles Darwin, “Letter to Caroline Darwin, on 3-

captain understood Guanabara Bay not only as a natural but also as a political landscape. In this perspective, the Beagle was as much a part of the scene as the Sugar Loaf. The bay was an arena for exchange of signals and meanings, between the city and its visitors, both parties doing their best to impress each other as representatives of their respective societies.¹⁴

Brazil, Rio de Janeiro and Guanabara Bay

Historians usually point to the 1870s as a crucial decade for the history of Brazil and for the crises of the Empire.¹⁵ The decade coincided with the end of the Paraguayan War (1864-1870), which increased the status of the military in the Empire. Anti-slavery laws were approved as the abolitionist movement grew, as well as the republican movement, particularly in Rio de Janeiro city and São Paulo.¹⁶ Railroads transformed the Fluminense hinterland, shifting economic primacy from fluvial to railroad villages.¹⁷ In Rio de Janeiro city, the Imperial Government called a commission of experts to study ways to improve the city's sanitation system. The decade not only witnessed changes at all levels, it also set the ground for even more radical events in the future.

During the next decade, such radical events transformed both the labor and political regimes of Brazil. Princess Isabel, presumptive heir of the Empire, signed the

12th April 1932," in *The Correspondence of Charles Darwin*, ed. Frederick H Burkhardt and Sydney Smith (Cambridge: Cambridge University Press, 1991), 220.

¹⁴ For a detailed discussion on the travelers' account on Guanabara Bay and their importance for the perception of the bay by the Brazilians themselves, see Luciana de Lima Martins, "Paisagens Brasileiras, Olhos Britânicos: Rio de Janeiro dos Viajantes 1800/1850" (UFRJ, 1998); Anna Maria Fausto Monteiro de Carvalho, "Baía da Guanabara: Os Itinerários da Memória," *Revista USP*, no. 30 (1996).

¹⁵ Carvalho, *Teatro de Sombras*, 25-36.

¹⁶ The Free Womb Law, signed in 1871, declared free any child born from a slave mother, at the same time that established a complicate compensations system for the slave-owner for the upbringing of the child.

¹⁷ Fluminense, from the Latin *flumen* (river), includes anything related to the Province (later State) of Rio de Janeiro. The lowlands around the bay are known as "Baixada Fluminense." In contrast, Carioca, from the Tupi name for a creek near the city, refers to residents of Rio de Janeiro city.

Golden Law which abolished slavery in Brazil on May 13, 1888. Eighteen months later, the royal family was invited to leave the country when the Republican government took over on November 15, 1889. Both events marked the political distance between Rio de Janeiro city and the province of Rio de Janeiro—and created a political split in Guanabara Bay, in addition to the administrative one. The Province of Rio de Janeiro had a weak republican and strong slaveholder tradition. If the Court, pro-republican newspapers and the politicians in the city of Rio challenged the establishment on issues regarding the Imperial government, slavery, or the monarchic regime itself, little of this radical effervescence reached Niterói, much less the rural domains in the province. In 1888, when slavery was abolished, the Province of Rio de Janeiro had the second largest number of slaves; only Minas Gerais had more.¹⁸ Of the nine representatives in the country who voted against the Golden Law, eight were from the state of Rio de Janeiro. Abolition of slavery, without the much demanded compensation to slave-owners, was the final blow that precipitated an open economic crises in the state.¹⁹ Abolition eventually led the province's politicians who felt betrayed by the Crown to embrace republican ideas but it would be too little, too late, for them to forge any significant alliances that would improve their status among the soon-to-be new government. If the Province of Rio de Janeiro, together with Pernambuco and Bahia, were key supporters of the Imperial

¹⁸ Most slaves were concentrated in the Vale do Paraíba, the main center for coffee plantations. Renato Luis do Couto Neto e Lemos, "República e Política Regional no Estado do Rio - 1889/1992," *Revista do Rio de Janeiro* 1, no. 4 (1986): 28.

¹⁹ Coffee production in the state reached its peak in 1881, with 2,600,000 bags of coffee, most of it from the Vale do Paraíba. The crisis was not too far away: in 1887, the exports from the State fell spectacularly to 50% of the previous harvest, and just showed an ephemeral recovery in 1897. Lemos, "República e Política Regional no Estado do Rio - 1889/1992," 29-50. For a classic study on coffee plantations in the Vale do Paraíba see Stanley J. Stein, *Vassouras, a Brazilian Coffee County, 1850-1900: The Roles of Planter and Slave in a Plantation Society*, Harvard Historical Studies 69 (Princeton, N.J.: Princeton University Press, 1985).

Government, in the new Republican Regime, these areas found themselves politically subordinate to the more dominant states of Minas Gerais and São Paulo.²⁰

In the power reshuffling brought about by regime change, the Republic further isolated Rio de Janeiro city from the poorer Rio de Janeiro state (formerly the province of Rio de Janeiro). At the same time, the Army rose to dominance over the Navy, and the Navy in large part had been loyal to the monarchy. Many of the highest officers of the Navy rebelled against what they saw as a military dictatorship under the President Floriano Peixoto, “Iron General.” Guanabara Bay was one of the major battlefields in the rebellion, and both Niterói and Rio de Janeiro suffered from shelling by rebel forces. The bombardment finally forced the old issue of moving the state capital from Niterói to Petrópolis, in the Fluminense hills. Ten years later, the state administration returned to Niterói, and this moving of the capital forth and back exemplifies the special relation of competition and dependency that Niterói experienced with Rio de Janeiro city.

The First Republican period was also characterized by large investments in the administrative structure of the capital.²¹ As discussed in Chapter 2, Rio de Janeiro city would become the model for Brazilian civilization, a symbol of order and progress. Niterói returned to its state capital status, but it was no longer by any means the urban center of political power. The city of Campos dos Goitacazes, a sugarcane producing region in the north of the state, held this position through the career of Nilo Peçanha, a shrewd politician from Campos who dominated state politics during the first thirty years of the Republic. Peçanha stressed the agricultural vocation of the State by supporting

²⁰ Marieta de Moraes Ferreira, *A República na Velha Província: Oligarquias e Crise no Estado do Rio de Janeiro (1889-1930)* (Rio de Janeiro: Rio Fundo, 1989), 18.

²¹ The First Republic or Old Republic is the period between the proclamation of the Republic in 1889 and the Vargas Revolution in 1930.

product diversification. It could have been a saving strategy for the flood-prone lowlands around Guanabara Bay. They could not support extensive, export-oriented plantations, so fundamental in the Brazilian economy, partly because the topsoil had been quickly depleted, but also due to the relatively small surface area appropriate for large scale agriculture. Even at its peak, coffee and sugar production around Guanabara Bay paled in terms of scale to the Vale do Paraíba or Campos dos Goitacazes. Ironically, although the lowlands were located near to the most important harbor of the Empire, they just could not deliver the export production that would assure them political and economic relevance. Food production for the urban Rio de Janeiro and Niterói held the hope for development in the region, but it would require extensive—and expensive—sanitization programs, i.e., swamp drainage and disease control. Without sanitization, Fluminense politicians despaired, Guanabara lowlands were condemned to depopulation, decadence and irrelevance.

The decline of Guanabara lowlands' elites in the Fluminense politics mirrored the decline of Rio de Janeiro's influence over the destiny of the nation as a whole, as the participation of Rio de Janeiro in the coffee export business declined steadily.²² In other words, Guanabara lowlands had limited say in state politics, and by its turn Rio de Janeiro state had limited say in national politics.

In the classic narrative of Brazilian history, the Old Republic is followed by the First Vargas Era (1930-1945), inaugurated by the revolution that put the gaúcho Getúlio

²² For a discussion on the oligarchic divisions in the State of Rio de Janeiro, see Ferreira, *A República na Velha Província*, 17. The only shot the Fluminense oligarchy had to national power was result of chance: Peçanha was the vice-president to Affonso Pena, who died in office in 1914. Peçanha's fifteen-month administration was shadowed by a dispute on his succession.

Vargas in office.²³ Rio de Janeiro state sided again with the wrong faction when the state's political elites, leaderless after the death of Nilo Peçanha in 1924, supported the soon-to-be-deposed President Washington Luis. Once in power, Vargas entrusted the administration of Rio de Janeiro state to a long line of interventores, administrators appointed by the federal government, with little connection to the state's political elites.²⁴

Vargas called his dictatorial phase the Estado Novo, New State.²⁵ It in fact represented a large restructuring of the Brazilian state to one where the central government had strong influence over the states.²⁶ During the authoritarian Estado Novo political power was, as during the Empire, again centralized at the national level, and Rio de Janeiro, as the national capital, enjoyed the benefits of the new regime. The growth and concentration of the national government state led to a new wave of investments in Rio de Janeiro city, mostly for public buildings and infrastructures. By 1944, approximately 10% of the adult population of the Federal District worked for the

²³ Resulting from the alliance of politicians and military defeated in the rigged elections of 1930, the movement erupted in Rio Grande do Sul and Minas Gerais, and soon overtook the whole country. The arrival of the gaúcho rebels in Rio de Janeiro symbolically marked the victory of the revolution and the beginning of the Vargas Era, when the rebel leaders tied their horses to a cherished carioca obelisk in the Central Avenue, for the ever-lasting fury of its residents.

²⁴ Mônica Almeida Kornis, "Pacificação e Derrocada," in *A República na Velha Província: Oligarquias e Crise no Estado do Rio de Janeiro (1889-1930)*, ed. Marieta de Moraes Ferreira (Rio de Janeiro: Rio Fundo Ed., 1989), 301.

²⁵ The First Vargas Era (also known as the Second Republic) was an eventful fifteen-year period. From 1930 to 1934, Vargas led a provisional government. A new constitution was signed in 1934, and Vargas was chosen as President for four more years. However, in 1937 before national elections could take place, Vargas staged a coup, closing the Congress and producing the fourth Brazilian constitution—a constitution that gave him full control over the Executive, Legislative and Judiciary branches. Vargas stepped down after World War II, in a relatively calm transition to a democratic period.

²⁶ One of the most symbolic scenes of the Estado Novo was a public ceremony in which state flags were replaced by the Brazilian flag and burned. For those 15 years, there were no state government elections. Instead interventors were appointed by the president.

government.²⁷ Changes in public service were not limited to the size of the bureaucracy; the Estado Novo implemented major reforms in public service, many of which had a long-lasting impact on the State and on Brazilian history. For instance, the Administrative Department of Public Service (Departamento Administrativo de Serviço Público-DASP), created in 1938, stated that civil servants could not exercise functions in different state institutions. As it was common for state university professors to hold positions also at public research institutions and state administrative departments, this measure streamlined the ranks of government service, and caused a thorough renovation of the state bureaucracy.²⁸ The new rules made it more difficult for the engineers in Rio de Janeiro city to jump from their private companies to public office. Open competitions for state jobs became even more competitive as recruitment became less prone to political interference.²⁹ Job stability attracted young and promising professionals, and long-term career plans in government became possible as the bureaucracy developed relative immunity from political turmoil. Administrative reforms enabled the creation of a solid technical staff. Lejeune de Oliveira and Fausto Guimarães, who are discussed respectively in chapter 3 and 5, entered public service just before these reforms, and their professional trajectories developed within the framework of the Vargas restructuring of the state. Lejeune initiated his career at the Institute Oswaldo Cruz, while Guimarães

²⁷ This includes all population above 18 years, including retired workers, housewives and students. The rate for the whole country is circa 2%. Instituto Brasileiro de Geografia e Estatística - IBGE, *Estatísticas do Século XX*, vol. 2004 (Rio de Janeiro: IBGE - Instituto Brasileiro de Geografia e Estatística, 2003).

²⁸ Schwartzman, *A Space for Science*, 35. The stated purpose of the DASP was to modernize the state bureaucracy and to create a non-political technical staff, independent from political winds and clientelism. Although the degree in which it accomplished its purpose is debatable, there is little doubt that the reforms changed the public sector in Brazil. I will discuss some of the impact of the DASP reforms on the Guanabara Bay's institutions in Chapter 4.

²⁹ A downside of the reforms, though, was the difficulty to renew cadres. Before announcing an open competition, state agencies had to assure the federal administration that they had long-term funding for the hiring. In times of budget cuts, it meant that institutions could go years without new openings, employing interns instead of permanent staff. See Chapter 3.

worked at the Water Department of the Federal District. Independently and later in collaboration with each other, workplace stability enabled them to create institutional spaces for monitoring and studying Guanabara Bay's water and ecosystems, at best a marginal goal within their institutions of origin.

The First Vargas Era was also known for incentives to industrial production through an import-substitution policy, a necessity due to the Depression of the 1930s, and then the World War II. Despite the creation of the Barra Mansa and Barbará steel mills, both in the Rio de Janeiro state, Guanabara Bay's industrialization was slow compared with the state of São Paulo's. Both sides of Guanabara Bay had opposite shortcomings to industry. On the Federal District shore, where a reliable infrastructure would normally attract investments, new businesses had to compete with the state apparatus and a blooming tourist industry for expensive real state. On the Fluminense shore, real estate was affordable, but there was no basic infrastructure such as a suitable port and rail facilities.

Two States and One Bay

After the Second World War, Brazil experienced a period of democratic rule that lasted until 1964, yet full of the regular assortment of coups attempts, most of them planned and thwarted not too far from Guanabara's shores.³⁰ When the 1946 Constitution was signed in Rio de Janeiro city, it was the fifth constitution in the history of the country. It lasted twenty-one years, a longer life than two of its predecessors. In those years, one president committed suicide, another resigned from office, a third was forced

³⁰ See Elio Gaspari, "A Ditadura Derrotada," *O Sacerdote e o Feiticeiro* (São Paulo, SP: Companhia das Letras, 2003), 35-50.

to accept a humiliating parliamentary regime, only to be removed from power by a military coup.³¹ Meanwhile, the country's capital was transferred from Rio de Janeiro to an artificial city, Brasília, in the middle of the central highlands, far removed from Guanabara Bay.

The transition from nationalistic dictatorship to populist democracy in 1946 was smooth, almost placid. Many projects initiated by Vargas were completed by his successors. An example would be the creation of the Universidade de Brasil, an artificial island in Guanabara Bay. In addition, the labor regime established in the Vargas Era, specially regarding public administration and the need for open competitions, remains almost unaltered to this date. Economically, the postwar period was remarkable: between 1947 and 1955, Brazilian industry grew 122%, passing from 18.74% of Gross Domestic Product in 1940 to 29.83% in 1960.³² Most of this growth took place in the São Paulo, which by 1954 was the home to more than 50% of Brazil's industrial sector. Yet even if Rio de Janeiro lagged behind São Paulo in relative numbers, it still showed vigorous growth in absolute figures. Textiles and pharmaceuticals companies were distributed (although unevenly) on both shores of the bay, while the fish processing industry established itself firmly in Rio de Janeiro state. The large oil refinery of Mangueiras

³¹ The former dictator Getúlio Vargas was elected president in 1950, with a populist agenda. Surrounded by accusations of corruption, he committed suicide rather than being removed by a coup, in 1954. Jânio Quadros resigned in 1961, just six months after taking office. His vice-president, João "Jango" Goulart, was sworn in as president in the same year and removed from office by the 1964 military coup.

³² Gerald K. Haines, *The Americanization of Brazil: A Study of U.S. Cold War Diplomacy in the Third World, 1945-1954*, America in the Modern World (Wilmington, DE: SR Books, 1989), 63; IBGE, *Estatísticas do Século XX*, 374. The Federal District also held the highest per capita income rate of the country: Cr\$17,941.20 (US\$944.77) against Cr\$11,081.00 (US\$583.52) in the state of São Paulo, in 1952. São Paulo, the Federal District, Minas Gerais and Rio Grande do Sul held together circa 70% of all national income. The comparison of the Distrito Federal and the State of São Paulo include urban and rural areas of the São Paulo State. Instituto Brasileiro de Geografia e Estatística - IBGE, *Anuário Estatístico do Brasil* (Rio de Janeiro: IBGE, 1953), x.

began activities in 1954, near the Inhaúma cove in the Federal District.³³ A second refinery, Refinaria de Duque de Caxias, was installed in 1961 in the municipality with the same name, in Rio de Janeiro state. The two refineries became important attractions for industrial activity in the region—thus, contrary to popular saying, oil and water became inseparable in the politics of Guanabara Bay.

Politically, the loss of the capital to Brasília yielded mixed political results for the city of Rio de Janeiro. Indubitably it represented a sad blow for the proud Cariocas, who took solace in claiming that Rio was still the “cultural capital.” But it did not imply an immediate loss in political power. The city was granted state status—the State of Guanabara—and kept a great deal of its symbolic relevance for the country. The first governor of Guanabara state, Carlos Lacerda, conspired and circulated in the highest political circles, and had remarkable autonomy to obtain international loans for investment in the state. Most of the administrative buildings (and staff) remained in the city for years; the actual transfer to Brasília took at least a decade. Many federal institutions would never leave Rio de Janeiro. For example, the Instituto Oswaldo Cruz or the Universidade do Brasil (renamed Federal University of Rio de Janeiro) reported directly to their ministries, but were still in Guanabara’s territory. Most of the everyday administration of the city had already passed to municipal jurisdiction in 1947, though there was still much integration between the federal and municipal agencies. The new state thus had an autonomous and well-trained technical bureaucracy, and facilities originally planned for the national capital. It was a very developed and wealthy state

³³ The private-owned Manguinhos refinery was one of the few refineries in the country. The same year it began its activities, a large popular campaign for the nationalization of the oil industry achieved the creation of Petrobrás, the state-owned company with legal monopoly over extraction and oil concessions in Brazil. John D. Wirth, *The Politics of Brazilian Development, 1930-1954* (Stanford, Ca: Stanford Univ. Press, 1970), 163-73.

whose territory did not extend much beyond the urban limits of Rio de Janeiro city. It was not surprising that its per capita income was the highest of all the states of Brazil.

Rio de Janeiro state underwent an industrialization process itself as well, but never to the levels of its wealthier neighbor. With a much poorer infrastructure, it was unable to attract new industries or to regulate and monitor the industries it possessed.³⁴ In contrast to Guanabara State, Rio de Janeiro state was still largely rural, although the cities of Magé and Niterói (around Guanabara Bay) and Volta Redonda (Southwest of the state, in the Vale do Paraíba) industrialized faster than the rest of the state. In particular, the region of Guanabara Bay was viewed as lacking potential for industrialization, exactly because of its proximity to the Guanabara State. Although some state agencies in Niterói suggested joined activities for developing the region, the concept of metropolitan planning would not come about until the early 1970s.³⁵ The bay was once split between a city and a state. Now there were two states, but the schism remained.

From the Dictatorship to the Merger of the States

Brasília in 1964 was a sparsely populated capital, particularly from Thursdays to Tuesdays. Politicians traveled back and forth from Brasília to Rio de Janeiro to keep together the administrative structure (still located in the former capital) and the legislative structure (already in the new capital). Brasília presented the quandary of a president and

³⁴ The first industrial census for Rio de Janeiro state that actually lists more than the title and location of the plant dates of 1970s—and it was recognizably defective. Marcello Monteiro Vannier, Ricardo Silva Araújo Silveira, and Edgard Mattoso Faquer, "Avaliação da Carga Poluidora da Baía da Guanabara - Contribuição do Estado do Rio de Janeiro" (paper presented at the VII Congresso de Engenharia Sanitária, Salvador, BA, Brazil, November, 1973). At least in 1962, an attempt to list and classify the industries operating in Guanabara Bay resulted in a candid admission of ignorance by the Fluminense authorities. Secades, "Relatório do Grupo de Trabalho," 12.

³⁵ See Fundação para o Desenvolvimento da Região Metropolitana do Rio de Janeiro - FUNDREM, *Macrozoneamento da Região Metropolitana do Rio de Janeiro* (Rio de Janeiro: Governadoria do Estado do Rio de Janeiro, 1979), 12.

Congress landlocked in the central highlands of Brazil while the strikes, rallies, and public demonstrations that characterized the unrest of the early 1960s took place elsewhere—in São Paulo, Minas Gerais, and above all Rio de Janeiro. The coup that ousted President João Goulart on 1 April 1964, would be remembered visually not by the take-over of the presidential palace in Brasília, but by the TV-recorded slap that delivered the military complex of Praia Vermelha, near Copacabana, into the hands of the Army rebels.³⁶ It was not too far away from where Mem de Sá established the first Portuguese settlement in the Bay.

Brazil was thus again under authoritarian rule, and it would remain so for at least another twenty years. Popular movements and organizations such as worker unions, community associations, and even political parties, were carefully regulated, if not outright forbidden. Censorship of the press, cinema, theater, and cultural activities became intense after 1967. While a nascent environmental movement flexed its muscles in Europe and the United States, denouncing pollution, nuclear risks, and the loss of biodiversity, Brazilian civil society struggled to keep activists alive. Activists had to find creative forms of political participation that escaped the regime's radar. The Catholic Church was crucial to this process and absolutely fundamental in the defense of human rights. The Church became a *de facto* safety umbrella for a number of organizations that otherwise most likely would have disappeared. However its ideological roots precluded the Church, even in the most progressive cases of those years, from embracing the agendas of the "new social movements" on the rise in the rest of the western world such

³⁶ General Muricy, one of the coup's plotters, slapped the face of the sentinel on watch, striding unencumbered into the building to declare that the Army would no longer submit to the president. It was one of the few physical confrontations on that day, and it was broadcast for the rest of the country. Elio Gaspari, "A Ditadura Envergonhada," *As Ilusões Armadas* (São Paulo, Brazil: Companhia das Letras, 2002), 160.

as reproductive rights, gay pride, and environmental awareness.³⁷ Therefore, while human rights movements, labor associations and social networks in defense of indigenous populations could find some room for development within the Church, the “new social movements” fell behind.

The new regime of course presented its own new constitution in 1967. This was followed by a thorough change in 1969, and together these may be considered the sixth and seventh constitutions in the country’s history. The new constitutions re-initiated the centralization process that had been abandoned at the end of the Vargas dictatorship. A new tributary revenue pyramid channeled most taxes to the federal government, which led to large infrastructure investments which depended upon the federal government.³⁸ The federal government accepted the role gladly. The military government could in fact be characterized by a series of monumental projects (some would say "pharaoh-like") that pointed to the regime’s aspirations for grandeur and to celebrate Brazilian technology.³⁹ Some of these large-scale initiatives included what was then the world’s largest dam, a five-thousand kilometer road in the middle of the Amazon rainforest, and a thirteen kilometer bridge across Guanabara Bay.⁴⁰

³⁷ For the role of the Catholic Church and social movements during the dictatorship, see Andrew Hurrell, "Brazil and the International Politics of Amazon Deforestation," in *The International Politics of the Environment: Actors, Interests, and Institutions*, ed. Andrew Hurrell and B. Kingbury (Oxford, England: Claredon Press, 1992), 401; Lise Fernanda Sedrez, "A Meeting of Minds: Coalitions, Representations and American Non-Governmental Organizations in the Brazilian Amazon" (New Jersey Institute of Technology, 1998), 84. For a discussion on “new social movements,” see Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement* (Washington, DC: Island Press, 1993).

³⁸ Rogério Forastieri da Silva, *Histórico das Constituições Brasileiras* (São Paulo, SP: Editora Núcleo, 1989), 67.

³⁹ It was not unlike the positivist/nationalist agenda in the First Republic, in the early twentieth century, as I discuss in the next chapter.

⁴⁰ Itaipu Dam lost the title of world’s largest dam to the Chinese Three Gorge Dam, closed in 2003. The Transamazonian Highway cost twelve billion dollars in 1974 and it is only partially in use today. The Ponte Rio-Niterói, inaugurated in 1974, is still in use—it was at the time the fourth- longest bridge in the world.

Yet the single piece of legislation that had the largest impact on public administration was the infamous Ato Institucional 5 (Institutional Act 5) that gave the president dictatorial powers, including the authority to interfere directly at all levels of public service. In a country where public servants had become fairly used to immunity from political chiefs since the administrative reforms of 1937, Institutional Act 5 permitted compulsory retirement or dismissal for public servants accused or suspected of subversive activities or sympathies. In a regime that prided itself as technocratic and intolerant of corruption, Institutional Act 5 shook the foundation of its technical bureaucracy. Some institutions felt the blow more than others. The Instituto Oswald Cruz lost at least ten leading scientists, in what is now known as the “Manguinhos Massacre.” Universities—especially in the social sciences and humanities—also suffered heavy casualties. Even in institutions where the impact of Institutional Act 5 was not so visible, a combination of censorship, anti-communist paranoia, and a repressive dictatorship not shy about using any means necessary to keep the state bureaucracy under control, fostered a climate in which technical expertise had to concede to political expediency in public administration.

For Guanabara Bay, the most important project of the military regime was merging the states of Rio de Janeiro and Guanabara, which eventually occurred in 1975. Politicians had discussed the merging hypothesis since the 1950s, when the foundations of Brasília were planted in the central highlands. What was to be done with the city of Rio de Janeiro? The 1946 constitution required a referendum for any change in the federal structure, but there was never enough political interest to push the proposal forward. With the lack of a definitive answer, the stand-alone-state independent solution

triumphed. But the 1967 constitution disregarded the referendum requirement altogether, providing the legal means for the project. Moreover, the military government was committed to a geopolitical project for Brazil in which the federal structure would be redesigned to optimize the country's potential for development. Merging the states of Guanabara and Rio de Janeiro fell under this larger agenda, as well as the later split of Mato Grosso into two states, and the campaign to settle the Amazon rainforest. More immediate economic imperatives also played a role in the merger scheme. Both Rio de Janeiro and Guanabara Bay had performed relatively poorly in the two recent industrial booms, in the 1950s and during the Brazilian economic miracle of 1970-1974.⁴¹ The most popular explanation was that Guanabara and Rio de Janeiro were "a body without a head and a head without a body."⁴² Guanabara had strong lungs, but it needed air to breath, while Rio de Janeiro had enough air, but sickly lungs. The merger, argued businessmen in both states, would put together the wealthy, sophisticated city of Rio de Janeiro (currently disguised as Guanabara state), and the poor, backward state of Rio de Janeiro, benefiting both. The fact that Guanabara was the only state in the country controlled by the opposition party was most likely another consideration by the military regime. It was believed the traditional Fluminense conservatism would serve as a control over the no-less traditional carioca avant-garde.⁴³

The merger (known among Cariocas and Fluminenses as the *fusão*) of Guanabara and Rio de Janeiro brought the political map full circle: Rio de Janeiro city was now the

⁴¹ The expression economic miracle refers to the period between 1968 and 1973, when the average growth rate of the Domestic Product was 11,2%. Likewise, industry's expansion rates varied, according to the sector, between 12 and 18%. Mônica Hirst, *Military Governments (1964-85)* [webpage] (2002 [cited May 29, 2004]); available from http://www.mre.gov.br/acs/diplomacia/ingles/h_diplom/gm017i.htm.

⁴² Helio de Araújo Evangelista, "A Fusão dos Estados da Guanabara e Rio de Janeiro segundo uma Perspectiva de Análise Geográfica" (PhD Diss., UFRJ, 1998), 37.

⁴³ Evangelista, "A Fusão dos Estados", 34-45.

capital of Rio de Janeiro state, and Guanabara Bay as a whole fell under the jurisdiction of this state. But the unequal development of its shores, and its political trajectory based on the histories of the bay, the city, and the country overlapping in a single place, created a map of the Guanabara Bay that could not be erased.

Demography and Municipalities

Over the course of five hundred years, Guanabara Bay was the locale for ethnic wars (the Tupinambás and the Portuguese) and religious experiments (the France Antartique and the Jesuits), for investments and neglect, and for violence and dreams of grandeur. The bay was split once and then joined again a hundred and fifty years later. It would be easy to forget all these revolutions and look at Guanabara as a simple, self-asserting unit. After all, is it not the same waters bathing both sides of the bay? The next chapters will make it clear that things rarely are so simple. Political divisions may dictate development in one place of the Guanabara Bay, and the return of the mangroves on another. These divisions may actually change the regime of waters, by determining a merger of a whole archipelago, as it was the case with the creation of the new campus of the University of Brazil, on the artificial Fundão Island.

There is another kind of change beyond political that can easily go undetected. The bay was not only water and shorelines, nor just a space for political disputes. The bay was also a place where people lived and reacted to incentives and to neglect to either move in and establish families, or to leave. Sometimes their arrival was orderly, within the legal framework of immigration policies; sometimes they arrived as squatters on land reclaimed to the bay, attracted by jobs and industrialization, thus adding their makeshift houses to the new shoreline. Sometimes their move was disorderly, displaced by hunger,

misery, disease, and exclusionary housing policies. A demographic map of Guanabara Bay is crucial to understanding the backdrop against which its institutions developed.

Any attempt to estimate the population living off the resources of Guanabara Bay in nineteenth century must be taken with a grain of salt—indeed, a handful of salt. The first national census did not occur until 1872. Before that, only the Court (Rio de Janeiro city) had anything similar to a census, albeit sometimes with gross, flagrant distortions.⁴⁴ Measuring the Brazilian population would be problematic until 1940. After the national census of 1872, the next census took place in 1890 under the Republican regime. The questionnaire was complex, the tabulation was not finished on time, and it took several years to be published—so long in fact that the Governor of the State of Rio de Janeiro decided to order his own state census.⁴⁵ The next census in 1900 was an unmitigated disaster. The data obtained was so flawed that the whole census was discarded as useless, though the data for the capitals of selected states and the general aggregated data per state was published in 1908. The Federal District decided to sponsor its own census in 1906, just after the drastic urban reforms carried out by Mayor Pereira Passos.⁴⁶ The next national census occurred in 1920, and was considered fairly accurate, but the next census planned for 1930 was cancelled by the Vargas Revolution. From 1940

⁴⁴ The total costs of the 1872 were 170 contos de réis. Misleading responses to the census were punishable with 20\$000 fines per individual, or 100\$000 per landlords. Império do Brazil, *Recenseamento da População do Império do Brazil a que se Procedeu no Dia 10. de Agosto de 1872* (Rio de Janeiro: Leuzinger, 1873), 20.

⁴⁵ It was particularly difficult because it shifted from the questionnaire by parishes (religious divisions) to municipalities (civil divisions). J. P. Favilla Nunes, *Recenseamento do Estado do Rio de Janeiro - Feito em 30 de Agosto de 1892, por Ordem do Exm. Sr. Presidente do Estado Dr. José Thomaz da Porciúncula* (Rio de Janeiro: Companhia Typographica do Brazil, 1893).

⁴⁶ See Chapter 2.

onward, a national census was carried out every ten years based on standards established by the League of the Nations.⁴⁷

It is not only the quality (or the lack thereof) of the census that complicates the task of creating a demographic map of Guanabara Bay over time. There is also a mismatch between the primary physical unit—the bay, which was not measured in the census—and the administrative units or municipalities that were measured. Which municipalities should be included? Only those on the shores of Guanabara Bay? And should one include all the population of a given municipality—even if the larger portion of the territory is landlocked—or just the districts close to the bay?⁴⁸ How close to the bay is close enough? And if the products of the bay circulate in the whole municipality, why shouldn't we this total population be counted? Worse, if the bay received the organic waste of those living on the tributary rivers, would the Guanabara basin, instead of the Guanabara Bay, be a better unit for analyses? Finally, is it possible to compare the population of a given municipality over a hundred years if the territory of this city has been split, added, subtracted, and otherwise redefined, as had happened to most Fluminense cities? Because of all these uncertainties, any estimate of the population that enjoyed the resources of the Guanabara Bay remain rough estimates.

For purposes of contextualization, Table 2 provides a comparison between the populations of Rio de Janeiro and Brazil from the nineteenth century until 1980.

⁴⁷ Luis Patricio Ortiz, *Os Censos Demográficos* [webpage] (Universidade Estadual Paulista - UNESP, 2000 [cited March 20, 2004]); available from <http://www.saudepublica.fmb.unesp.br/docs/ortiz%20censo.doc>.

⁴⁸ The territory of Rio de Janeiro city, for instance, is split between the Sepetiba Bay basin and the Guanabara Bay basin, although the population living far from Guanabara Bay basin or the nearby oceanic beaches was negligible until at least 1970.

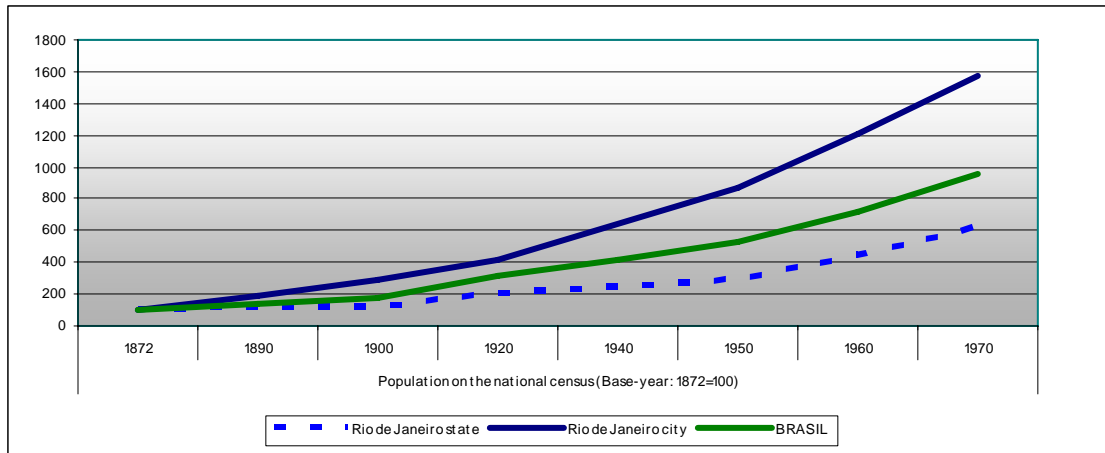
Graph 1 provides a graphic summary of the data from Table 2. Using 1872 as year base, the figure compares the populational growth of Brazil, Rio de Janeiro city, and Rio de Janeiro state.

Table 2 - Population for Rio de Janeiro and Brazil

Year	Brazil	Rio de Janeiro city	Rio de Janeiro state	Population of Rio in relation to Brazil (%)
1776	1,900,000			
1808	4,000,000			
1819	4,396,132			
1821		112,695		
1830	5,340,000	124,978		2.34
1854	7,677,800	178,055		2.32
1872	10,112,061	280,467	782,724	2.77
1880	11,808,215	359,549		3.04
1890	14,333,915	522,691	876,884	3.65
1900	17,318,556	687,699	926,035	3.97
1906	20,569,894	816,921		3.97
1910	23,077,185	900,023		3.90
1920	30,635,605	1,157,873	1,559,371	3.78
1930	37,625,436	1,544,612		4.11
1940	41,236,315	1,764,141	1,847,857	4.28
1950	51,944,397	2,377,451	2,297,194	4.58
1960	70,070,457	3,281,908	3,402,728	4.68
1970	93,139,037	4,251,918	4,794,578	4.57

SOURCE: 1936 IBGE estimates for the population of Brazil and Rio de Janeiro city from 1776 to 1935; national census from 1872 to 1970, in IBGE 2003. Estimates for Rio de Janeiro state were not available, therefore only the official census figures were used. From 1776 to 1872, there are estimates for Brazil as a whole only. Intermediate years were eliminated, except for the first year basis, 1821. From 1872 on, only the decennial years are used, except for 1906, when there was an actual census for Rio de Janeiro, as this was deemed more reliable than simply posting data for 1900 and 1910. From 1940 to 1980, official data census for each year was used.

Graph 1 - Compared populational growth for Brazil, Rio de Janeiro state and Rio de Janeiro city, 1872-1970



SOURCE: See Table 2.

Table 3 is a rough demographic map of Guanabara Bay, and it is referred to in the text of the next chapters. For the sake of simplicity, the data was generated backwards. Data for Table 3 is derived from documents produced in 1974 by the Institute of Sanitary Engineering and a consultant collaborator, Hydrosience Incorporated. The documents listed municipalities considered to be main users of Guanabara Bay, and the figures for area and demographic density were derived from that table.⁴⁹ This data was then cross-referenced against demographic data generated by Rio de Janeiro state for the population of the Metropolitan Area of Rio de Janeiro from 1940 to 1970. The metropolitan area roughly overlaps with the area drained by the Guanabara Bay basin (see Fig. 6). From the municipalities listed, and using previous censuses data, possible territorial changes and redistributions of population were identified.⁵⁰

⁴⁹ Hydrosience Inc., "Water Quality Model of Guanabara Bay - Bra-73/003 Technical Report 5," in *Environmental Control Programme in the State of Rio de Janeiro Brazil* (New Jersey, NJ: United Nations Development Programme, World Health Organization, 1977), 18.

⁵⁰ My thanks to the IBGE staff in Rio de Janeiro, who kindly provided me with their unpublished compilation of all municipalities of Rio de Janeiro state, with date of creation, additions and subtractions.

Table 3 - Demographic map of Guanabara Bay, 1872-1970

Municipalities	Area	Population								Population density in 1970 (Pop/SqKm)
	SqKm	1872	1890	1906	1920	1940	1950	1960	1970	
Rio de Janeiro city	1,171	280,467	522,691	816,921	1,157,873	1,764,141	2,377,451	3,307,163	4,315,746	3,631
Cachoeira de Macacu	1,055	^a 7,556	^a 16,123		^b 16,010	14,069	16,272	27,064	33,893	32
Duque de Caxias	442	^c	^c		^c	^d 24,711	92,459	243,619	431,397	976
Itaboraí	526	^e 16,968	^e 23,873		27,428	24,370	30,228	41,739	65,912	125
Magé	718	15,314	13,985		18,816	23,401	36,761	59,076	113,023	5,818
Nilópolis	22	^c	^c		^c	^f 22,341	46,406	96,553	128,011	5,818
Niterói	130	35,673	34,269		86,238	142,407	186,909	249,000	324,246	2,494
Nova Iguaçu	764	^g 14,081	^g 19,709		33,396	53,985	145,649	359,364	727,140	951
São Gonçalo	228	^h	17,811		47,019	89,528	127,276	247,754	430,271	1,887
São João do Meriti	34	^c	^c		^c	ⁱ 39,569	76,462	191,734	302,394	8,893
Rio Bonito	462	^j 18,771	^j 27,017		24,999	22,831	25,157	27,694	34,434	84
Rio de Janeiro state (total)	4,381	^k 819,604	876,884	^l 926,035	1,159,371	3,611,998	4,674,645	6,709,891	8,994,802	2,053
<i>Estimate Guanabara Bay Region</i>		388,830	675,478		1,411,779	2,181,784	3,161,030	4,850,760	6,906,467	
<i>Guanabara Bay Region minus Rio de Janeiro city</i>		108,363	152,787		253,906	417,643	783,579	1,543,597	2,590,721	

SOURCE: Data from IBGE 2003; SEPDET 2002; Hydrosience Inc. 1974. ^aSant'Anna do Macacu; ^bSant'Anna de Japuíba; ^c belongs to Iguaçu or Nova Iguaçu; ^d refers to District of Caxias, in Nova Iguaçu (autonomous as a municipality in 1943); ^e São João de Itaboraí, ^f refers to District of Nilópolis in Nova Iguaçu (autonomous as a municipality in 1947); ^g Iguaçu; ^h belongs to Niterói (autonomous in 1890); ⁱ District of Meriti in Nova Iguaçu (autonomous as a municipality in 1947); ^j Nossa Senhora da Conceição do Rio Bonito; ^k free population: 255,806; Slaves: 162,394; ^l refers to the incomplete 1900 census.

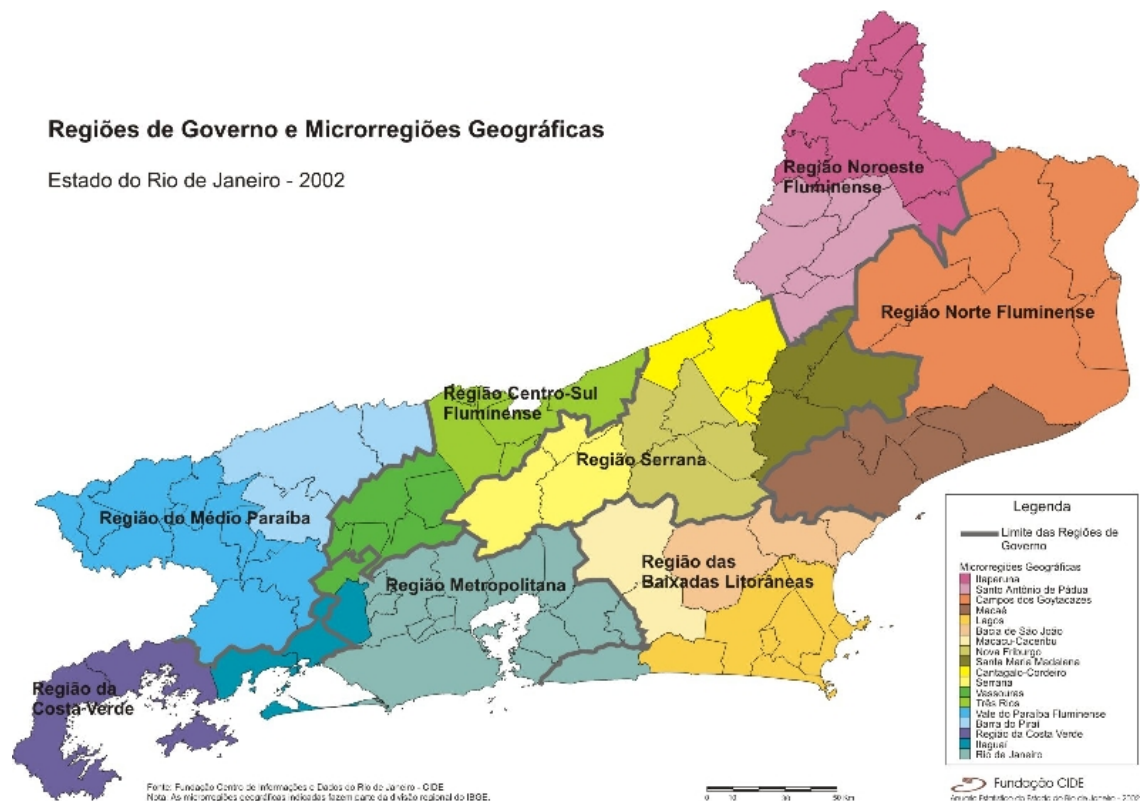
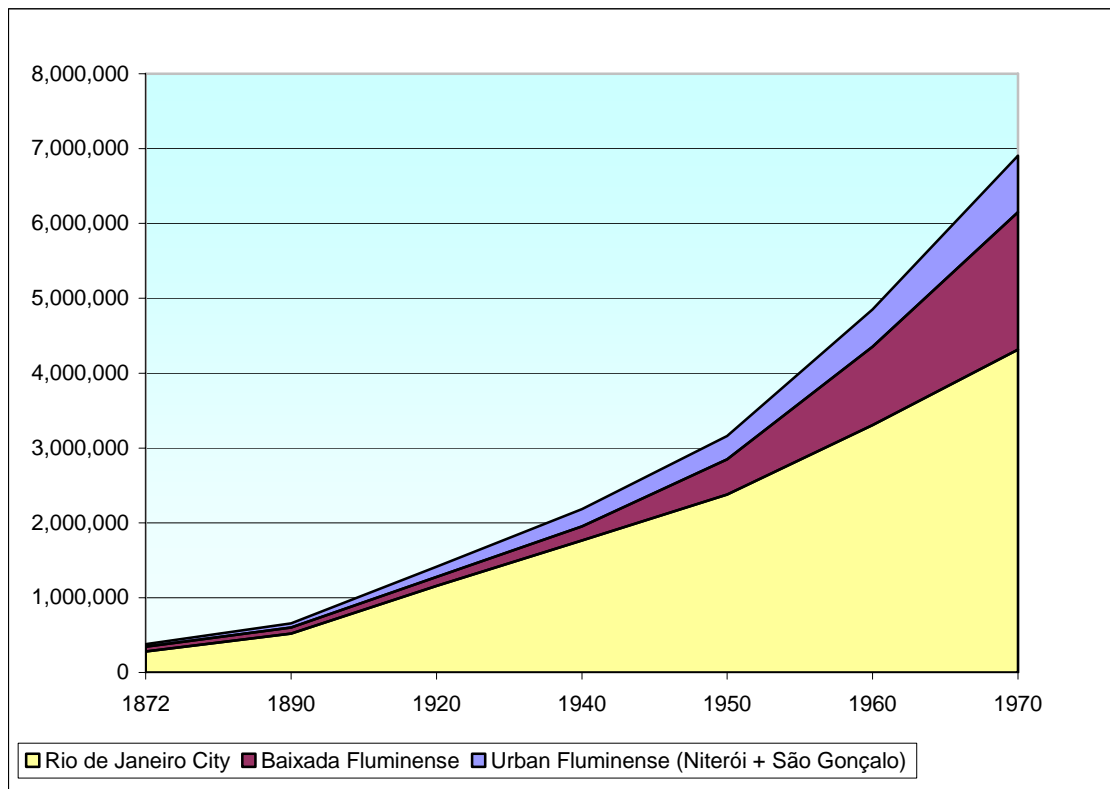


Fig. 6 - Geographic and administrative microrregions for Rio de Janeiro state, 2002. Map in SEPDET 2002.

The data from Table 3, was used to create two graphs. Graph 2 illustrates population increases in the three regions of Guanabara Bay from 1872 to 1970: Rio de Janeiro city, the urban area of Niterói and São Gonçalo, and the Guanabara Baixada. Population size was estimated for the decennials without reliable census data (1900, 1910 and 1930).

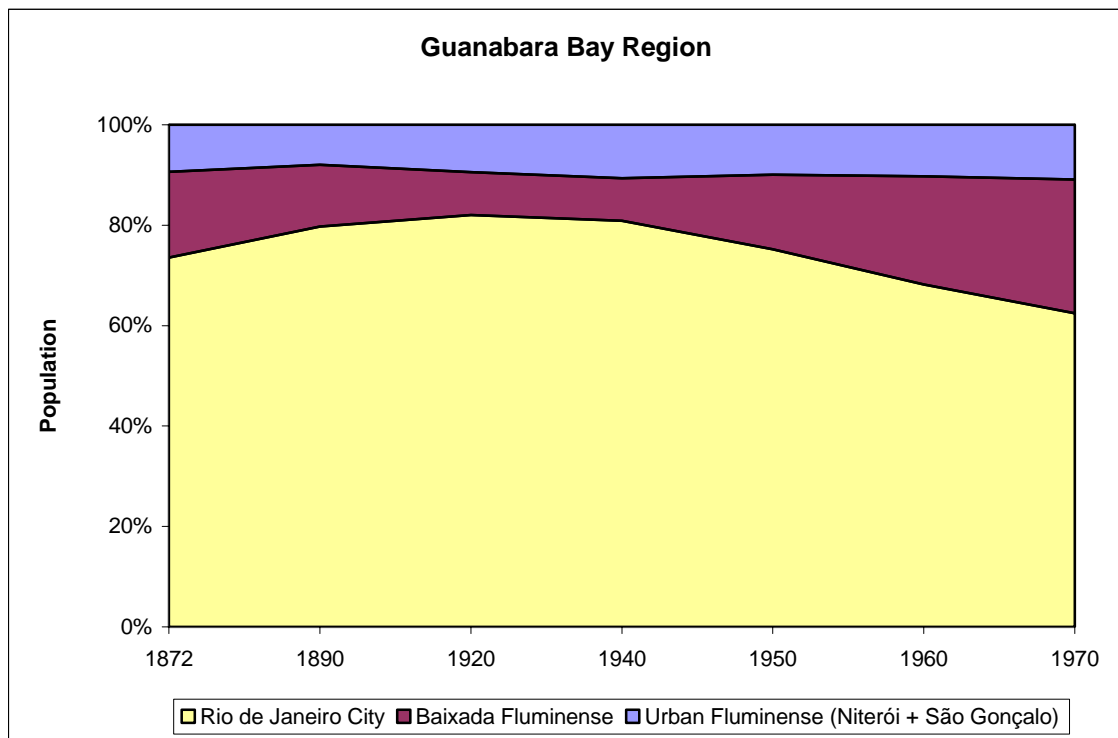
Graph 2 - Population growth in Guanabara Bay, 1872-1970



SOURCE: See Table 3

Graph 3 uses the same data, but instead illustrating the population percent of these three regions compared with the total population of the Guanabara Bay region. While the Graph 2 shows the impressive absolute population growth in the region, particularly after 1890, Graph 3 illustrates how the 1940s, marked by both the First Vargas Era and the World War II, represented a turning point for the Guanabara lowlands. While from 1870 to roughly 1940, the graph shows a process of relative depopulation for the region, the trend was radically inverted after in World War II, and the population in the former rural area grew much faster than the one in Rio de Janeiro city or in the Niterói.

Graph 3 - Population distribution in Guanabara Bay



SOURCE: See Table 3

The following chapters discuss some of the reasons for these population trends, which followed closely the industrialization and urbanization patterns that changed the demographic portrait of Brazil in the twentieth century. The main focus, however, is on how different institutions sought to manage Guanabara Bay and its uses against this complex backdrop of shifting jurisdictions and demographic challenges. As the political definition of Guanabara Bay changes over time, so would change the meaning of the Bay for these institutions.

Chapter 2

Engineering Modernity: An Uneven Landscape

In 1894, in his weekly chronicle, the Brazilian writer Machado de Assis complained about the remains of a bridge standing at Glória beach. The bridge was part of an abandoned plan for yet another embankment on Guanabara Bay. The works were interrupted, but the bridge foundations remained, a ruin of a stillborn modernity. From that would-be bridge, Machado directed his remarks to the fever of land reclamation projects that proliferated in the city of Rio de Janeiro at the end of the nineteenth century. Not that there was anything wrong with such projects, he rushed to assure his readers, “I think we have more bay than we need.” But since small embankments were in order, why not reclaim the whole bay, building a new and modern city from Rio de Janeiro to its neighbor on the other shore, Niterói? “Close your eyes and imagine all this huge bay completely filled with buildings and boulevards,” he suggested. “What a metropolis!” To pay for this magnificent work of engineering, the government should sell virtual real estate in advance, as well as concessions for future public services such as sewage, public transportation and illumination. The government could even sell the bay’s fish—as the bay itself would soon cease to exist.¹

Machado’s ironic wit was right on the mark. By the end of the nineteenth century, there were few spots or beaches in Rio de Janeiro city that had not been the object of one plan or another for improvements. Land reclamation had been part of the history of

¹ Joaquim Maria Machado de Assis, “26 de Agosto de 1894,” in *A Semana, Obras Completas de Machado de Assis* (Rio de Janeiro: W. M. Jackson, 1959), 169.

Guanabara Bay since the early foundations of the city, in the sixteenth century. Rio de Janeiro city was first established on top of the hills and was only gradually able to drain and conquer the wetlands that dominated the lowlands. Yet, it was as part of the effort to make Rio de Janeiro a modern city that land reclamation gained an unprecedented impulse by Machado's time. These projects were tied to certain international concepts of modernity that were changing, cleaning and enlarging cities all over the world. Rio de Janeiro, as the capital of Brazil, was the symbol of a nation that sought a dignified place among all nations. The State would thus be the major sponsor for the modernization process in a Brazilian version, that combined nationalism, scientific rationalization, and technological transformation.²

Machado's second point was more subtle: contrary to contemporary beliefs about man's scientific control over nature, making modernity could be a chaotic, contradictory enterprise, leaving many unfinished bridges along the way. In Guanabara Bay, several modernizing projects competed for a place under the sun.³ Many would fail. For those that eventually came to pass, the final result would be rather different from what the blueprint proposed. The Guanabara Bay that emerged during the early decades of the twentieth century bore the marks of both fulfilled and unfulfilled projects, which in many ways set the pattern for future changes that would take place on its shores, waters, and basin.

² On the correlation of science, technology and nationalism in Brazil, see Maria Inez Turazzi, *A Euforia do Progresso e a Imposição da Ordem. A Engenharia, a Indústria e a Organização do Trabalho na Virada do Século XIX ao XX* (Rio de Janeiro/São Paulo: COPPE/Marco Zero, 1989).

³ For urban projects for Rio de Janeiro created by world-famous architects and engineers, from Pereira Passos and Agache to Le Corbusier, see Maria Alice Rezende de Carvalho, *Quatro Vezes Cidade* (Rio de Janeiro: Sette Letras, 1994).

Modernization brought fast and radical changes to the bay's outline, water quality, physical appearance, siltation rate and vegetation. Engineers were the most enthusiastic proponent of such changes, as landscape building was also social building. Changes in nature reflected and made viable the larger project of changing Brazil. Disciplining nature—or bringing human order to nature—was the premise and symbol of “progress.” Not coincidentally, “order and progress” was chosen in 1889 as the motto for the new Brazilian Republic; inscribed on the flag, it remains today.

The modernization that engineers sought for Guanabara had a double face: one was embellishment, the other, sanitation. On the one hand, due to the symbolic position of Guanabara Bay, modernity would enhance the bay's celebrated beauty, to show how Brazil's civilization and technology matched the country's superb nature. Visitors prodigally praised Guanabara Bay. Herman Melville, in his book *White Jacket*, claimed that if Salvador was the Bay of All Saints, Guanabara was the “Bay of All Delights—the Bay of All Beauties.” Spix and Martius, two naturalists who visited Rio de Janeiro in 1817, claimed its “beauty, variety and splendour far exceeded all the natural beauties which we had ever beheld.” Charles Darwin, in 1832, agreed “the landscape reached its most brilliant colors, and each shape, each shadow, so completely exceeded in magnificence all that the European had always seen in his country of origin that one did not know how to express one's sensations.”⁴ On the other hand, engineers needed to make the bay healthy, which implied heavy state-sponsored sanitary works on sewage,

⁴ Herman Melville, *White-Jacket; or, the World in a Man-of-War*, vol. 5, *The Writings of Herman Melville* (Evanston [Ill.] Northwestern University Press, 1970), 156. Johann Baptist von Spix, Karl Friedrich Philipp von Martius, and Hannibal Evans Lloyd, *Travels in Brazil, in the Years 1817-1820: Undertaken by Command of His Majesty the King of Bavaria*, 2 vols. (London: Longman, Hurst, Rees, Orme, Brown, and Green, 1824), 54. Charles Darwin, *The Voyage of the Beagle* [Internet Resource] (Gutenberg Project, August 23 2002 [cited June 34, 2003]); available from <http://www.gutenberg.net/etext/3704>.

water transportation, river dredging, swamp draining, and costly fights against yellow fever and malaria.

The simultaneous goals of beautification and sanitation were the aspiration, and engineers embraced them enthusiastically. On the ground and in the water, Guanabara Bay proved to be more complicated. First, the bay was not a clean canvass where engineers could erect their projects of modernity. Rather, it had a complicated history of at least 350 years of uneven development from European settlements, and an even longer history of indigenous settlements.⁵ Vegetation, physical characteristics, and population distribution in the late nineteenth century was the result of power shifts, sporadic investment and neglect, and economic booms or busts over the centuries. Guanabara Bay was not the same in Niterói as it was in the Fluminense lowlands, nor in the city of Rio de Janeiro: the Bay was a fragmented space in political, demographic, economic and environmental terms. In addition, the engineers' concept of modernity, had its own history. Engineers were subject to political negotiation and embedded in a historical context; they were deeply involved in the political framework of Brazil and of Guanabara Bay, either as members of the government or as beneficiaries of public concessions—and often both.

The rise of engineers during the late nineteenth century as the voice of science taming nature would shape Guanabara Bay's future. But this mission to tame nature yielded uneven results, as the political and environmental interplay in Guanabara Bay varied from one shore to the other. The politics of changing nature did not differ from politics-as-usual; they shared the importance of personal networks, the definition of

⁵ Dean, *With Broadax and Firebrand*, 56.

budgets, and the prioritizing of one area over another. The aspirations of modernity might be similar throughout Guanabara Bay; the outcomes were not.

Managing Nature—or managing Guanabara Bay was a necessary step to bring modernity as dreamed by engineers to the Brazilian shores. To understand changes in the environment of Guanabara Bay at the turn of the twentieth century, it is necessary to first explore the bay’s historical background and diversity, and how it came to play such an important role in the nation’s perception of itself. Second, it is equally important to understand the rise of a group that saw itself as the champions of modernity—the engineers of Rio de Janeiro— as well as their organizations and connections to political power. Only in this context will the practical tasks to which the engineers applied their efforts provide a meaningful lens through which read the landscape they helped to create in Guanabara Bay for the years to come. Then, we can travel around the bay to identify the areas where the projects of modernity thrived and where they failed.

Urban Bay, Rural Bay

Europeans first settled in Guanabara Bay in 1502, shortly after their arrival in what would become Brazil. Between the native Tamoios and Tupis, and the newly arrived Portuguese and French, the estuary of Guanabara has a long history of human occupation. Surrounded by mangrove forests, the estuary at that time had a large basin with 52 rivers draining into it. The rivers ran fast from the range of mountains nearby, only to slow down to a meandering, lazy course in the extensive Fluminense lowlands

around the bay. Tides, sediment loads from the mountains, and low altitudes created a landscape of marshes and swamps.⁶

Occupation of the bay meant filling the swamps, both near the ocean as well as the hinterland. In practice, this meant replacing the mangroves with sugarcane and coffee in the Baixada Fluminense, or with streets and harbors in the cities of Rio de Janeiro and Niterói. Each of these cities was located on either side of the entrance to the Bay on the coast, and city and hinterland were closely connected by the common work of draining and filling. The job of draining was never complete. Constant effort was required to keep the wetlands dry.

Although Rio de Janeiro city was definitively the heart of the region, life in the city related directly to activities in hinterland. The city and hinterlands needed each other. Most produce for the federal capital was cultivated in the Baixada. The roads for gold and domestic slave trade from Rio de Janeiro city to Minas Gerais and back passed necessarily through the Fluminense lowlands, feeding the trading posts and the fluvial villages.⁷

This complementary coexistence changed dramatically in the nineteenth century, when Rio de Janeiro city became the capital of Brazil. Its population increased from about 25,000 inhabitants in 1808 to 522,651 in 1890, and then to 811,443 by 1906.⁸ In contrast, the Guanabara Lowlands, still in the province of Rio de Janeiro but no longer linked to the city of Rio, saw its population continuously decline and its economic

⁶ For a more detailed description of Guanabara Bay see Chapter 1.

⁷ Maria Therezinha de Segadas Soares, "Nova Iguaçu: Absorção de uma Célula Urbana pelo Grande Rio de Janeiro," *Revista Brasileira de Geografia* 24, no. 2 (1962): 159.

⁸ Niterói became then the capital for the province and later the state of Rio de Janeiro. The province of Rio de Janeiro became State of Rio de Janeiro after the end of the Empire, in 1889. Soares, "Nova Iguaçu," 161.

significance disappear.⁹ The federal government took over many municipal roles for Rio de Janeiro as a city, while the provincial government of Rio de Janeiro, deprived of its most important city, could not keep up with river cleaning and swamp draining in the Baixada.

In the Baixada Fluminense region during the mid-nineteenth century, sedimentation, which had always been high, increased even more owing to deforestation. Where once the Atlantic rainforest stood, now there was often only exhausted, eroded lands, the price paid for the long existence of hundreds of sugarcane and coffee plantations.¹⁰ Increasing siltation encouraged re-growth of mangroves and aquatic vegetation. Mangroves grow back easily, and as they do, they retained even more sediments from the meandering rivers, turning the Baixada into a very flood-prone terrain. Dredging Guanabara rivers to keep them open for the circulation of goods and to prevent floods became a costly activity for the state government, and falling levels of sugarcane and coffee production in the area no longer justified the expense.¹¹ Thus while floods in Rio de Janeiro city were also common, they commanded public intervention; in the Baixada Fluminense, increasingly severe floods were just another aspect of the decadence of the countryside.

Because coffee demanded new fertile soils, and thrived better in hills rather than in swamps, coffee growers soon abandoned lands near the city of Rio de Janeiro for new lands in the west, en route to São Paulo. Sugarcane in the Baixada had trouble competing

⁹ See Chapter 1 for the relationship between Rio de Janeiro city and Rio de Janeiro state in the nineteenth century.

¹⁰ Dean, *With Broadax and Firebrand*, 158.

¹¹ Yearly reports of the Province of Rio de Janeiro, 1862 and 1902. See James Simon, *Provincial Reports: Rio de Janeiro* [website] (The Center for Research Libraries, May 19 2004 [cited June 12, 2004]); available from <http://www.crl.edu/content/brazil/jain.htm>.

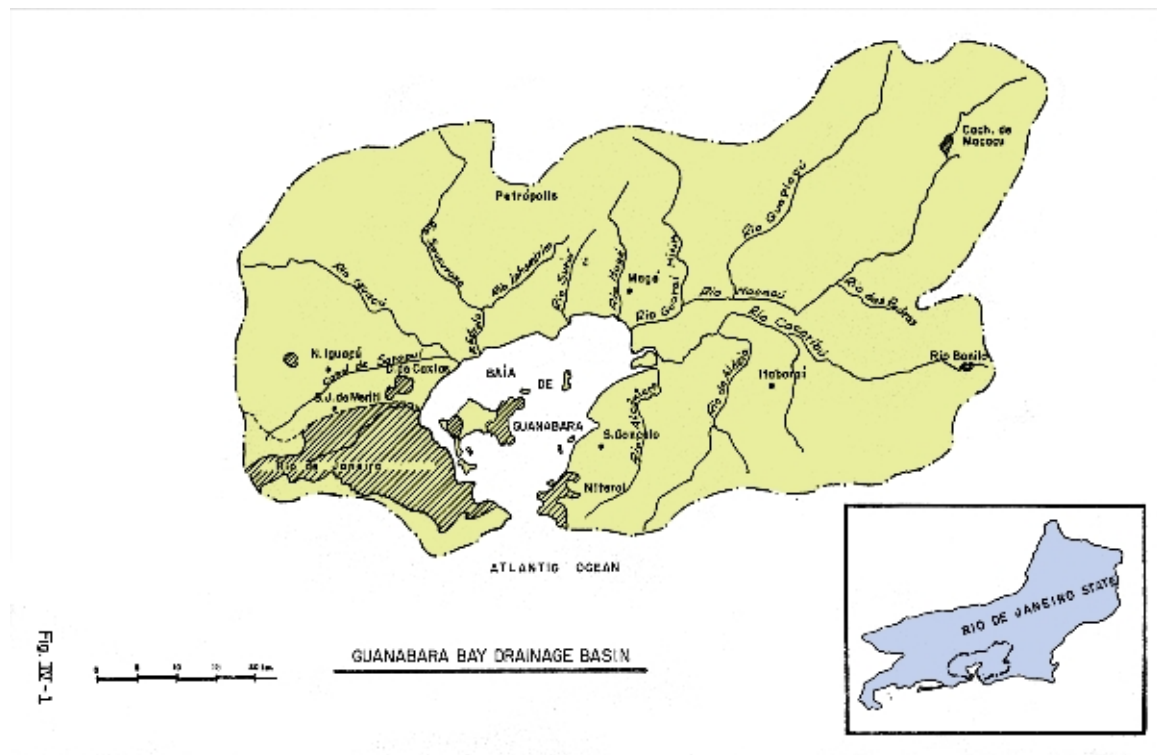
with the production from Campos dos Goitacazes in the northern part of the province. The swamps expanded as the population deserted the Baixada, and yellow fever and malaria threatened the few who dared to stay.¹²

As the rivers filled with silt and the swamps expanded, a railroad network took over the transport of coffee arriving now from the Paraíba Valley to the west and south. The Guanabara fluvial system had never been very reliable for the large-scale capitalistic enterprise of coffee. The river system was too influenced by tides; the water levels were too low during droughts to serve as a transportation artery; and its rivers and canals suffered from too much obstruction. The first steps to link Rio de Janeiro and the Serra do Mar uplands by railroad began in 1840, and a major connection was completed in 1864.¹³ By 1890, the many harbors along the shores of the bay were mostly abandoned, and the circulation of goods and passengers even in the large rivers was declining.¹⁴ (See Fig. 7.)

¹² In 1907, Fluminense president Alfredo Backer claimed that swamp waters covered a quarter of the Fluminense Baixada, “where [there are] myriad species of flora and fauna whose existence is a continuous circle of biologic transformations, making these marshes true active laboratories of life and death.” Alfredo Backer, *Mensagem Apresentada a Assembléa Legislativa em 1 de Agosto de 1908 pelo Presidente do Estado Doutor Alfredo Backer* (Rio de Janeiro: Typ. do Jornal do Comércio, 1908), 27.

¹³ Nilo Peçanha, *Mensagem Apresentada a Assembléa Legislativa do Estado do Rio de Janeiro em 1 de Agosto de 1915 pelo Presidente do Estado Dr. Nilo Peçanha* (Rio de Janeiro: Typ. do Jornal do Comércio, 1915), 14.

¹⁴ Marieta de Moraes Ferreira, *Em Busca da Idade de Ouro: As Elites Políticas Fluminenses na Primeira República (1889-1930)* (Rio de Janeiro: Editora UFRJ/Edições Tempo Brasileiro, 1994), 35.



Even in better times, most villages in the Baixada had only been trade stations for the large plantations. Rio de Janeiro city was only a few hours away, and the villagers never found it necessary to replicate most urban activities. Local bureaucracy and parochial life were the principal influences in these small villages, while commercial and private activities were more dispersed within the hinterland.¹⁵ But when the Baixada's economy fell, it fell hard, and even this limited activity was almost totally erased.¹⁶

¹⁵ Soares, "Nova Iguaçu," 164.

¹⁶ Iguaçu, for instance, was a very important village in the Baixada until the mid-nineteenth century. In 1878, Justice Rodrigo Otávio described it as little more than a ghost-city. “A few hours away from the Caju Pontal (in the Capital), through the river Douro turnpike, the village of Iguaçu was, then, a large dead township. It was constituted mainly by one large and long street, and its time of prosperity was attested to by the large two-story houses and the large warehouses, everything now closed ... The railroad ... drained all the commercial activity, reducing Iguaçu to poverty and death. The village was deserted, the canals were abandoned, cramped with vegetation and mire; the waters rose, covering the fields, turning them useless for any crop and filling the air with miasmas of malaria and hookworm disease that plagued those poor people who could not leave. ... Only on Thursdays, when court was held in the village, there was some movement.

By 1883, Baixada Fluminense was worse than deserted: its abandoned lands, according to the state's chief of police, were hideouts for "dangerous elements," such as the quilombos (communities of runaway slaves) or calhambolas (quilombo's residents) in Iguaçu and Estrella among the paludes (mangroves), in the flooded terrain between the Iguaçu and Sarapuí rivers.¹⁷

By the end of the nineteenth century, Guanabara Bay was fragmented into very distinctive sub-regions. On the west side of the bay lay a thriving urban center, Rio de Janeiro, the political and economic capital of the country. With little connection to the rest of the bay and directly under federal jurisdiction, the city nevertheless had to battle disease and inadequate urban services, well below what the elite expected for the federal capital. Just across the bay was a second important city, Niterói, capital of the state of Rio de Janeiro, overshadowed by its wealthier neighbor, but housing a number of politicians who recalled a golden age for the state—and wished for its return. Finally also in the state of Rio de Janeiro was the poor, malaria-ridden lowland, the Baixada Fluminense. Encircling the bay, it had lost in production or transportation of goods to the capital. This was the bay where a new generation of public officers would make their laboratory and showcase for modernity projects. (See Fig. 8.)

The village council house opened; other than the judiciary staff, only lawyers and plaintiffs attended the proceedings. Later everything fell into the usual silence. For a long time the justices had not lived in the village; it was so close to the Court [Rio de Janeiro city] and the workload was so small, that everybody lived in the Court, going to Iguaçu only on Judgment days, or when absolutely necessary." Rodrigo Otávio, quoted in Soares, "Nova Iguaçu," 263.

¹⁷ Augusto Francisco Caldas, *Relatório do Chefe de Polícia da Província do Rio de Janeiro* (Rio de Janeiro: Typographia Montenegro, 1883), 60.



Fig. 8 – Map of the Neutral District (detail), 1880. Map by E. de Maschek in Czajkowski and Sendyk 2000.

Engineers, Politics and Beauty

In March of 1889, the city of Rio de Janeiro once again suffered a harsh summer drought. The public fountains were dry, and the population had to agonize with long lines with every rumor of when water was to be delivered. After signing an expensive, and

most probably insufficient, contract with a famous engineering company, the Imperial government could at best promise relief no earlier than in 40 days. The Republican press, particularly the fierce journalist, Ruy Barbosa, accused the Imperial Government of criminal indifference and sheer incompetence in addressing the woes of the capital's population.¹⁸ With modern technology, the city could get water in six days, not forty, claimed Barbosa. To prove his point, Barbosa published a letter by a young professor at the Escola Politécnica (Civil Engineering School), Paulo de Frontin. In the letter, Frontin proposed a temporary solution that would bring plenty of affordable water to the capital by the following Saturday. The Ministry of the Empire called Barbosa's bluff, in the hopes to unmask what the Ministry saw as a plot by Republicans to blame the government for the drought by creating unrealistic hopes about relief. The Government offered Frontin the financial and material resources that he requested—and nothing more. Frontin recruited his colleagues and students from the Escola Politécnica, and hired workers wherever he could find them. Engineers, children of the Carioca elite, doubled as manual workers to build a long system of wooden flumes from the São Pedro river to the public fountain in the Largo da Carioca. On March 23, as promised, the population of Rio celebrated the arrival of 15,000 cubic meters of water per day.¹⁹

The “Water in Six Days” episode was a minor event in the process that would bring the Republicans to power in Brazil on November 15 of the same year. But the symbolic import of the water episode was not lost on contemporary observers. Frontin's

¹⁸ Ruy Barbosa (1849-1923), one of the most shrewd politicians in Brazil, was also a journalist, diplomat and justice. He drafted the 1891 republican Constitution and would influence Brazilian politics until his death in 1923.

¹⁹ The idea of having the *jeunesse doreé* of Rio de Janeiro working as manual laborers held a special flavor in 1889, as the slavery had been abolished less than one year before. Raymundo Athayde, *Paulo de Frontin: sua Vida e sua Obra*, Coleção Cidade do Rio de Janeiro (Estado da Guanabara: Secretaria-Geral de Educação e Cultura, 1961), 46-50.

motto, “Faith in National Labor and Science,” was vindicated, and he became forever identified as a symbol of Brazilian excellence in engineering.²⁰ Ruy Barbosa was euphoric—he had single-handedly turned a technical problem into a high-profile political dispute between Republicans and Monarchists, and linking the Republican faction to concepts of national competence, technology, and modernization. The Imperial Government had endured yet another defeat in what would be its last year of existence. Nine months later, Barbosa would be sworn in as Finance Minister of the new Republican government. Amidst all this excitement, Guanabara Bay was forever changed: a minor detail in the dispute was that the blessed water originated in the São Pedro River, a tributary of the Sepetiba Bay Basin, which had not been previously connected to Guanabara Bay. In the decades to come, water supply for the City of Rio de Janeiro would rely increasingly on the São Pedro and Guandú rivers, creating a man-made tributary for Guanabara Bay, a tributary made of wooden flumes, but also of human bodies: the living flesh and bones of the Carioca citizens. From then on the population of Rio would drink the water from Sepetiba Bay basin and release it into Guanabara Bay. And from then on, large-scale transformations in the water, shoreline, and vegetation of Guanabara would be hailed as emblematic of the national genius.

²⁰ Paulo de Frontin was at once a typical and exceptional engineer. He was typical for his social origins, his well-connected family with houses in Petrópolis and Rio de Janeiro, his education in the Escola Politécnica, his enthusiasm for Comte’s positivism and for his participation in government and private enterprise. At the same time, Frontin’s career was far from typical. He courted fame when he was still very young, and become a role model for engineers in the early 20th century. Frontin created his own enterprise, the Empresa Industrial de Melhoramentos do Brasil, which was active in the renovation of the port of Rio de Janeiro, the installation of railroads, and in the 1903 urban reforms of Rio de Janeiro. He was a well-known Republican and the tutor of an imperial prince; he taught in the prestigious high school Colégio Pedro II, as well as in the Escola Politécnica II, and served as mayor of the Federal District and Senator for the Republic. Not less important, he founded the Derby Club of Brazil, for horse-racing aficionados, and the Club de Engenharia, of which he was president until his death, in 1932. Athayde, *Paulo de Frontin*.

Engineers were at the heart of this confluence of politics, technology, and the transformation of nature. Major modifications of the Guanabara Bay overlapped with the rise of engineering, almost surpassed law and medicine as favored career for the elite.²¹ Through technological solutions, engineers held the key to social planning. Throughout the world, technology defined government-led projects from Japan, to England, to San Francisco. In Brazil, this process was particularly influenced by the French philosopher Auguste Comte, and his doctrine of social positivism. Comte asserted that humanity would only reach full maturity of thought when it abandoned metaphysics and embraced an unrestricted adherence to the scientific method, employing science to understand the laws of nature and society. Comte's philosophy was enthusiastically adopted by the military and civil engineers. His social positivism became for many, literally, a religion. Comte's influence was especially felt in the Republic, and his formulation for a positivist theory, L'amour pour principe, l'ordre pour base, et le progrès pour but, inspired the theme for the Brazilian flag, "Order and Progress."²²

As Comte influenced engineers, engineers influenced everything else. They graduated from the Escola Politécnica, joined the Club of Engineering, and from there were present in nearly all levels of public administration in Rio de Janeiro.²³ They

²¹ Schwartzman, *A Space for Science*, 27.

²² Ivan Monteiro de Barros Lins, *História do Positivismo no Brasil*, Brasileira (São Paulo: Companhia Editôra Nacional, 1964), 18. For an excellent discussion on the presence of Comte's positivism in the national symbols of the Brazilian republic, see José Murilo de Carvalho, *A Formação das Almas: o Imaginário da República no Brasil* (São Paulo: Cia. das Letras, 1990), 23-46.

²³ The Escola Politécnica, modeled after the homonymous French institution, split in 1872 from the traditional Military Academy, until then the only center for studies of engineering. Schwartzman, *A Space for Science*, 190. Brazil's youth shared the fascination with engineering and technology with the rest of the world, in the late nineteenth century. Hélène Harter, in her very interesting work on engineers in American cities, quotes the French writer H. Monnier exalting the power of engineers in the contemporary world. Engineers, claimed his character Joseph Prudhomme in his memoirs, were the best suitors that a hopeful father could wish for his daughter: "If a young lawyer provokes on you a quite pitiful effect, what can you say of a young physician! You are ready to call him a poor nobody. Don't try to disguise it, dad. But as

believed that science and technology offered solutions to all problems. Technical solutions only demanded boldness unencumbered by political compromise and funding limits.

The rise of engineers in public administration started in 1872, when the Polytechnic School (Escola Politécnica) was created. That same year, the Imperial government called an Imperial Commission for Improvements in Rio de Janeiro, and for the first time, engineers were in charge of the city's urban planning.²⁴ They were asked to conceive a large, integrated project to address the city's sanitation issues. Eighteen years later in 1890, when professors from the Escola Politécnica such as Paulo de Frontin, and former members of the 1872 commission such as future mayor Pereira Passos, founded the Club of Engineering (Club de Engenharia), the role of engineers in key positions of the State administration was already cemented.²⁵

Although national in its goals, the Club focused on the city of Rio de Janeiro as the showcase for national engineering. Its members took for granted Rio's destiny as the modern capital of Brazil, and their own role in realizing this destiny. The Club of Engineering was also a space where government and academia would meet. Government

soon as a young engineer of bridges and roads, even a simple civil engineer, presents himself before you, you think of the channels, the railroads he built and his likely rewards; you don't mind that he invites your daughter for a dance, and you give him your best smile if he condescends to exchange some words with you. That is understandable, dad. In a time of machines like ours, the engineer is a king." Quoted in Hélène Harter, *Les Ingénieurs des Travaux Publics et la Transformation des Métropoles Américaines, 1870-1910*, Séries Internationale (Paris: Publications de la Sorbonne, 2001), 9.

²⁴ Engineering training was a blanket definition for a number of activities connected to analyzing physical reality. Everardo Backheuser, for instance, was an engineer of the Municipality of Rio de Janeiro, but he is better known today for his studies on geography. In his 1918 book on the Brazilian coast, Backheuser goes into length to discuss how the Guanabara Bay area was in the four preceding centuries, distinguishing between man-made embankments and natural siltation. Together with Augusto de Souza, Backheuser is one of the best sources for environmental changes in Guanabara Bay until 1900. Everardo Backheuser, *A Faixa Litorânea do Brasil Meridional: Hoje e Ontem* (Rio de Janeiro: Besnard Freres, 1918).

²⁵ Fernandes, "O Remédio Amargo", 87.

officials turned to the Club to find the best of Brazilian technology to help move Brazil toward modernity. There was an ideal overlap between the urban reformers in the Club and the office holders that would implement the plans. Not surprisingly, club members such as Passos, Frontin, Candido Gafrée, and Eduardo Guinle, also led the companies that would execute these projects.²⁶ As Maria Alice Carvalho suggests, industrialists and engineers, as well as some wealthy tradesmen, crowded the opening meeting of the Club de Engenharia in 1890 because they shared a common faith that engineering was the path to Brazilian grandeur.²⁷ This alliance of science and entrepreneurship needed a geographic space to display the virtues of progress, and Guanabara Bay, specifically the city of Rio de Janeiro, was this space. This alliance also needed resources and the legal structure to realize their social experiment, and this was possible only through their close connection to the government in Rio de Janeiro.²⁸

The urban reforms, led by mayor Pereira Passos from 1903 to 1908, constitute the best example of this connection between Brazilian aspirations to modernity, the city of Rio de Janeiro, and the Club of Engineering. Trained in Paris, and therefore very familiar with Baron of Haussman's transformation of the French capital, Passos redesigned the

²⁶ The Club of Engineering was so symbolically involved with the urban reforms during Pereira Passos administration that it was a very hard (and ironic) blow when exactly their own building crumbled still in the construction phase at the Avenida Central (the main boulevard). A definitively bad omen for the symbol of the Brazilian technology. Giovanna Rosso del Brenna, *O Rio de Janeiro de Pereira Passos: Uma Cidade em Questão II* (Rio de Janeiro: Index, 1995), 35.

²⁷ Maria Alice Rezende de Carvalho, "Governar por Retas: Engenheiros na Belle Époque Carioca," in *Quatro Vezes Cidade* (Rio de Janeiro: Sette Letras, 1994), 66.

²⁸ At least eleven out of 21 mayors from 1892 to 1930 were engineers, which includes the most active members of the Club of Engineers, such as Paulo de Frontin (founder), Pereira Passos (founder), Carlos Sampaio, and Souza Aguiar. See Appendix B. About the close relationship between business and administration, see Fernando Antonio Faria, *Os Vícios da Re(S)Pública: Negócios e Poder na Passagem para o Século XX* (Rio de Janeiro: Notrya Editora, 1993).

center of Rio de Janeiro.²⁹ Backed by the federal government (President Rodrigues Alves was often blamed for investing most of the federal budget for public works in the federal capital), Passos modernized the port of Rio de Janeiro, turned historical hills into large boulevards, and reclaimed land from the bay. Along the way, he moved low-income populations from downtown to the outskirts of the city, creating large, French-style public buildings in their place.³⁰

The Passos Reform was emblematic of this period with its emphasis on technological solutions to social conflict, its focus on physical beautification informed by trends in cosmopolitan architecture, and its authoritarian methods to obtain these goals. Sanitizing and embellishing the central areas of the city created a serious housing deficit, particularly for the poor. Likewise, the focus on beauty and sanitation also meant giving priority to tackling some social diseases, more visible and likely to harm the city's reputation, while allowing other more deadly diseases to fester.³¹

The Passos Reform also emphasized sanitation and beautification at the expense of Guanabara Bay. It privileged land reclamation and celebratory public works. The bay's shoreline became a flexible limit to expand the city of Rio de Janeiro. These

²⁹ If Rio de Janeiro has been the most studied city in Brazilian historiography, the Passos Reform is arguably one of the most studied periods in the history of the city. For more on the Pereira Passos Reform, see Benchimol, *Pereira Passos, um Haussmann Tropical*; Brenna, *O Rio de Janeiro de Pereira Passos*.

³⁰ France was model and inspiration for scientists and technicians in Brazil. The examples of École Polytechnique and Baron de Haussmann, the influence of Auguste Comte, were constitutive elements in a larger background of Gallic influence in the arts, sciences and elite culture in Brazil.

³¹ These are all contemporary criticisms. The newspapers "O Malho," "Jornal do Brasil" and "Jornal do Commercio" often complained of the lack of affordable housing for the population being removed from the shanty houses in downtown Rio. The politician Barbosa Lima spoke several times at the City Council against the health priorities of the Pereira Passos Government. Should not the government start its public health campaign attacking the most deadly diseases?" asked Lima. "What will the government do against the Tuberculosis? Is it not the most deadly? Thus, the important, according to the government, is not to die of yellow fever, because it puts us in a bad sight for the foreigners; it is not to die of bubonic plague, because this is the famous Bombay plague, and it may kill two or three thousand people some years from now! Now, to die of tuberculosis, there is nothing wrong with that!..." Barbosa Lima in the Municipal Chamber, Session 12/11/1903, Annaes C.D., quoted in Brenna, *O Rio de Janeiro de Pereira Passos*, 55.

characteristics were not new or unique—Machado de Assis’ ironic piece on land reclamation preceded the Passos Reform by at least ten years, and many other cities grew at the expense of their shorelines, as for instance, San Francisco.³² But the Passos Reform became the reference for future urban reforms. Afterwards, urban reformers had a historical model and legal structure to push this limit as far as possible. Thus in 1922, for the centennial celebration of independence, Castelo Hill (the foundation site for the city) was razed and its land dumped along the shore to create yet another piece of land from the bay for a beautiful boulevard. Flamengo, Botafogo, Copacabana, Ipanema, all southern beaches, had their outlines change over time. A new district, Urca, emerged from the waters around the Sugar Loaf. Major arteries were carved from new embankments on the mangroves, including President Vargas Avenue and Brazil Avenue. In the 1940s, embankments reclaimed more land from the bay for two airports, Santos Dumont Airport in downtown Rio, and Galeão Airport in the Ilha do Governador. The campus of the Universidade Federal do Rio de Janeiro (then Universidade Nacional) was erected in the 1950s on the top of eight merged islands. In 1966, quadrennial celebrations for the city included the inauguration of the Aterro do Flamengo, a huge public park built on landfilled area. And in 1992, as part of preparations for the United Nations Environment and Development Conference in Rio, another mangrove was buried to build a highway. Most of these projects used the Passos Reform’s Federal Law 939, or similar versions of it, which gave the mayor ample discretion to override local or private interests for the sake of the public interest. See in Fig. 9 a comparison between the current

³² Matthew Booker, at Stanford University, is currently finishing his dissertation on the tidelands of San Francisco Bay, which includes a remarkable chapter on the water lots of real estate in São Francisco.

Western shoreline of Guanabara Bay and a projected map of the same area in the sixteenth century.³³



Fig. 9 - Landfills in Guanabara's shoreline. Illustration by Elmo Amador, in Rio de Janeiro (RJ). Secretaria Municipal de Meio Ambiente, *Manguezais do Rio de Janeiro* (Rio de Janeiro: Secretaria, 2000).

³³ Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 145.

Engineers in Rio de Janeiro saw sanitation and beautification as two aspects of the same project: straight lines on the shoreline, instead of chaotic beaches; long and clean boulevards, not narrow colonial streets; and majestic parks in the place of swampy lakes.³⁴ Embellishments were all examples of order, a necessary premise for progress and modernity. Once the new city was orderly and healthy, it would also be beautiful. Rio was supposed to be the symbol of Brazil, a jewel in Latin America, a man-made wonder worthy of the magnificent scenery of Guanabara Bay, a landmark of progress and civilization in the tropics.³⁵ At the very least, Rio had to be better than Buenos Aires.³⁶ (See Fig. 10.)

³⁴ The Club of Engineering held a conference in 1899 entitled "Sanitation and Beautification of the Federal Capital." J. S. de Castro Barbosa, "Saneamento e Embellesamento da Capital Federal," *Revista do Club de Engenharia* 3 (1901).

³⁵ During the ceremony of inauguration of the city's main boulevard in 1908, the official speaker Getúlio das Neves compared the boulevards and embankments surrounding the Guanabara Bay to a "pearl chocker around a mermaid's neck." Quoted in Simone Petraglia Kropf, "Sonho da Razão, Alegoria da Ordem: O Discurso dos Engenheiros Sobre a Cidade do Rio de Janeiro no Final do Século XIX e Início do Século XX" (Pontifícia Universidade Católica, 1995), 125.

³⁶ Comparisons and ill-disguised rivalry with the Argentinean capital were constant in many articles about the needs of reform of the city. Brenna, *O Rio de Janeiro de Pereira Passos*, 65-69.

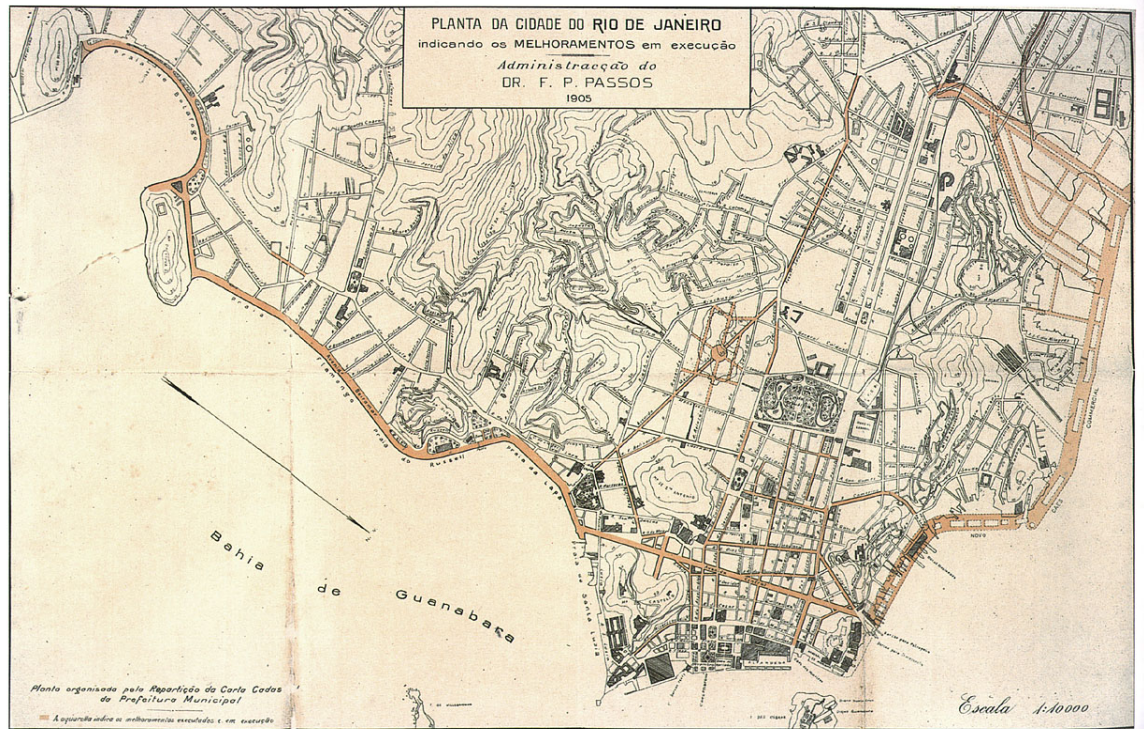


Fig. 10 - The Passos Reform in progress, 1905. Map in Anonymous, in Czajkowski and Sendyk 2000, 68.

It was again a chronicle by Machado de Assis that shed lights on the apparent puzzle of a state that bragged of its perfect natural beauty, and yet demanded beautification improvements on this same nature as symbol of civilized grandeur. After guiding a European friend to the most outstanding landmarks of Rio de Janeiro, Machado was disappointed that his friend's first remarks are about the amazing natural beauty. Machado's nativist feelings, as he called it,

has always suffered from this adoration to nature [by visitors]. Seldom have they spoken about us, people: some do, badly; few speak well. What they all agree is that it is a *pays féérique*. It has always seemed to me a way to dismiss the man and its works.... I have not done, or have had done, the sky and the mountains, the forests and the rivers. I found them ready, and I see they are admirable; but there are other things to do.³⁷

³⁷ Joaquim Maria Machado de Assis, "20 de Agosto de 1893," in *A Semana, Obras Completas de Machado de Assis* (Rio de Janeiro: W. M. Jackson Editores, 1959), 359.

On the other side of the bay, beautification became a equally fundamental concern for Niterói, and engineers acquired a similar status as they had in the federal capital. Niterói emulated Rio as much as it could. Beautification projects in Niterói were contemporary with the Passos Reform, and were completed around the same time in 1909.³⁸ But the reasons for Niterói projects were different. Without aspirations to national glory, Niterói hoped to avoid being swallowed by Rio de Janeiro city, which was less a model than a disproportionate competitor. Niterói's supporters splited between demands for an even closer, profitable relation with its powerful neighbor versus plans for complete economic independence from the national capital. Both groups saw the answer to their needs in Guanabara Bay. The first group dreamed of a bridge between Rio and Niterói on an underground railroad.³⁹ The second group wanted an autonomous harbor for Niterói, a source of income dreamed by Fluminense presidents since 1882. The harbor was eventually built in 1920, with enormous costs to dredge the bay and rectify the shoreline. Ten years after the port was built, comparisons with Rio still hurt Niterói.⁴⁰ Port and urban reforms were expensive investments for the underfunded city, and overall failed to achieve the desidered goals. Despite their shortcomings, the reforms demanded a

³⁸ The Niterói projects included new docks in Gragoatá, boulevards on the shoreline, and galleries for runoff drainage. Niterói also duplicated federal law 939, increasing the municipal power to alienate propriety and to combat public nuisances. It was a law of exception, for temporary relief of the serious urban problems, but the strongest argument in favor of the law was that Rio de Janeiro had used it as well. Backer, *Mensagem Apresentada a Assembléa Legislativa*, 15-26.

³⁹ Plans for bridge or tunnel across Guanabara Bay were first mentioned in the State reports in 1850, a bridge was eventually built more than one century later, in 1973. Arquivo Nacional, "Construção de um Caminho de Ferro por um Tunel Submarino Ligando o Rio de Janeiro a Niterói" (Proposal, Rio de Janeiro, 1890).

⁴⁰ Fluminense Governor Manuel Matos lamented then that the excellent transportation system to the capital by railroads and highways caused the Niterói port to be severely underused. Manuel de Mattos Duarte Silva, *Mensagem Apresentada a Assembléa Legislativa do Estado do Rio de Janeiro em 1 de Agosto de 1930 pelo Presidente do Estado Dr. Manuel de Mattos Duarte* (Rio de Janeiro: 1930), 30.

large share of Niterói's budget, because these projects followed the high standards of modernity set by Rio de Janeiro.

Rio de Janeiro city thus stimulated a new generation of urban reformers trained as engineers to test their ideas of beauty and modernity. The concept of modernity was global, and in Brazil, it had a strong French accent.⁴¹ The concept was also national, particularly in the new republican regime, which took pride in proclaiming its modernity as a break from the monarchic tradition. The push for modernity also had very significant local consequences, as its influence spilled past the city of Rio de Janeiro to the rest of the bay, shaping political priorities by defining which social problems to address, and how to address them. Indeed, public works that fulfilled the concepts of modernity changed places, spaces, and local communities forever. Nevertheless, there was no other possible path for progress in the eyes of these reformers. Modernity was more than just urban reforms; it was the nation's destiny. As expressed in the newspaper *Jornal do Brasil* at the inauguration of the Avenida Central, the main city artery built during the Passos Reform:

[if the Independence Day marked for Brazil] the beginning of the country's life as free people, for the capital, [the inauguration of Avenida Central means] ... the beginning of its physical reform, of its aesthetical rebirth, from which, as we have stated several times, will necessarily follow intellectual enhancements, moral improvement. ... [The reforms are] an urgent and pressing need, for this municipality that is the heart and brain of the country to raise to the importance and grandeur that befits the country, and then it will

⁴¹ For a discussion on contemporary progressive/modernity projects throughout the world, see Jeffrey D Needell, *A Tropical Belle-Époque: Elite, Culture and Society in Turn-of-the-Century Rio de Janeiro*, Cambridge Latin American Studies (New York: Cambridge University Press, 1987); Daniel T. Rodgers, *Atlantic Crossings: Social Politics in a Progressive Age*. (Cambridge: Belknap Press of Harvard University Press, 1998).

not shame the nation before its residents, nor before the rightly fair eyes of the foreign [world].⁴²

Public Works, Health, and Sanitation

Sanitation predates beautification as the Holy Grail of Carioca engineers in the nineteenth century, following some heart-breaking public health disasters in the city. Disaster was often the best friend of modernity. A plague, an especially gruesome bout of malaria, or a major flood could do wonders in convincing the government to implement yet another project, sometimes reviving projects that remained in blueprints for decades. Many public health and sanitation works carried out in Guanabara Bay, in urban areas, or the countryside, were ad hoc answers to disaster, as with the “Water in Six Days” episode that awarded Frontin his fame. Although it would take three decades to take shape, the urban plans that formed the basis for the Passos Reform were conceived after two violent epidemics of yellow fever and cholera in 1873 and 1876. Public health concerns motivated many commissions, blueprints, and many campaigns, frequently to address promises unfulfilled by the previous commission, blueprint, or campaign.⁴³ Public health projects also sought to conceive solutions that would prevent disasters,—or more likely than not, the recurrence of the disaster that prompted the project in the first place.

Debates on sanitation in Guanabara Bay among engineers sought to address two major problems that could lead to disasters: the final destination for sewage and garbage, and the fight against paludismo—epidemic diseases such as malaria and yellow fever associated with miasmas or flooded areas. Sewage and garbage disposal were mainly

⁴² *Jornal do Brasil*, September 8, 1904, quoted in Brenna, *O Rio de Janeiro de Pereira Passos*, 216.

⁴³ Both in the imperial as in the republican periods, there was a curious irony in the gap between the vigorous governmental response to disasters by demanding immediate plans and the decades it took until such plans were actually implemented, if they were.

urban problems, and it wouldn't be until the 1970s when Guanabara Bay as a whole would receive sewage service outside the cities of Rio de Janeiro and Niterói. But paludismo hit both urban and rural areas, and the endemic aspect of the diseases required the combined effort of engineers and health experts (sanitaristas) to combat the disaster.

Sanitary concerns created an alliance of physicians and engineers to reshape Rio de Janeiro and Guanabara Bay. Both groups were at once idealistic and authoritarian. During the Passos Reform, the impositions led by these groups upon the poor of Rio eventually led to riots against forced vaccination and the sanitary police.⁴⁴ Both engineers and health experts forged the concept of sanitation in Brazil, and the conviction that victory over disease, through science, was the key to Brazilian development.

Sewage, Garbage and Beaches

The creation of a sewage system was the first large-scale intervention of modern engineers in Guanabara Bay. Cities have always faced the twin problems of procuring adequate drinking water and carrying off or diluting wastes. Rio de Janeiro was no different. Until 1840, slaves carried large barrels with human waste on their shoulders at night and discharged the load into watercourses, small creeks, beaches, open ditches or any vacant lot. Niterói used the same system, while in the rural Baixada Fluminense, any body of water was good enough. Eventually all this material would drain into the

⁴⁴ Popular, ugly, unhealthy habitations in the city center were demolished, and the population was pushed away to the periphery or up the hills, creating the *favelas* (slums). The riots against vaccination turned Rio de Janeiro city into a battlefield, and the rioters barricaded the narrow streets with furniture, old carriages and fire. To make things worse, military officers joined the rioting population and the popular rebellion acquired the fumes of a coup. There are no statistics for the number of deaths, but over a hundred people were wounded and more than a thousand exiled to the Amazon confines. Eduardo César Marques, "Da Higiene à Construção da Cidade: o Estado e o Saneamento no Rio de Janeiro," *História, Ciências, Saúde--Manguinhos* 2, no. 2 (1995): 35; Nicolau Sevcenko, *A Revolta da Vacina: Mentis Insanas em Corpos Rebeldes*, História em Aberto (São Paulo: Editora Scipione, 1993).

Guanabara Bay. According to Morales de los Rios, either the barrels (or the slaves themselves) received the name of “tigers,” because of the dirty spots on the clothes when the material spilled. Many slaves preferred working almost naked for this job to protect their clothes, and it was common to see groups of slaves bathing in lakes and beaches at dawn in an effort to get rid of the stench. In 1842, French citizen Francisco Gravasser bought a concession from the City Council to provide hermetically closed barrels transport the barrels in carriages to the beaches, where anchored boats waited to discharge all waste and fecal material in the middle of the bay, returning the cleaned barrels to the city.⁴⁵

Yet much of the waste remained in the city for a long time, in ditches or vacant lots, before reaching the bay. When floods hit Rio de Janeiro, all this material floated around the city, further soiling the streets and Rio’s aspirations to become a European city in the tropics. In 1835, the imperial government passed a law to implement a sewage system in the city. The law increased property taxes (the “urban tenth”) in certain districts, lifted the importation taxes for building materials necessary for sewers and run-off water systems for these districts, and hired a contractor to build the system in these districts. The contract was signed, broken, passed to a second then third contractor, but not a single sewer would be completed for the next twenty-one years.⁴⁶

After yet another tropical storm in 1852 flooded the streets of Rio de Janeiro with rain and sewage, the young Brazilian Emperor, D. Pedro II, sent a team to study the sewage system in England. At that time, only the city-state of Hamburg, London, and the

⁴⁵ Adolfo Morales De los Rios Filho, *O Rio de Janeiro Imperial*, 2nd ed. (Rio de Janeiro: Topbooks Editora, 2000), 67.

⁴⁶ De los Rios Filho, *O Rio de Janeiro Imperial*, 68.

New York City borough of Brooklyn, had sewage systems.⁴⁷ Rio de Janeiro would join this select group. But proceeding from the studies to inauguration of the first sewers took twelve years.

Eventually, The Rio de Janeiro city Improvements, Limited (or just “The City,” as it was known by Rio’s residents) won the concession to build and manage the sewers for ninety years. Concession contracts were common in the modernization wave that swept Latin America by the turn of the century, for railroads, utilities or urban services. A concessionary, as in the case of The City Improvements, was a private company hired to execute a task for a limited amount, or profited from managing a service for a certain period of time.⁴⁸ The City Improvements contract seemed the most efficient, successful solution for the problem, and it pleased Carioca boosters in which Rio was now one of the only four cities in the world with a sewage system. The state-of-the-art system kept runoff draining to the bay completely separated from the sewers. The company built the first treatment station on land reclaimed from the bay, at Glória beach. Sewage accumulated in large tanks, chemical products were added, causing organic material to precipitate to the bottom. The treated water was then discharged to the bay, while the sludge was transported to “mud ships” (*navios lameiros*), and then dropped in the middle of Guanabara Bay.⁴⁹

⁴⁷ Charles Julius Dunlop, *Chronicas: Fatos, Gente e Coisas da Nossa História* (Rio de Janeiro: CEA, 1973), 36.

⁴⁸ The City Improvements held its concession for ninety years, starting in 1857, but actually not functioning until 1864, until 1945. Wherever possible, governments tried to establish concessions, instead of intervening directly in public services. The concession for the reform of the Port of Rio de Janeiro, for instance, went to Paulo de Frontin’s *Companhia Melhoramentos*, in 1904.

⁴⁹ Eduardo José Costa König da Silva, *História* [webpage] (Sociedade dos Engenheiros e Arquitetos do Estado do Rio de Janeiro, 2001 [cited June 18, 2003]); available from <http://www.seaerj.org.br/historia.asp>; José Ribeiro Silva, *Os Esgotos do Rio de Janeiro: História do Sistema de Esgotos Sanitários da Cidade do*

The City Improvements managed only wastewater and sewage, but solid waste also found its final destination in Guanabara Bay. Cars collected garbage three times a week—twice a week in downtown, since 1847. The City Council paid freed blacks to clean the streets, and by 1852, the streets were actually washed—at least the areas where carriages of the elite traveled. Once collected, solid garbage and waste was piled up on *lixões* (garbage dump sites) near the bay. This was usually a swamp or other unused spot, but certainly nothing that could be considered a, “sanitary landfill.” Despite one expensive and unsuccessful attempt to incinerate several tons of waste, most solid waste was still dumped on Sapucaia Island as late as 1918, as was the case during the previous century.⁵⁰

The concession of sewage to City Improvements was a good solution for a large part of the city, but it put sewage administration beyond the direct influence of the public engineers, and some of them criticized the plans for the Company as faulty and expensive. André Rebouças, an influent engineer during the Empire, berated the system as “an infect enterprise whose maximum error was to turn Guanabara Bay into a cloaca.”⁵¹ Moreover, because City Improvements chose to build in the most expensive real estate (and thus further inflating the value of that real estate), the remaining parts of the city were too poor to fund a parallel system. A major source of complaints by poor residents against the city can be attributed to this lack of proper sewage treatment.

Rio de Janeiro, 1857-1997, 2 vols., vol. 1 (Rio de Janeiro: Centro Cultural da SEAERJ/CREA-RJ, 2002), 96.

⁵⁰ Abreu, *Natureza e Sociedade no Rio de Janeiro*, 37. See also Chapter 4. Sapucaia Island and Pinheiro Island, where the Oswaldo Cruz Institute installed a Hydrobiology Station in 1937, belonged to same archipelago. After 1918, a new dumping site was inaugurated in the promontory of Caju, but Sapucaia Island, bearing centuries of accumulated refuse, was still occasionally used.

⁵¹ André Rebouças, a mulatto, was also one of the most famous Brazilian abolitionist. Deeply grateful to the royal family for the abolition of slavery, he followed them into exile in 1889.

Another dimension of this problem was the unwillingness of City Improvements to upgrade the sewage system to keep pace with a growing population. The sewage system aged fast, and by the turn of the century, floods due to clogged runoff galleries were common.

Rio's failure to develop a satisfactory solution for sewage and run-off waters was not for a lack of trying. Engineers had elaborated plans to address the runoff of pluvial waters in the capital since the early nineteenth century, and physicians urged implementation. From 1824 to 1896, the government (federal and municipal) sponsored plans for at least a dozen large projects for sewage and pluvial waters, and every one was aborted at the drawing table or during construction. The more detailed and rigid the plan, the less likely it would be implemented. Instead, projects accumulated one after another, creating a "paper city" far away from the real, unhealthy, irregular Rio de Janeiro. The city dealt with floods on a case-by-case basis, which meant that every year the municipality had to remove tons of mire and mud from the streets.⁵² In Niterói, the situation was no different. For instance, the concessionary for public transportation in Niterói, the Fluminense Transportation Cantareira Company (Companhia Cantareira de Viação Fluminense), which in 1907 signed a contract to build a sewage system in the city, decided one year later the contract was unprofitable. The company was regretful, but could not fulfill its obligations. "The contract," raged provincial president Oliveira

⁵² Alberto Pires Amarante, "Problemas da Erosão e do Escoamento das Águas na Cidade do Rio de Janeiro," *Revista Brasileira de Geografia* 22, no. 4 (1960): 660-65.

Botelho, “just increased the roll of frustrated attempts to sanitize the city,” a roll that was already long.⁵³

By 1919 The City Improvements’ services fell well short of its promises. The company had five discharge points to the bay, but only one had some level of sewage treatment. Arthur Neiva, Director of Sanitary Services, in 1918 complained very graphically about the pollution of Guanabara Bay by organic material. The beach of Santa Luzia, according to him, received all fecal and waste material from a very dense neighborhood, including waste from a large hospital, Santa Casa de Misericórdia. To make matters worse, Santa Luzia was not far from a very popular recreational beach. The waters of the Botafogo Bay, a small inlet near the Sugar Loaf hill and one of the more noble addresses in the city, presented fecaloid reaction when laboratory tested, and smelled accordingly.⁵⁴ A fecal stinking beach on the most famous postcard of Rio de Janeiro was not what Carioca boosters had in mind for the city.

Lacking even a mediocre sewage system, the rivers and creeks of Fluminense Baixada and the outskirts of Rio de Janeiro city received waterwaste, runoff from the farms and sugarcane mills, industrial discharge, and solid matter. The only solution was the rectification of the rivers, i.e., to straighten rivers into channels, thus allowing the material to reach the Guanabara Bay faster. This way, engineers could avoid the

⁵³ Francisco Chaves de Oliveira Botelho, *Mensagem Apresentada a Assembléa Legislativa em 1 de Agosto de 1911 pelo Presidente do Estado Dr. Francisco Chaves de Oliveira Botelho* (Rio de Janeiro: Typ. do Jornal do Comércio, 1911), 49.

⁵⁴ Arthur Neiva, "Extinção Da Febre Amarela No Brazil" (Report, Rio de Janeiro, November 23 1918). Botafogo Bay’s fate was not different from other bodies of water in urban areas. Big cities on small rivers, such as Moscow and Madrid, quickly outstripped the waters’ power to assimilate organic wastes in the twentieth century. “Only primary sewage treatment—trickling through filters—took place until 1912-1915, when British engineers developed the sludge activation process. In the 1920s and 1930s big cities in the western world began to build sewage treatment plants.” The city of Washington, DC, built its first in 1934, and Moscow built small sewage treatment plants in the late 1930s and big ones in the 1960s. McNeill, *Something New under the Sun*, 129.

accumulation of garbage and polluted waters in private propriety and populated waters. The downside of this solution was that rectified rivers needed frequent dredging—and two years of dredging would cost almost as much as the total amount for the channel rectification project.⁵⁵

Despite these attempts to rationalize the use and discharge of water in Guanabara Bay, engineers could not build the modern landscape they desired. No laws dealt consistently with water pollution until the late 1930s.⁵⁶ Floods would still be a reality in Rio in the year 2004; piped water did not reach the suburbs until the 1930s, and the sewage system in Rio de Janeiro still caused concern well into the twentieth century. As a matter of fact, organic pollution may still be the most urgent problem of the Guanabara Bay in the twentieth-first century. The emphasis of urban reformers on beautification in downtown caused them to neglect of a crucial element in the city's life: the low-income population and their habitations. The new boulevards required sparrows as in Paris—and Pereira Passos ordered a shipload of sparrows, which were to be freed on the day of the inauguration of the Central Avenue.⁵⁷ The poor and colored population in Rio were instead like biguás, black birds that lived in the mangroves and lakes. The poor hardly fit into the image of an European city, the model for beauty and modernity.

Expelled from downtown by the Passos Reform, the poor reproduced in other areas (hills or recently landfilled areas, such as Avenida Brasil), the same chaotic, unsanitary communities the urban reformers had berated and fought to eliminate from

⁵⁵ Francisco Chaves de Oliveira Botelho, *Mensagem Apresentada a Assembléa Legislativa em 1 de Agosto de 1912 pelo Presidente do Estado Dr. Francisco Chaves de Oliveira Botelho* (Rio de Janeiro: Typ. do Jornal do Comércio, 1912), 25.

⁵⁶ For a discussion on water pollution legislation, see Chapter 5.

⁵⁷ Brenna, *O Rio de Janeiro de Pereira Passos*, 76.

downtown. Urban reformers had radically modified Guanabara's shoreline to answer old demands of sanitation, flooding and transportation, but the population's increase just created new demands in different areas, bringing more pressure on the resources of Guanabara. Although few urban structures anywhere in the world had demonstrated the flexibility required to deal with urban population growth in the 20th century, it is equally true that the urban reformers in Rio tended to focus their attention on one area of the city—the most visible and glamorous showcase—and pushed anything else that did not fit their concept of a modern city out of view. Guanabara Bay, into which “rich” and “poor” waters flowed, could not afford to do the same.

Miasmas, Vectors, and the Dredging of Swamps

Yellow fever and malaria belonged to the group of diseases commonly diagnosed as “paludismo” during the nineteenth century in Brazil. As much as sewage and garbage, they posed a great public health problem for administrators. Solutions depended very much on an understanding of the disease in question. In the nineteenth century, a significant shift occurred in medical knowledge, when vector theory triumphed over the theory of miasmas.⁵⁸ Curiously, for Guanabara Bay this radical change made little difference. This lack of impact occurred for two reasons. First, regardless of the disease theory, engineers still shared with health experts the control over the public health agenda, as those who carried on public works. Second, their common solution for both theories was to drain and fill Guanabara Bay's marshes and mangroves.

⁵⁸ The miasmatic theory claimed that inhaling or even having contact with air derived from the decomposition of corpses and decaying material could cause the unbalance of gases (miasmas), leading to disease and death. Epidemics were thus connected to the environment. Water and heat, two powerful inducers to decomposition, as well as the miasmas from the swamps, rivers, sewage, soil, and—why not?—the poor and their shacks were understood to be dangerous disease vectors. Marques, “Da Higiene à Construção da Cidade,” 56.

Despite the switch from the early miasma theory to the vector theory of malaria, methods for disease eradication did not change much. Demolishing hills in order to improve air circulation in the cities, or canalizing rivers to avoid the creation of swamps were the engineers' typical answer to sanitation problems. Health experts could argue among themselves about the validity of contagious theory versus miasmatic theory, but the basic recipe for sanitation remained the same.⁵⁹

Flood-prone areas, critical points according to miasmatic theory, were virtually all areas around or within Guanabara Bay. Paula Freitas, leader of the Engineering Commission for urban reforms in Rio, explained the miasma theory as applied to the city of Rio de Janeiro:

As a result of fluctuation in the level of underground water, and alterations in temperature, moisture and air, such a conflict of the air and the water on the organic matters is generated in the soil that it contains, that these matters ferment and release gases that are harmful to the public health ... Rio de Janeiro ... is no more, in almost all its lowlands, than a unventilated swamp.⁶⁰

Miasmatic theories would rule among many urban reformers in Brazil long after the theories had been discredited in the rest of the world. After all, miasma theory did

⁵⁹ Pedro Soares Caldeira was perhaps alone in the scientific establishment in defending the mangroves. In 1884, courting a similar scientific discourse, and in fact, departing from the same theory of miasmas, Caldeira arrived to a diametrically opposed conclusion regarding the link between mangroves and disease in the Fluminense Baixada. The mangroves, according to Caldeira, were not swamps but Nature's solution to the swamps. Given time, the mangroves themselves would create meadows and gain more land for agriculture. Caldeira noted that the outbreaks of yellow fever were concurrent with the destruction of tidal vegetation; the reason for that, according to him, was that mangroves released natural tannin in the waters, which kept the epidemics in check while the mangroves were abundant. With so many mangroves destroyed, "the amount of tannin that our waters will not receive is immeasurable. Men disturb the conditions created by nature for the balance of its forces, and this action does not go unpunished." Caldeira made a better case for connecting the loss of the mangroves to the loss of fisheries and to the increase of floods. Moreover, what he lacked in solid evidence for his tannin case, he compensated with enthusiasm. Pedro Soares Caldeira, *O Corte do Manguê: Breves Considerações Sobre o Antigo e Actual Estado da Bahia do Rio de Janeiro, Consequencias da Destruição da Arvore Denominada Manguê, Methodo Barbaro da Pesca e Decadencia Desta Industria* (Rio de Janeiro: J. Villeneuve & C., 1894), 11.

⁶⁰ Freitas, Paula, quoted by Kropf, "Sonho da Razão, Alegoria da Ordem", 71.

have some truth: swamps and floods were a propitious environment for the diseases. This was not because of fermentation or creation of harmful gases, but for the reproduction of vectors of yellow fever and malaria. Malaria and yellow fever have similar modes of transmission: the virus is carried by a vector (in both cases a mosquito) from an infected person to a healthy one. The major vector for malaria in Brazil, a native mosquito called *Anopheles darlingi*, reproduces well in swamps. The insect is active from dusk to dawn, and is more common in rural areas. The vector for yellow fever, the *Aedes aegypti* mosquito, is an urban nuisance. It needs clean, stagnant water, active from dawn to dusk; its range is no more than 500 meters, and it rarely flies higher than one meter from the ground.⁶¹ Both malaria and yellow fever vectors found favorable environments in Guanabara Bay. Not only a major killer, these diseases were a very serious threat to Rio de Janeiro's aspirations to become a symbol of dignity for Brazil.

As in the Baixada, floods were commonplace in the city, especially during the torrential summer rains of December to March. People just coped with floods as a part of daily life. Pedro I, after his inauguration as the first Emperor of independent Brazil in 1822, crossed the flooded streets of Rio by foot, with water up to his knees, followed by a grandiose parade of noblemen and enthusiastic commoners.⁶² This relative nonchalance lasted until the great yellow fever epidemic in the summer of 1849-1850.⁶³

⁶¹ *Aedes Aegypti* is also the vector for the dengue fever. The World Health Organization considered the mosquito eradicated from Brazil in 1956. It was reintroduced again in 1965, probably by the port of Belém. In 1986 it arrived in Rio de Janeiro, bringing the first dengue epidemic in the city—where it is now endemic. In the summer of 2002, public health officers registered over 80,000 cases of the dengue in Rio de Janeiro state—including this author—and the unprecedented figure of 37 deaths by hemorrhagic dengue in three months. Secretaria Municipal de Saúde do Rio de Janeiro, *Dengue e Epidemias no Rio de Janeiro* (Rio de Janeiro: Prefeitura da Cidade do Rio de Janeiro, 2002), 5-9.

⁶² Amarante, "Problemas da Erosão," 631.

⁶³ Sidney Chalhoub, *Cidade Febril: Cortiços e Epidemias na Corte Imperial* (Rio de Janeiro: Cia. das Letras, 2001), 45.

The first malaria epidemic took place in Brazil maybe as early as the 16th century, but the *Aedes aegypti* (or *Stegomyia fasciata*) arrived in Brazil in 1849, bringing yellow fever back after almost a two-century absence. The mosquito most likely traveled by slaveship, in clay jugs used for storing water during the trans-Atlantic trip, as mosquito larvae can remain dormant in moist clay for almost one year. Some historians believe the disease first arrived in Brazil aboard the *Navarre*, a slaveship that docked in Rio on December 3, 1849. The ship had stopped in New Orleans, Havana and Salvador.⁶⁴ Ten days later, a yellow fever epidemic broke in Salvador, and by the end of the summer of 1849-1850, about a third of the 266,000 inhabitants of Rio got yellow fever. In a panic, the authorities adopted draconian legislation, ordering the sick to be taken away from the city. Slaves who left garbage on the streets were to be whipped, and because many physicians associated the disease with promiscuity, women were not allowed on the streets after 6 pm, the Hail-Mary hour. The official death figure from this first epidemic was 4,160, but contemporary newspapers and observers mentioned figures as high as 10,000, 12,000 or 15,000 deaths.⁶⁵

The epidemic was the starting point for social medicine in Rio de Janeiro. Draining swamps to fight the miasmas then became a national priority. By 1850, public health was viewed as an issue for engineers as much as for physicians. The Imperial government established a Commission of Engineers for Rio de Janeiro in 1850, affiliated with the Ministry of the Interior. The commission's first focus for urban reform of Rio de

⁶⁴ Although absent from Brazil since the seventeenth century, yellow fever was well known in North America. According to Melosi, "Yellow fever first attacked the Atlantic coast in the 1690s, peaked around 1745, subsided through much of the remaining century, and then reappeared savagely in the 1790 in the port cities of Boston and New Orleans. In 1793 yellow fever took 5,000 lives in Philadelphia—one out of every ten residents. By the 1820s yellow fever virtually disappeared in northern states, but remained a chronic problem from Florida to Texas." Melosi, *The Sanitary City*, 19.

⁶⁵ Chalhoub, *Cidade Febril*, 61.

Janeiro was the northern sector of the city: the Mangue (Mangrove) canal, from the Campo da Aclamação until the Raiz da Serra do Andaraí, which was basically mangrove forest.⁶⁶

Guanabara Bay, long a source of pride for its beauty, had now become a source of fear that only modern science, through urban engineering, could soothe. In the corollary of the positivist doctrine, the order-less beauty of nature was dangerous, and it needed disciplining by the orderly beauty of science and technology to achieve progress. For Paula Freitas, modern engineering:

[had to transform Rio de Janeiro in the very core of its] Nature, because, if she was prodigal in doting the [Rio de Janeiro] city with hills covered by extensive forests, and springs of clear water, if she was generous in carpeting it with a huge bay, considered the most beautiful in the world, on the other hand She also gave it low lands, usually swamps, where more and less serious diseases find the germs for their development, often with intense terror for its inhabitants.⁶⁷

Yellow fever inspired this fear, but it was by no means the most deadly disease in late nineteenth century Rio. Tuberculosis, smallpox, cholera and bubonic plague killed far more people every year than any palude disease—not to mention the occasional and deadly outbreaks of typhoid fever. In 1904, when yellow fever was virtually tamed, tuberculosis still killed an average of forty people weekly in Rio de Janeiro city.⁶⁸ Yellow fever, however, had a critical feature: its death toll was much higher among whites than blacks. According to Ruy Barbosa, mortality was around 92% among immigrant colonies—exactly when Brazil was competing with giants such as the United States,

⁶⁶ Kropf, "Sonho da Razão, Alegoria da Ordem", 63.

⁶⁷ Paula Freitas (1884) quoted in Kropf, "Sonho da Razão, Alegoria da Ordem", 87.

⁶⁸ Oswaldo Cruz, "As Moléstias do Rio," *Gazeta de Notícias*, December 1, 1906.

Canada, and Argentina for European immigrants/settlers. Yellow fever threatened the dream of “whitening Brazil.” Yellow fever, said Barbosa, “gave us, to the eyes of the civilized world, the image of a slaughterhouse for the white race.”⁶⁹ This image was reinforced in 1885, when the Italian ship Lombardia arrived in Rio de Janeiro for a diplomatic mission. The visit turned into tragedy when yellow fever killed 200 of its 340 sailors. Rio’s harbor was then on known as a deadly port, and tourist ships from Europe preferred to avoid Rio in favor of Buenos Aires.

By 1904 yellow fever in the capital was controlled. The number of casualties fell from 469 cases in 1903 to only 39 in 1904. The victory over the disease was achieved not so much by draining the swamps, but from a public health campaign led by the physician Oswaldo Cruz, with full support of the same President Rodrigues Alves that backed the Passos Reform.⁷⁰ A sanitary police invaded houses and broke any receptacle of rainwater that could favor the reproduction of mosquitoes that caused yellow fever. Moreover, families and physicians were required to report any case of disease, and the patient would be removed to a hospital or quarantined, far away from the city. Cruz paid the population to trap and kill rats, and convinced the federal government to impose mandatory vaccination against smallpox.⁷¹ Wildly criticized in the press, partly for his authoritarian

⁶⁹ The higher morbidity among Europeans not previously exposed to the disease is understandable, though the figures quoted by Ruy Barbosa are most probably too high. What is relevant here is that these were the figures believed by the government. Ruy Barbosa, quoted in Chalhoub, *Cidade Febril*, 57.

⁷⁰ Cruz trained medicine and public health at the Institute Pasteur in Paris. In 1900 he founded the institute now bearing his name (then called Instituto Soroterápico Federal), in Manguinhos. Initially, it was part of the Department of National Hygiene; eventually, it was severed from the public administration to become an autonomous research center in 1908. Scientists from the Institute often also held office at the Public Health Department. There was a permanent revolving door between the two institutions. Erica Nancy Stepan, "Scientific Institution-Building in a Developing Country: The Oswaldo Cruz Institute of Brazil" (PhD diss., University of California-Los Angeles, 1971).

⁷¹ Of course, the population soon learned to breed rats for profit. Marques, "Da Higiene à Construção da Cidade," 26.

practices and partly for mistrust on his methods, Cruz's campaign almost broke the alliance between engineers and physicians on sanitation. Few people were convinced mosquitoes could have caused so many deaths, and some positivist military officers joined the population in the riots against vaccination. Draining swamps was a more worthy, tangible, and understandable way to fight disease than breaking pots. But Cruz's success in controlling yellow fever in the capital could not be denied, and physicians instead of engineers assumed control of the Department of Public Health.⁷²

Frustrating Modernity: the Sanitation of the Fluminense Baixada

Focusing on the Passos Reform and on Cruz's success, it is easy to forget that just beyond the city limits, others dreamed of modernity—and failed. The Fluminense Baixada was the battlefield for many sanitation projects since the late nineteenth century. Malaria and depopulation would plague the region until the 1930s, when a combination of chemical application (DDT) and heavy federal intervention works finally changed the scene.⁷³

As the concept of sanitation as public works projects, translated into swamp draining and river rectification, became widely accepted, it pushed the alliance between engineers and physicians beyond the urban limits. Looking from the city toward the hinterland, the coordinator of Sanitation and Rural Protection Division (*Departamento de Saneamento e Profilaxia Rural*) in the Federal District, Arthur Neiva, said that malaria in

⁷² Sevcenko, *A Revolta da Vacina*, 56.

⁷³ By 1950, Rio de Janeiro state still allotted Cr\$2,500,000.00 (US\$131,648.24), plus Cr\$600,000.00 (US\$31,595.58) yearly, for a campaign against malaria which included heavy use of DDT. Edmundo Macedo Soares e Silva, *Introdução à Mensagem Apresentada pelo Governador do Estado do Rio de Janeiro à Assembléia Legislativa em 15 de Março de 1950* (Niterói: Estado do Rio de Janeiro/Imprensa Estadual/Divisão de Obras, 1950), 17.

the Fluminense Baixada could only be re-conquered after sanitizing the region. Without that, there could be no hope for a re-occupation of the area. He acknowledged that sanitation of the *sertões* (the backlands) would not be a priority because the poor state of Brazilian cities required state intervention more urgently, and because city sanitation held more hope for success. Surely sanitation was a requirement for any successful colonization. The blueprint was clear and had already been successfully tested at the borders of the Federal District and the state of Rio de Janeiro:

All the region crossed by the rivers Meriti and Pavuna, due to hydrographic works, and due to the opening of canals and ditches for soil drainage, deforestation, destruction of bromelias, rectification, regularization and reestablishment of the river Pavuna from its estuary up to beyond Anchieta, over nine kilometers upriver, is free from malaria. It was endemic there, with huge epidemic outbreaks every year, while today even sporadic cases of malaria are very rare.⁷⁴

In the Fluminense hinterland, resources were much more limited, and the swamps expanded rather than contracted. Plans for sanitizing the Baixada had been proposed, developed, approved, and then postponed for lack of funds since 1835 by every Fluminense president, first during the Empire, and then in the Republic. During the first years of the Republic, when the decadence of the Fluminense state was dire, drainage of the swamps and marshes in the Baixada for Fluminense politicians represented the possibility of return to a Golden Age. While Oswaldo Cruz carried out his door-to-door campaign against yellow fever in the city, the Baixada could only dream of better times. Fertile lands, now covered by the swamps, waited for transforming labor, to become again the breadbasket of Brazil, hoped Fluminense boosters.

⁷⁴ Arthur Neiva, "Relatório do Departamento de Saneamento e Profilaxia Rural do Distrito Federal" (Report, Rio de Janeiro, 1921). Bromelias, beautiful plants from the Bromeliaceae family, retain water in their leaves, creating a hospitable environment for reproduction of mosquitoes.

Fluminense president Quintino Bocayuva reminded his fellow state senators of the “tenacity and energy” of the “true apostle of science, Dr. Oswaldo Cruz,” who wiped out a disease that, “undermined the credit of our uncontested [?] salubrity.” Likewise, the Baixada would be drained and, “soon, incorporated to our arable zone, increasing our patrimony ... with outstanding fertile lands, surrounded by extensive navigable rivers and railroads for transportation.” European immigrants would then run to settle on the Fluminense lands.⁷⁵ Without a full combat against malaria and yellow fever, however, any attempt at “modernization” and valorization of the countryside was doomed. In 1911, another Fluminense president, Oliveira Botelho, blamed a new outbreak of yellow fever and malaria in the village of São João Marcos on the previous government, which had allowed the building of a dam and lake by the Rio de Janeiro Tramway Light and Power Company Limited without the necessary precautions to avoid paludismo. The dam was to provide energy to Rio de Janeiro city and Niterói, but once it was built, “the water invaded pastures, cultures, forests, houses, barns, and even a cemetery; following the water was the fever, in each and every house.”⁷⁶ Playing with modernity, as represented by the dam, could be a dangerous business with unintended consequences, if not backed by sound sanitation.

Niterói, signified a case somewhere in between the experiences of Rio and Baixada Fluminense. With its small urban nucleus and large rural area, the city was

⁷⁵ The potential of sanitation projects to turn the flooded Baixada into “outstanding fertile lands” was evoked successively by the presidents of the State of Rio de Janeiro Joaquim Mauricio de Abreu in 1895, Dr. Francisco Chaves de Oliveira Botelho in 1911, and Manuel de Mattos Duarte Silva, 1927 to 1930—respectively Joaquim Mauricio Abreu, *Mensagem Enviada à Assembléa Legislativa do Estado do Rio de Janeiro pelo Presidente Dr. Joaquim Mauricio de Abreu na 1a. Sessão Ordinaria da 2a. Legislatura em 15 de Setembro de 1895* (Rio de Janeiro: Typographia e Lithographia Carlos Gaspar da Silva, 1895), 25; Botelho, *Mensagem Apresentada a Assembléa Legislativa*, 63; Silva, *Mensagem Apresentada a Assembléa Legislativa*, 30.

⁷⁶ Botelho, *Mensagem Apresentada a Assembléa Legislativa*, 27.

plagued by both yellow fever and malaria. The decadence of the hinterland drained State finances and had a deadly impact in Niterói. Sanitary Rio de Janeiro city was an example for the rest of the country to be followed by every Brazilian city. And, as in the case with embellishment, Niterói followed Rio's lead. The appeal to health experts and engineers on the other side of the bay was exactly the same as for those in Rio de Janeiro city, but the results were different. Unlike Brazil's capital, Niterói only had promises of federal resources. It could not even count on the resources of its own impoverished state. Politics in the State of Rio de Janeiro was dominated by farmers who wanted resources to be reinvested in the rural area, or by politicians from Campos in the north of the State who had little interest in the state capital. When both these groups shared power, they saw state politics as a platform upon which to dominate national politics, with dreams of restoring Rio de Janeiro state again as influential in the young Republic.⁷⁷ Niterói boosters had little influence in state politics, as it was hard to argue the "unique potential" of developing a city located right in front of the model city for the country. Niterói supporters did however try, and the sanitation of Niterói was the first item on their agenda. The police chief employed inmates to clean Niterói's swamps, and the Fluminense president ordered studies for razing hills where necessary, and hired Carioca and Canadian companies to build a sewage system. But as late as 1928, the governor pointed to the perfect sanitation of Rio in contrast to Niterói as a cause of Niterói's decreasing population.⁷⁸ In terms of sanitation, Niterói was in better shape than the Baixada in 1928, but always some steps behind Rio de Janeiro city.

⁷⁷ Ferreira, *Em Busca da Idade de Ouro*, 12-23.

⁷⁸ Manuel de Mattos Duarte Silva, *Mensagem Apresentada a Assembléa Legislativa do Estado do Rio de Janeiro em 1 de Agosto de 1928 pelo Presidente do Estado Dr. Manuel de Mattos Duarte* (Rio de Janeiro: 1928), 30.

Eventually, hydraulic works, canals, ditches, and deforestation were the projects implemented in the Fluminense sertões, including the Guanabara Baixada in the 1930s, just as Arthur Neiva had proposed in the earlier decade.⁷⁹ The projects were carried out with federal and international funds.⁸⁰ In the meantime, the industrialization of Niterói and Rio de Janeiro continued to attract agricultural laborers to the suburbs, further straining the infrastructure around the bay.⁸¹

The sanitation of the Fluminense lowlands was long delayed but made more urgent—and less viable—by the loss of political and economic significance of the Region. Hildebrando Goes, the engineer responsible for definitive works of sanitation under the Vargas administration, listed no fewer than twelve commissions during the first Republican period, which tried to accomplish the goal of sanitizing the lowlands but and failed, with significant losses of invested resources.⁸² The first of these sanitary

⁷⁹ Despite the long economic occupation of the region, Guanabara Bay region still counted with a large forest cover by the early twentieth century. Moreover, the economic decadence of the region allowed the regrowth of the Atlantic rainforests in areas that were far from navigable rivers to be economically profitable for cash crops. See Dean, *With Broadax and Firebrand*, 180.

⁸⁰ Since 1907, the Rockefeller Health Commission Against Hookworm Disease from the US worked in sanitation projects with the Fluminense government to control hookworm disease in the countryside. Agnello Geraque Collet, *Mensagem Apresentada a Assembléa Legislativa do Estado do Rio de Janeiro em 1 de Agosto de 1917 pelo Presidente do Estado Dr. Agnello Geraque Collet* (Rio de Janeiro: Typ. do Jornal do Comércio, 1917), 23.

⁸¹ Soares, "Nova Iguaçu," 168.

⁸² This figure is conservative: Hildebrando Goes did not include on his list earlier efforts by the Empire in 1872 and later, as well as smaller projects in the Republican period that did not leave the drawing board. Only four commissions had actually some impact on the Baixada landscape and its demographics, generating substantial studies about the region. The first of these commissions was called by State of Rio de Janeiro in 1894 and was abolished only in 1902. The second, this time carried on by the Federal Government, lasted from 1910 to 1916. The third large-scale attempt to sanitize the Baixada was also sponsored by the Federal Government, and the Ministry of Viação e Obras Públicas, which hired the Eng. Aguiar and the Companhia de Melhoramentos da Baixada Fluminense to fill in the Inhaúma Cove, and this work lasted from 1921 to 1932. (See more on the Inhaúma Cove in Chapter 4). Finally, Hildebrando Goes headed the commission that eventually brought the project to satisfactory completion, from 1930 to 1940. Except for the project by Eng. Aguiar in Inhaúma Cove, none of these commissions focused exclusively on the Guanabara Bay Basin. At the same time, the political and economic significance of the Guanabara Bay, its proximity to the capital and the presence of the most populated villages in a seriously depopulated Baixada, caused the projects regularly start their works in the Guanabara Basin. Few of these commissions,

commissions was established in 1894 and lasted until 1902. Its report represents a powerful snapshot of the aspirations, technology, and human capital expended in the many frustrating attempts to bring modernity to the lowlands.

The 1894 commission limited as their target area a surface of 18,000 SqKm roughly one third of which was swamp land. The target area included parts of the Sepetiba Bay Basin, as well as the Guanabara Basin, but the commission had concentrated its work in the municipalities of Magé and Iguaçu, northeast of the Guanabara Bay, a total area of 224,590 hectares. According to the 1892 census, the population in the total region was 527,000 inhabitants, or 93,390 households.⁸³ Demographic density varied from 2.280 to 0.15 inhabitant per hectare, with a clear predominance of women. The commission pointed to the gender imbalance as evidence of, “the deficiency of industrial activity where men could find occupation and primary needs, being thus forced to migrate.”⁸⁴ It complained about the lack of systematic studies on morbidity in the region. Relatively reliable estimates for Niterói showed a noticeable increase of morbidity attributed to impaludism, over a thirty year period. As Niterói was in much better shape than the swamp region served by the rivers Macabú, Macacu, Magé, S. João, Pilar, Guandu e tributaries, the commission believed the mortality numbers in the wetlands would be much higher than in Niterói. Swamp and paludismo then explained the decadence of industry and agriculture in the villages on the shores of those rivers, in contrast to others municipalities “in better climatic conditions” along the coast, “where

despite their ambitious plans, were able to go much further. Hildebrando de Araujo Goes, "Baixada Fluminense," *Revista do Clube de Engenharia* 6, no. 67 (1940): 34.

⁸³ Nunes, *Recenseamento do Estado do Rio de Janeiro*, 2-4.

⁸⁴ Comissão de Saneamento da Baixada Fluminense, *Memórias Sobre o Saneamento da Baixada do Estado do Rio de Janeiro - Noções Estatísticas, Zona Meridional Designada pelo Nome Baixada do Estado* (Rio de Janeiro: [Governo da Província do Rio de Janeiro], 1895), 7.

favorable climate blossomed the cultures of coffee and sugarcane, textile industry, liquor distillation, etc.”⁸⁵

The economic decadence of the region was therefore blamed on sanitary conditions, and once these obstacles were removed, it was believed the Baixada would again become the wealthy region it was in the first half of the nineteenth century. After all, almost all its municipalities in the target area were served by railroads. Moreover, a project for a massive road network awaited approval and funding from the federal government. Dredging the swamps should liberate one third of the Baixada lands for agriculture, more than making up for the exhausted lands where coffee and sugarcane cultures had deserted. Draining the swaps would not only rid the region of a deadly disease, it would create an area with reliable transportation, good communication and fertile lands— a sure recipe for economic success.⁸⁶

The commission sought to emulate the large-scale draining projects in France, hoping for an equally clear and measurable valorization of the Fluminense Baixada.⁸⁷ The commission’s goals were to “improve the river regime” and “to eliminate the swamps.” To accomplish these goals, the commission prescribed a straightforward but comprehensive plan that would deeply change the Baixada landscape. This included the removal of vegetation, widening and rectifying river courses, and leveling of longitudinal declivities and a complex system of intercepting canals with lateral dikes and levees, to

⁸⁵ Fluminense, *Memórias Sobre o Saneamento*, 8.

⁸⁶ Fluminense, *Memórias Sobre o Saneamento*, 9.

⁸⁷ France was again the most sought after model for draining wetlands. Engineers in the sanitation commission were particularly impressed to the extensive and profitable projects, in which property gains exceeded more than twice the draining costs. Fluminense, *Memórias Sobre o Saneamento*, 10.

protect the lowlands from flooding and high tides and to move the water overflow to the Guanabara Bay.

The 1894 sanitary commission failed spectacularly in its goals. It soon found that the conditions of labor were very different than in the cities. According to weekly reports from work teams, they were plagued by almost every possible disaster. Torrential rains delayed the works, the energy supply was unreliable, and engineers and workers despaired over receiving regular food shipments. Disease was the worst obstacle. Engineer Alvarenga Peixoto, in charge of the dredging of the Magé River, added to his ordinary report a sanitary bulletin, noting the absences due to disease. Not one week passed when someone would not have fallen ill, most likely with malaria. The disease did not distinguish between his team members, whether manual workers, engineers, or foremen, striking an average two to three people out of 30 per week.⁸⁸ There is no record of the actual area drained in this effort.

* * * * *

In Guanabara Bay, engineers were the main advocates of a vision of modernity that dominated the late nineteenth century. They championed the concept, and they used their organizations and influences in government to push forward what they considered to be technological solutions to the nation's social problems. Their new privileged status in public administration benefited from the rising popularity of modernity throughout the world at that time. Engineers as urban reformers were both the creators and promoters of

⁸⁸ Alvarenga Peixoto, "Boletim Diários dos Trabalhos" (Typed notes, Rio de Janeiro, February 1896).

one concept of modernity. Particularly in Rio de Janeiro city, engineers instigated urban reforms that transformed the city as the symbolic and political capital of Brazil, and, in the process, transformed the country.

From the end of the Empire to the first decades of the Republican period, engineers changed the landscape in Guanabara Bay. They built bridges, embankments, sewage systems, channels, aqueducts, drained swamps, and rectified rivers. And yet, everywhere could be seen the unfinished bridges: projects of modernity that did not materialize.

Comparing the urban reforms in Rio de Janeiro city to the sanitation efforts in the Fluminense lowlands and Niterói reminds us that modernity projects are not always successful and incur unforeseen costs. It is easy to focus only on the Passos Reform, its major landmarks still visible in the city of Rio de Janeiro in the large avenues and the regal buildings, and therefore neglect to consider its larger context. It is easy to forget the Passos Reform was only the most successful in a series of attempts to transform the city that preceded it. All these attempts to transform the city were inspired by similar concepts of hygiene, order and grandeur, and all with different levels of success.

The uneven map of Guanabara Bay, contrasting the Rio de Janeiro city with the hinterland, serves as a metaphor for the distribution of power and resources in Brazil. The sanitation projects failed or succeeded due to a complex interplay of factors that included politics, knowledge, and resources. Modernity was expensive. For the Passos Reform to last, it counted on the weight of two Federal administrations that invested heavily in its success, and only in a limited and visible part of the city. Niterói and the Fluminense Baixada did not have these advantages. State politicians struggled whether to invest

scarce resources in the large Fluminense lowlands or in the prosperous northern part of the state; malaria proved to be more resilient than yellow fever; and Rio de Janeiro state could only dream about the amount of resources made available to the mayor Pereira Passos.⁸⁹ Modernity also requires constant maintenance and new investments. The remarkable accomplishment that The City Improvements represented for the city paled in the long-run as the investments did not follow. Every new attempt at sanitation of the Fluminense Baixada would dredge the rivers as if nobody had done it before, like a Sisyphus task.

If the Brazilian version of modernity contemplated only some areas, it also included only some people. The urban reforms displaced poor people from downtown Rio de Janeiro, burning down their unhealthy, overcrowded habitations, because the modern city could not tolerate them within its limits. Public officers razed Senado Hill, leaving around 5,000 people without homes because the city needed more “ventilation.” On the other side of the Guanabara Bay, malaria and poverty expelled the rural population from the Baixada Fluminense, who then migrated to the cities for jobs and better health. Displaced from the city, which was too modern, and from the lowlands, which were not modern enough, the poor crammed into new slums (favelas), either up the hills or in the mangrove forests. They built houses where there was no infrastructure, on the shores of the bay, on palafitte, on the top of the hills, and wherever else they could, bringing even more pressure to the rivers and bay.

⁸⁹ A rough estimate for the Passos Reform, published at the *Jornal do Commercio* in 1906, quoted figures of 300-400 thousand contos de réis (or from US\$95.25 million to US\$127 million). All the revenues of the State of Rio de Janeiro in the same year added to 7,799 contos de réis (or US\$2.48 million). *Jornal do Commercio*, “A pedido,” November 21, 1906, quoted in Brenna, *O Rio de Janeiro de Pereira Passos*, 560; Nilo Peçanha, *Mensagem Apresentada a Assembléa Legislativa em 1 de Agosto de 1906 pelo Presidente do Estado Dr. Nilo Peçanha* (Rio de Janeiro: Typ. do Jornal do Commercio, 1906), 40.

Whether successful or failures, all these public works modified the bay. Although the draining and canalization of rivers in the Fluminense lowlands did not succeed in creating a new fertile and healthy region, it did increase siltation in Guanabara bay. Embankments in Inhaúma Cove, while failing to achieve immediately their stated purposes (that is, real estate) had an immediate effect on the water circulation regime in that part of the bay. Even when a project succeeded by fulfilling its avowed goals, it seldom, if ever, took into account the unintended consequences on the bay (alteration of water regime, organic and industrial pollution, siltation). These consequences would become the long-term effects of modernity, as much as the unfinished bridges and large boulevards.

Finally, the efforts to bring modernity to Guanabara Bay in the first decades of the Republic had yet another impact on the future of the Bay: they created legal and strategic templates for future public works. The laws that allowed large reforms in the city of Rio de Janeiro inspired future administrations to develop similar legislation. On the other hand, federal and state government oscillated between concessions, such as the contract with The City Improvements, and direct intervention to carry out necessary public works. Direct intervention meant the government hired personnel to plan and execute the public works, with the option to subcontract some services. Direct intervention was not always very efficient; even the most basic acts, such as purchasing axes and shovels, could generate more bureaucracy and delay than the engineer in charge cared for. But in areas that returns were unlikely to come in the short-run, such as the sanitation of the Fluminense Baixada, or that required huge initial capital, such as the Passos Reform, concessionaries usually failed to fulfill their contracts and direct interventions was a

protection against endless judicial quarrels. Based on the experience of those years, future works in Guanabara Bay would be completed by concessions when public administrators could find a reliable partner. Companies desired concessions for public services and land reclamation works, but for most sanitation works, dredging and other low-return public works, public power was the major contractor for Guanabara Bay.

Chapter 3

To Protect and Defend: The Navy

The first government institution to stake a claim over Guanabara Bay was the Navy—if one accepts the Portuguese warships that expelled French settlers in the 16th century as the precursors of the Brazilian Navy. Guanabara was coveted by both the French and Portuguese. The bay's calm waters could shelter countless ships, while its narrow and deep mouth defended ships from storms and enemy fleets. A military defense of the bay was therefore a primary factor leading to the importance of the city of Rio de Janeiro to the Portuguese colony, and later in the Brazilian Empire. Defense of the Bay was the privilege and responsibility of the Navy in the twentieth century as well as in the sixteenth, though interpretations of what defense implied changed over the centuries. While a traditional view of defense of Guanabara Bay meant only protecting the national territory from invasions by foreign fleets, it later evolved to include the selection of strategic sites for the Navy headquarters (such as Guanabara Bay), the training of local fishermen (potential sailors), the diplomatic representation of Brazil in international forums, and the elaboration and enforcement of coastal regulations. All these derived duties placed the navy at the center of the environmental management of Guanabara Bay.

The Navy is in many senses unique among the institutions studied in this dissertation. First, the Navy was actively present in Guanabara Bay much earlier than the other institutions contemplated in this thesis. Secondly, its relationship with the bay was all-encompassing, as only the Navy could claim jurisdiction over the bay in its entirety until 1975. While several municipalities, including the city of Rio de Janeiro, focused

only on the segment of the bay within their territorial limits, the Navy oversaw the whole bay. The Navy held property on both sides of Guanabara; it had jurisdiction over its waters, regulating fishing and transportation; and it issued permits for building on the shoreline on the so-called “*terras de marinha*” (marine lands). If anything floated, swam or at least could get wet, it fell under the jurisdiction of the Navy. Because of this long-term and flexible definition of an institutional mission, the Navy was closely related with the environmental management of Guanabara Bay, though few would dare call it an environmental institution.

This chapter explores how the Navy engaged in pollution control programs in Guanabara Bay, and how it is related to its long and multifaceted relationship with the bay. The argument here is that Navy was able to deal with pollution because it was already responsible for so many roles beyond defense, as long as they had to do with water. The Navy that emerges in ministerial reports, internal documents and newspaper clippings was an overarching institution with vested interests in labor, natural resources, and diplomacy. When sea pollution became a political issue in the 1950s, the Navy was at least willing to face the challenge at the ministerial level, as well as through several individual initiatives by its officers. In the context of the larger debate on environmental management as proposed in this dissertation, the Navy’s ties to Guanabara Bay were similar to other civil and scientific institutions in that there was uncertainty as to where individual initiatives ended and the institutional mission began. On the other hand, the Navy was eager to take a leading role in the pollution debate, and add pollution control to the myriad list of water-related issues that port captaincies handled.

Beyond classic defense duties, the Navy was also responsible for protecting and stimulating civil navigation, deciding labor disputes among fishermen, sailors and naval companies, and generally enforcing the law. Through its several agencies, the Navy held legislative, judicial, and executive authority over Brazilian waters. This power led to several conflicts with municipalities around Guanabara Bay who had final authority on such issues as the definition of taxes for internal navigation, or the licensing of professional fishermen. If these conflicts were common—and exasperating for the Navy Ministers—in the early decades of the Republic, they became less so after the Vargas Era. This was because the administrative reforms of the centralizing Vargas government defined more clearly attributions among the several ministries and government branches. Second, but equally important is that during the same period, the primacy of the Navy over the waters was no longer contested. Thus, when oil pollution in the seas became an issue in the international arena in 1954, the Navy was the natural interlocutor. Likewise, when pollution of Guanabara Bay rose to the status of a national problem in the 1970s, it was again the Navy, now empowered by the military regime as *supra-parti*, that was able to broker an agreement between the two states that shared the bay in order to control pollution. It is important to notice the ambivalence with which the navy saw oil pollution: while some branches would minimize the problem and warn international bodies to keep their distance from Brazilian waters, other Navy departments took a hands-on approach and tried to bring in partners (mainly domestic) for pollution control projects.

From defense to anti-pollution activism, the trajectory was less the result of redefinition of its institutional mission than a response to specific circumstances. Chief among the Navy's concerns was the defense of the Brazilian coasts. Its Ministers

believed the best way to defend was by assuring control over the sea—and such a primary duty had to override any other claim. Therefore whenever the Navy perceived a challenge to its control of the seas, it reacted strongly. The Navy reacted to land-grabbing during Rio de Janeiro city's modernization frenzy; it reacted against municipalities eager to step over its prerogatives, and it reacted against international treaties perceived as threats to national sovereignty.

In addition to these external challenges, the Navy also suffered the same lack of continuity, internal disputes, and professional jealousies that plagued the Brazilian state bureaucracy. These contradictions were particularly evident in Guanabara Bay, where general oversight by the ministers located in Rio de Janeiro city conflicted with the micromanagement of everyday naval duties. Such contradictions materialized also in the ambiguous role took by the Navy on oil pollution control by 1960s, in which individual officers studied solutions for pollution in Guanabara Bay while at the same time, naval envoys attempted to obstruct efforts to create concrete pollution controls at international conventions.

This chapter begins with a description of the special relationship the Navy had, as a federal administrative institution with political interests, with Guanabara Bay—a relationship that was threatened and eventually reasserted in the First Republic. Next, I analyze the Navy's non-defense roles, such as its patronage of commercial navigation and fisheries, and show how these roles were not uncontested. Finally, fast-forwarding to the Vargas Era, I discuss how pollution shaped the Navy's agenda in the 1950s.¹

¹ The decision to bypass a closer discussion of the Navy in the Vargas Era was not taken lightly. According to Max Justo Guedes, since 1922 to the late 1950s, the *tenentistas* rebellions and World War II took a heavy toll on the Navy's resources and energy. National politics and strictly military duties dominated most,

International sea pollution motivated the Navy to take a position of resistance to foreign-imposed environmental regulation, while coastal pollution in Guanabara Bay inspired Navy officers to engage in anti-pollution networks.

Place: Guanabara Bay as Headquarters

The defense of Guanabara Bay, the headquarters for the main military port of Brazil, was a high priority for the Navy, both in the Imperial period and under the Republic. The Navy's primary duties included the protection of Rio de Janeiro and Niterói from any hostile fleet. It was thus unfortunate that since 1861, when a diplomatic quarrel led to the blockade of Guanabara Bay by British ships, the most serious threat to the Bay came from the Navy itself—twice in fact.²

The rebellions in the earlier decades of the Republican period were particularly traumatic for the Navy. Navy rebels twice dominated the Bay in less than twenty years; Navy cannons twice threatened Rio de Janeiro and Niterói, causing embarrassment for the admiralty. On the first occasion, the Rebellion of the Fleet (*Revolta da Armada*), Navy officers rebelled in 1893 against hard-line president General Floriano Peixoto. According to the rebels, Peixoto refused to submit to the constitutional rules for presidential elections, and arrested anyone that dared to protest. There was a severe

if not all, of its activities, as it is confirmed by a careful analysis of the ministerial reports between 1930 to 1947. So, although much can be said of the development and transformation of the Navy in the Vargas Period, there was little immediate impact of this transformation on the Guanabara Bay. At most, we can assert that the old disputes with the municipalities over fisheries and navigation ceased when the strong central government took over in 1930. In that arena, the Navy won and lost at the same time: it won, because its concerns were embraced by the Vargas administration, as for instance, through the Fish and Game Code, and the Water Code, both dated from 1934; it lost, because the Fish Division was transferred to the Ministry of Agriculture, and the Commercial Navigation Division to the Ministry of Transportation and Public Works.

² For more on the Christie Question, see Roderick J Barman, *Citizen Emperor Pedro II and the Making of Brazil, 1825-91* (Stanford, Calif: Stanford University Press, 1999), 146.

schism between the Army, which supported Floriano, and the Navy, deeply offended by the arrest of its most popular admirals. On September 6, 1893, most of the Navy officers took arms against the government, in several parts of Brazil. The Navy controlled most of the ships and upper officers. The government controlled all the fortresses on land, including most Navy facilities. Guanabara Bay was isolated, and ships of five different nationalities were trapped in it. Both the rebels and the government expected reinforcements; from the South for the rebellion, and from the North for the loyalists. Although both sides agreed to spare Rio de Janeiro city from bombardment (except for military targets), Niterói did not have the same luck. The Fluminense administration and capital status was temporarily transferred to a safer city in the mountains, far away from Guanabara's shores. The rebellion was soon quelled. Rebel reinforcements failed to arrive, while the loyalist troops from the North infiltrated the bay. Food and water started to become a problem for the rebellion. Finally, when foreign ships initially sympathetic to the rebels closed ranks with the government, the movement was doomed.³

The second rebellion was radically different. The Rebellion of the Whip (*Revolta da Chibata*), led by low-class sailors, started on November 22, 1910. The sailors demanded an end to corporal punishment, better wages, and better food. They threatened to bombard Niterói and Rio de Janeiro, which they eventually did, although there was little damage to either city. The rebels, most of them black and illiterate, took over five of the most important ships in the Brazilian fleet (including the two modern and large

³ Hélio Leôncio Martins, *História Naval Brasileira*, vol. V-T. II (Rio de Janeiro: Serviço de Documentação Geral da Marinha, 1985), 36.

battleships, the São Paulo and Minas Gerais), commanding a total of 2,379 sailors.⁴

Showing remarkable skill in coordinating their forces, they maneuvered the ships in and out of the bay, avoiding government resistance. Less than one week later, the government gave in to the rebels, promising amnesty and agreeing to the rebels' demands. Due to a later development, the Navy had cause to arrest most of the rebellion's leaders. Some of these leaders were summarily executed aboard the ship that would have taken them into exile; others were indeed exiled to Acre, in the unforgiving heart the Amazon forest. Fifty-four rebels were piled together in a small cell in the dungeons of Ilha das Cobras (Island of the Snakes). By the next morning, only eight survived.⁵

By the end of the Rebellion of the Fleet, the gulf of wariness between the Navy and the Federal Government was visibly open. The golden age for the Navy in Guanabara Bay was during the Empire, when Navy officers enjoyed as much prestige as the titled aristocrats, and many officers were scions of well-connected elite families.⁶ With the advent of the Republic, the Navy lost its former status. Its share of the federal budget

⁴ The most famous leader of the rebellion, João Cândido, was the child of former slaves. Popularly known as the Black Admiral after the rebellion, Cândido reportedly said that the sailors were aware of the struggle for better work conditions by their British counterparts, as well as of the rebellion at the Battleship Potemkin. He denied, however, that the rebellion had larger revolutionary overtones. They only wanted, recorded Cândido in 1968, the abolition of the whip and better food. Fernando Granato, *O Negro da Chibata* (Rio de Janeiro: Objetiva, 2000), 35-36.

⁵ The Revolta da Chibata was a huge blow to the moral and the discipline of the Navy, not only for the rebellion itself, but also for the obvious illegality of the punishments. Discipline was broken twice: one when sailors mutinied, and again when Navy officers exacted their revenge rather than carried on the sentences on the prisoners. Edgar Morel, *Revoltas Populares no Rio de Janeiro* (Rio de Janeiro: Difel, 1987), 63.

⁶ From 1824 to 1861, the Navy invested in the building of a dry dock (*dique seco*), making the Arsenal da Corte one of finest of the world. Between 1865 and 1890, the Arsenal built several small and large military ships, including the Cruiser Tamandaré, the largest ship made in Brazil until at least 1960. Also during the Empire, the Navy hired European naval engineers to organize its Arsenal, or sent officers to train in Europe for this goal. It created a school of apprentices and equipped the several fortresses in the Bay. Yapery Tupiassu Guerra, "A Engenharia Naval" (Typed notes, Rio de Janeiro, 1982).

paled compared to the new funds offered to the Army.⁷ In addition, the Navy also lost some territory in Guanabara Bay. Punishment for the Rebellion of the Fleet was to strip control from the Navy a number of its domains, such as the Escola de Aspirantes (Cadets Academia), the Fortress of Glória, and others. In this context, a poorly disguised fear the Navy may rise again against the government rekindled old plans to move the military port from the capital.

The time for such considerations was ripe, and not only for political expediency. Rio de Janeiro city, under the modernizing frenzy of urban reforms, left little room for the needs of the Navy, especially if it wanted to follow the example of its counterparts abroad and invest in modern shipbuilding.⁸ Minister after minister complained of the inadequacy of the Arsenal to build new, modern ships, of the high cost to expand the arsenal and the military port in the land-hungry Rio de Janeiro, of the vulnerability of Guanabara Bay to attacks—painfully evident during the Revolta da Armada and the Revolta da Chibata. With most of the facilities spread on both sides of Guanabara Bay, ministers complained of the high costs to simply send orders and personnel from one installation to the next, with the consequent poor communications between facilities.⁹ To

⁷ In the Empire, the participation of the Navy Ministry and the War Ministry (Army) in the national budget was consistently 7% and 9%, respectively. At the time of the Rebellion of the Fleet, 1894, the Navy's share was only 5%, while the War Ministry was awarded 24%. It was an exceptional and violent year. In the following years, the Navy's share would oscillate between 8 and 9%, while the Army received from 12 to 15%. See Reports of the Ministério da Fazenda, 1890 a 1910, in James Simon, *Fazenda Ministerial Reports, 1821-1949* [website] (May 19 2004 [cited May 23, 2004]); available from <http://brazil.crl.edu/bsd/bsd/hartness/fazend.html>.

⁸ See Chapter 2.

⁹ The Navy sites in Guanabara Bay in 1923 included the Ilha Fiscal, Ilha das Cobras, Ilha das Enxadas, Ponta da Armação in Niterói, Ilha do Mocanguê, Ilha do Boqueirão Grande, the Fortress of Santa Cruz (returned to Navy control in 1914, after being under the Army's administration since the Revolta da Armada in 1893), other than several buildings in the cities of Rio de Janeiro and Niterói (such as the Tamandaré Building, the Casa Marcílio Dias, the Navy Library, and the Naval Complex in Praça Mauá). See Map. Veiga Miranda, civil Minister of the Navy in 1919, estimated that 80 hours of labor were wasted

address these communication problems, several ministers planned to move the Arsenal, the School of Naval Officers, and the main military port of the country from Guanabara to Jacuacanga in Ilha Grande, to the south of Rio de Janeiro state.¹⁰ And this reform may have succeeded if it was not for the efforts of Admiral Alexandrino de Alencar.

Senator Admiral Alexandrino de Alencar took office at the Navy Ministry at November of 1906. Few months earlier, a high commission studying the projects for the moving of the military port to Jacuacanga literally sunk to the bottom of Ilha Grande bay when the battleship Aquidabã exploded, and most of those who could challenge Alexandrino's ascension were killed in the explosion. While in the Senate, Alexandrino fought to nullify all agreements with international contractors for the Ilha Grande project. In the ministry, he claimed there were no funds to invest simultaneously in the fleet and in a new military port. Thus new ships were ordered from England and Guanabara Bay remained the center for all future projects for the Brazilian Navy.¹¹ Again, fate and the motives of individual characters, rather than strategic planning, would define the future of the bay.

daily just in communications between the several facilities. João Pedro Veiga Miranda, *Quatorze Meses na Pasta da Marinha*, 2 ed. (Rio de Janeiro: Serviço de Documentação Geral da Marinha, 1982), 65.

¹⁰ The first significant proposal to transfer the military port from Guanabara took place in the heels of the Revolta da Armada in 1893. The following administration kept the project alive, and Jacuacanga Bay, about one hundred miles south from Rio de Janeiro, was then suggested as a possible site for the new port. From 1902 to 1906, Minister Admiral Júlio de Noronha energetically pushed the transference forward, and freezing most investments in Guanabara Bay. The Navy therefore have a very limited role in the huge reconstruction of the commercial port of Rio de Janeiro, or even in changes of the Guanabara shoreline, as most of the Navy's attention was focused south of Rio on the Jacuacanga Bay. Plans for Jacuacanga included a new Arsenal, housing for officers and sailors, warehouses, hangars for naval airplanes, and defense buildings. The new port would also receive a brand new armada, new ships built by the British shipbuilding company Vickers Armstrong. Financial aspects for the deal had been renegotiated with the Federal government and the Vickers Armstrong Company such that the company would have the right to use the new Navy Arsenal. Joaquim Marques Baptista Leão, *Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil* (Rio de Janeiro: Imprensa Nacional, 1911); Martins, *História Naval Brasileira*, 25-29.

¹¹ Herick Marques Caminha, "Estrutura Administrativa da Marinha," in *História Naval Brasileira*, ed. Hélio Leôncio Martins (Rio de Janeiro: Serviço de Documentação Geral da Marinha, 1985), 35.

Alexandrino was Navy minister in three different governments. He imposed upon the Navy, and upon Guanabara Bay, his very own administrative style.¹² This meant that all and everything had to receive his "Do it" ("Cumpra-se") before execution. The entire Brazilian Navy was commanded from his third floor office at the Navy building near the Paço Imperial (the former Empire's government headquarters) in Rio de Janeiro. The ample windows of the admiral's office looked out over the landscape of Guanabara Bay. Thus the saying, "Mais vale um amigo no terceiro andar que dez anos de mar." ("A good friend in the third floor is worth more [for your career in the Navy] than ten years at sea").¹³ One of Alexandrino's pastimes was to point his eyeglass at the ships in the docks and check up on officers and sailors going about their routines. An ill-buttoned uniform or failure to salute the flag could lead to three days in Calabouço (Dungeon), or the Ilha das Cobras' jail. In his characteristic centralizing style, Alexandrino fought relentlessly to keep Guanabara Bay as Brazil's primary military port, despite several attempts to move it to Ilha Grande.¹⁴ Alexandrino's alternation in power left deep marks on the Navy. His administrations favored investment and modernization of Navy facilities in Guanabara Bay, while his predecessors and successors would rather have saved funds to build the

¹² Alexandrino was minister first from November 15, 1906, to November 15, 1910, during the Afonso Pena Presidency. When he took over, he was not only a rank-and-file admiral, but also a Senator for the state of Amazonas, and deeply involved in Brazilian politics. Then, another administration took over, and Alexandrino was sent to Europe officially to study new ship designs. As voices go, to take him off the way [*foi passear para não incomodar*]. He was again put on charge of the Navy from August 2, 1913 to November 15, 1919, by Presidents Hermes da Fonseca (until 1914) and Venceslau Brás (1914-1918). And he was again driven away in the following administration, and again brought to the Minister by the President Arthur Bernardes, on November 15, 1922. Alexandrino remained in the Minister until his death, on April 18, 1926. Adding all his time in office, he hold the office of Minister of the Navy for almost thirteen years, and promoted two broad administrative reforms in the Navy—never losing the iron grip that his centralizing personality demanded. Caminha, "Estrutura Administrativa da Marinha," 13.

¹³ Max Justo Guedes, Interview to Lise Fernanda Sedrez, May 24, 2002.

¹⁴ Caminha, "Estrutura Administrativa da Marinha," 35.

new military base in Ilha Grande.¹⁵ As soon as Alexandrine returned however, the blueprints were folded, filed, and forgotten.¹⁶

Historians traditionally describe the First Republic as a period of stability, in which the rich states of Minas Gerais and São Paulo alternated the presidency, thanks to rigged elections and a poorly disguised agreement among the elite. It is easy to forget that even within this quasi-harmonic State, there were bitter discordance and rivalry, as for instance between the Army and the Navy, or between one administration and its successors. The debate over transferring the military port from Rio de Janeiro to Ilha Grande illustrates some of these internal disputes. In a particularly bitter public report in 1919, former ministry Veiga Miranda complained repeatedly about a lack of continuity for long-term projects within the Brazilian State. According to Veiga Miranda,

the problem of our consecutive Presidents of the Republic was that they only consider their administration within their own four years, establishing disastrous issues of continuity for the life of the country. ... It happens often that if you leave your projects half-done, your successor will ignore them flatly, to give room to one's own projects.¹⁷

¹⁵ In fact, the Ilha Grande option was not dismissed until the 1930s. In both the administrations of Hermes da Fonseca (1910-1914) and Delfim Moreira (1918-1922), the Ilha Grande project was revived. In 1919, instead of Jacuacanga, the choice fell on the Ribeira inlet (also in Ilha Grande), which had the advantage of proximity to the Vale do Paraíba railroads. Two Navy ministries of the Delfim Moreira presidency, Gomes Pereira and Veiga Miranda, also claimed the military port in Ilha Grande as one of their main priorities Martins, *História Naval Brasileira*, 46, 196.

¹⁶ This tug-of-war may have continued after the death of Alexandrino in 1923, but the ministerial reports are silent about it. The 1920s however were a decade of unrest among the military, between the “tenentismo” and the rise of Getúlio Vargas in 1930. Other national questions took over the Navy’s agenda, and for better or worse, Guanabara Bay’s military port was firmly entrenched in the national defense chessboard.

¹⁷ Veiga Miranda, *Quatorze Meses*, 13. Veiga Miranda, a civil minister that held office at the Navy Ministry for fourteen months, reserved most of his shots to Alexandrino, at once former minister and his successor, suggesting that he was not only incompetent, but also undeserving of trust. According to Veiga Miranda, when the Revolta da Chibata broke, Alexandrino was on a ship to Europe, for an official commission. On the first day of the rebellion, President Hermes telegraphed to Alexandrino’s ship, seeking to confirm his presence onboard. The president suspected that the former minister, and not the sailor João Cândido, was the rebellion leader. It was a short-lived suspicion, continues Veiga Miranda, with no little malice: soon everybody realized that Alexandrino could not possibly be at the helm of the rebellion. The

Descontinuity, internal conflict and lack of long-term perspectives were a problem for the Brazilian state in its entirety, despite the apparent political stability of the First Republic. In this case, the inconsistency of the Navy policies resulted in a poor record of investments in Guanabara Bay, and overall fragility of the existent structures, such as the Port Captaincy (Capitania do Porto) of Rio de Janeiro. It was not a small price to pay, if considered that the Captaincies represented the Navy in most of its everyday dealings with municipalities, fishermen and other local users of Guanabara waters. Moreover, the fight over the location of the military illustrates the power of the symbolic aspects of Guanabara Bay within the Navy's high circles, as well as the type of centralized, top-bottom management that characterized the Navy.

Staking a Claim in Guanabara Bay: Beyond Defense

Defense duties were liberally interpreted by Navy ministries as implying a large range of activities. In the first decades of the Republic, the Navy concentrated on achieving three major tasks: to reorganize its own internal structure (thus the two administrative reforms by Minister Alexandrino, and one by Minister Calógeras); to modernize its facilities and fleet (thus the long discussion on a new military port and the ordering of new ships in 1910); and, to redefine its mission in Brazilian society, a mission that was to be as modern and progressive as the positivist Brazilian intelligentsia required.¹⁸ While Navy ministries could fight fiercely over whether the military port should be relocated, they were unanimous on the two major means to achieve this task: to foster civil navigation and to promote the fishing industry. What was not so clear

insurrects maneuvered too skillfully to have anything to do with the old admiral, who would once wreck his ship Belmonte on Guanabara Bay rocks. Veiga Miranda, *Quatorze Meses*, 33.

¹⁸ Martins, *História Naval Brasileira*, 26.

however were the obstacles to their planning. First, these noble goals only added to the burden of the already overtaxed system of Port Captaincies, the branch in the Navy most involved with non-defense duties. Second, the Navy's authority over regulating both civil navigation and fisheries in Guanabara Bay was not unchallenged.

The Navy sought to pursue these goals nationally at the cabinet level, and locally through the Port Captaincies, which were located in each important port of the country. The Captaincies were created in 1846 under the authority of the Navy Ministry, and they kept most of its tasks after the birth of the Republic.¹⁹ The port captain was basically a career military man with multiple tasks. He acted as a referee for any labor disputes at sea, including the Bay.²⁰ He monitored ship navigation and enforced Navy regulations; offered assistance in shipwrecks, and acted as police for embarkations and fishermen; and approved public or private works on the shorelines (deciding whether they did not interfere with navigation).²¹ Beyond their primary tasks of policing and maintaining the ports, or registering individuals employed in seafaring, Port Captaincies were also charged with monitoring ships, lighthouses, rivers, and navigable lagoons, river and port pilots, and, starting in 1903, the enrollment of personnel employed in fishing and the merchant

¹⁹ Luiz Geraldo Silva, *Os Pescadores na História do Brasil* (Recife, Brazil: Comissão Pastoral dos Pescadores, 1988), 91.

²⁰ The port captain was usually a Lieutenant-Colonel or a Colonel and had to serve for two years in a given captaincy. The Rio de Janeiro Port Captaincy was a coveted position for a young officer—most port captains from the Rio de Janeiro Captaincy reached the post of Admiral, and several became Navy Ministers. For a list of port captains, see Appendix C.

²¹ The Navy had veto power over constructions on “marine territories,” that is, any area that was located within 33 meter of the *linha de preamar* in 1831, if the port captain deemed such constructions to be a hindrance to navigation. The “marine territories” belonged to the Union, although the phrasing of the 1897 Constitution left some room for doubt. During the First Republic, the Navy often used this prerogative against small improvised piers, fish traps and other individual initiatives; it did not invoke the prerogative for any of the huge changes in the shoreline carried out by urban reformers in Rio de Janeiro city. One possible reason for it was that, during that period, the idea of transferring the military port to Ilha Grande was alive and well, and the Minister Júlio de Noronha could have wished to avoid conflicts with the Pereira Passos, as his reform was entirely supported by the Federal Government.

marine for the Navy's draft lottery. Although these new duties were defined in 1901, the personnel to fulfill these new duties were roughly the same as specified in the 1846 Naval Code.

The Port Captaincies had wide legal authority over Brazilian waters and seaworkers, but they were also highly inefficient due to their poor ability to enforce regulations. They held more duties than they could handle and kept a staff that was underpaid (sometimes unpaid), badly trained, and easily bribed. The Rio de Janeiro Port Captaincy was not different, despite its critical location.²² "There is not one among these tasks that the Port Captaincy can fulfill to satisfaction," despaired Minister Alexandrino. "Disheartening scenes take place every day in the Port Captaincy of Rio de Janeiro: important shipwrecks happen without help from the Port Captaincy for absolute lack of equipment or personnel."²³ Alexandrino's tendency to micromanage would certainly find such a scene troubling—after all, if the most important Captaincy in the country was so unprepared to perform, what could be said of its counterparts in less closely monitored states?

Frequent reformulation did not improve this situation. Not unlike the discontinuity that characterized the debate over the military port, every four years a new Navy minister developed a new plan to address these failures, just to see it thwarted from

²² According to an 1855 report, its lower staff was not trustworthy, took part in the abuses they were supposed to repress, had no stipends, and without supervision, did not perform even the then limited services for which the Captaincies were created. Silva, *Os Pescadores na História do Brasil*, 129. Little changed in the Republic. In 1898, thirty-three years after that first report, Minister Alves Barbosa repeated, "The foremen at the Port Captaincy are unpaid, and whenever the tasks are not in their interest, they either do not comply immediately or quit. Or they take bribes." Manoel José Alves Barbosa, *Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil* (Rio de Janeiro: Imprensa Nacional, 1898), 67.

²³ Alexandrino Faria de Alencar, *Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil* (Rio de Janeiro: Imprensa Nacional, 1907), 52.

lack of funding, or abandoned by the next minister.²⁴ To be fair, the Capitánias' failure to perform as requested did not rest solely on the shoulders of an incompetent staff, as there was ample confusion regarding their mission. For instance, customs officers had the same roles that had been defined as exclusive to the Captaincies, such as deciding on the docking and direction of commercial ships, as well as the power to enforce these decisions. Moreover, the Captaincies were supposed to observe and enforce articles of the Commercial Code, the Customs Code, the Tax Division, municipal laws, and the Ministry of Industry's regulations, as well as the Navy's, all of which lacked general coherence, and were often contradicting.²⁵

The disappointment toward the Rio de Janeiro Port Captaincy must be taken with a grain of salt. Were it as ineffectual as the Ministerial reports moaned, there would have been no need to bribe Navy officials to evade enforcement. Furthermore, there are records of successful operations against unregistered fishing ships, rogue merchant companies or unlawful fish traps. The same Alexandrino who complained the Captaincy fell short of doing its duty also stated "hundreds of people visit the Port Captaincy daily to deal with their business."²⁶ Failure to a certain degree was not so much a measure of the incapacity of the Port Captaincy at Guanabara Bay, but of the diversity of its expected duties. The Captaincy played a crucial part in fulfilling the non-defense roles claimed by the Navy, and as these roles expanded, so did the burden on the Captaincy.

²⁴ In 1910, one of these reforms transferred some of the Port Captaincy's responsibilities, including port management, from the Navy to the Ministry of Agriculture, Trade and Public Works, but the port captain was still in charge of enforcement. As a result, the Captaincies found themselves under the jurisdiction of both the Ministry of Public Works and the Ministry of Navy. Caminha, "Estrutura Administrativa da Marinha," 25.

²⁵ Silva, *Os Pescadores na História do Brasil*, 133.

²⁶ Alexandrino Faria de Alencar, *Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil* (Rio de Janeiro: Imprensa Nacional, 1908), 110.

These non-defense roles often set the Navy against other users of Guanabara Bay. Conflicts between the Navy and the municipalities around the Bay were numerous, and mostly arose because the duties of the Port Captaincy and municipal offices were confusing and often overlapped. In his 1907 report, Minister Alexandrino wrote,

We ask the attention of the legislative power to the old and unsolved issue of the undue intervention of the state and municipal authorities in federal dominion and jurisdiction, be it the marines lands, the sea ports, the navigation, police and monitoring domestic and fluvial, being necessary to limit the power and duties of these authorities. [The Port Captaincy of Rio de Janeiro had, within its district jurisdiction] five municipalities which legislate to their discretion regarding fishing, including open sea fishing, with no consideration whatsoever to where, in the sea, ends their jurisdiction and begins the Navy's.²⁷

This confusion exacerbated with the Republic, when in 1889, the Fluminense state and municipalities made every effort to claim larger jurisdictions, advancing onto traditional Navy prerogatives. Alleging that the laws of the young Republic gave more latitude to the states, Fluminense president Nilo Peçanha fought (and lost) in the courts for the right to exploit monazite sands, which were officially in federal territory under Navy jurisdiction (albeit Fluminense soil).²⁸ The Navy complained about the difficulties of dialogue with the municipalities when the duties between each were not clear. "It is possible to discuss and collaborate with the ministry of transportation and public works, as the duties are well defined," wrote Minister Barbosa in 1897. "With the municipalities,

²⁷ Alencar, *Relatório 1907*, 50.

²⁸ Peçanha, *Mensagem Apresentada a Assembléa Legislativa*, 36.

however, they claim ‘occupation for use’ over the marine lands (coastal zones), whenever the Navy did not regulate them.”²⁹

(a) Preserving national resources: Fishermen and fisheries

The Navy’s primary interest in civil navigation and fisheries were often contentious issues with the municipalities. In the first case, the municipalities hoped to increase their income by assessing heavy taxes on ships navigating within Guanabara Bay, which was seen by the Navy as contrary to national interests.³⁰ For fisheries, a common dispute was that municipalities wanted more and more reclaimed land, which threatened fish reproduction sites. But for the most part, conflicts between the Navy and municipalities focused on fishermen and fishing techniques, and this was yet another instance where the Port Captaincy of Rio de Janeiro was at the center of the dispute. For the municipalities, fishermen were potential sources of income, either by bringing fish to the markets or by paying taxes. The Navy argued fishermen were a vital resource for the country’s defense because of their first-hand knowledge of the coast, material resources

²⁹ Manoel José Alves Barbosa, *Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil* (Rio de Janeiro: Imprensa Nacional, 1897), 54.

³⁰ The Navy saw as its duty to encourage navigation within the bay, while the municipalities’ taxes hampered it. In 1902, Navy minister José Luz complained the municipalities charged a discretionary fee to all naval industries, pushing their extinction and blocking navigation within the ports. “It is necessary”, said the minister, “to protect the civil merchant marine in Rio de Janeiro.” Municipal fees were a considerable burden on cargo ship operators. Furthermore, ships could docking at any of the six municipalities in the bay of Rio de Janeiro had to present licenses issued by all or each of them. These license fees were charged in addition to the license issued by the port captaincy, which legally should have allowed any ship to navigate within the entire bay. For example, a 10-ton ship with regular trade, transporting produce or grain from small farm, would need 307\$500 (US\$72.23) per year to navigate freely within all ports of the bay. “A tugboat,” continues the Minister, “paying 453\$000 [per year, a total of US\$106.41] has a higher tax burden under the Rio de Janeiro municipality just to navigate in the port, than the largest ship of the Lloyd Brasileiro which, by paying to the Port Captaincy the amount of 309\$000 [US\$72.58] for two semester enrollments, may travel to all and everywhere, within or outside the republic.” J. Pinto Luz, “Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil,” (Rio de Janeiro: Imprensa Nacional, 1902), 26.

(fishing ships), and professional training. Fishermen needed to be channeled into the national structure, organized, and taught modern fishing techniques.

Both fisheries (or natural resources) and fishermen were seen as national resources, and the Navy therefore had a duty to protect them. In Guanabara Bay, one of the Navy-sponsored projects to improve fisheries in Brazilian waters was the short-lived Station of Marine Biology in the Urca beach, built under the coordination of the Instituto Oswaldo Cruz in 1916. The Station's goal was to study the introduction of exotic species of commercial fishes into the waters of Guanabara, and the Navy could not but applaud the initiative.³¹ Concurrently, after World War I, Navy Ministries were enthusiastic about the potential role fishermen could play in defense. The European war demonstrated how small vessels could tilt the fortune of war by hunting submarines, setting up and disarming mines, and providing overall monitoring of the coast. "Supporting the fish industry," wrote Minister Gomes Pereira, "will at once promote a crucial economic factor as well as it will stimulate the formation of material and human resources that could be used in the defense of the country."³² Fishermen were de facto potential sailors for the Navy, and not only in times of war, as Gomes Pereira suggested. Since 1897, the Navy used three methods to fill its ranks: voluntary personnel, a school for naval cadets, and the lottery draft among fishermen and merchant marine personnel enrolled with the Port Captancy, used whenever vacancies in the Navy required it.³³ The municipalities regularly protested against drafting, as it could harm their markets and naval industry.

³¹ J. Gomes de Faria and Aristides Marques da Cunha, "Estudos Sobre o Microplancton da Baía do Rio de Janeiro e suas Imediações," *Memórias do Instituto Oswaldo Cruz* IX, no. 1 (1917): 69. See also Chapter 4.

³² Antonio Coutinho Gomes Pereira, *Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil* (Rio de Janeiro: Imprensa Nacional, 1919), 40.

³³ Alencar, *Relatório 1907*, 56.

The Navy regularly rebuked their protests. “As long as the Legislature does not revoke this authorization [for lottery draft],” Admiral Alexandrino de Alencar answered to the Mayor of Iguaçu, in one of their numerous debates on fishermen, “I will deem within my authority to act accordingly, although I am willing to conciliate the interests of the municipalities with those of the Union.”³⁴ It was clear to both the mayor and minister that the dispute over jurisdiction of the bay was also a dispute over labor and over Guanabara’s fishermen.

Professional fishermen, although required to register by law, had a major incentive not to enroll at the Port Captaincy to avoid the draft lottery altogether. As a result, despite the importance of fish as a basic staple in the lives of Carioca and Fluminense citizens, the fishing population in Guanabara Bay during the nineteenth or early twentieth century is still unknown.³⁵ Census data, even when subdivided by profession, was not reliable until 1920.³⁶ Families living around the Bay would complement their income and diet with fish, shellfish and crab from the Bay, and yet they were not considered fishermen, either by the census purposes or the Navy.

³⁴ Answer to Mayor of Iguaçu, regarding n. 857 on the art.9 decree n.478 on 12/9/1897, in Alexandrino Faria de Alencar, *Annexo ao Relatório Apresentado ao Presidente da República dos Estados Unidos do Brasil* (Rio de Janeiro: Imprensa Nacional, 1907), 77.

³⁵ Although a reliable number for the number of fishermen is unavailable, the ministerial reports provide data that can do as proxies, if used carefully. For instance, the 1907 ministerial report stated that the Rio de Janeiro port captaincy destroyed over 500 unlawful fish traps, mostly inside Guanabara Bay, and that the captaincy registered 2,241 small vessels, 156 steam boats, 216 sport boats and 3,246 fishing boats. Assuming conservatively that most of these were small fishing boats, with crews between 3 to 4 fishermen, and admitting that at least 20% of the fishermen, particularly those building the fish corrals—did not register at the port captaincy, those number suggest that at least 13,000 people-plus their families—were engaged in fishing by 1907. Caveats do apply: the port captaincy enrolled people from a large part of the State of Rio de Janeiro, including Sepetiba Bay, and Ilha Grande, although Guanabara Bay was by far more populated; this estimate obviously ignores all the population that fished without boats, on the rich mangroves and coves of Guanabara; and possibly does not take into account fish industries, particularly sardines, that employed their own fishermen and used much larger boats. Alencar, *Relatório 1908*, 66.

³⁶ Not even Favilla Nunes, coordinator of the 1892 census for Rio de Janeiro state, trusted his own final numbers. Nunes, *Recenseamento do Estado do Rio de Janeiro*, 20. Moreover, in the census reports, professions were not separated by municipalities and fishermen from Campos (North of Rio de Janeiro state) could be easily included in any estimate for Guanabara.

Resisting enrollment for fear of being drafted, and not accurately counted in the census, fishermen and their families lived in Guanabara relatively outside the reach of the state. Particularly when residing beyond the immediate limites of the federal capital, in the back of the bay, they could easily set their (illegal) fishing traps, mostly undisturbed by the Port Captaincy.³⁷ Without even knowing how many fishermen worked in the Bay, the Navy was unable to enforce its rulings, even if it could win the dispute over jurisdiction with the Municipalities. “Roughly 6,000 individuals or 200 ships have no advice or interference of any kind from the authorities of the bay,” wrote Alexandrino in 1907.³⁸

The resilience of fish traps serves as an example of the limitations of the Navy’s authority within Guanabara Bay. Fish traps or fish corrals (*currais de peixe*), an old fishing technique, was seen as wasteful, damaging, and anachronistic, only practiced by ignorant fishermen (see Fig. 11). According to the Navy’s experts, the “corrals” increased siltation in rivers, coves and canals in the Guanabara. Without an outlet, waters would spill over the shore lands, “damaging, wasting, and making them insalubrious and disastrous—transforming Brazil, more and more, into a huge hospital,” wrote Rio de Janeiro’s fishing inspector of in 1913.³⁹ The corrals caused “noticeable modifications in the sea bottom [to the port of this capital],” and were “as damaging as the landfills (...)

³⁷ Lysia Maria Cavalcanti Bernardes, “Pescadores da Ponta do Caju - Aspectos da Contribuição de Portugueses e Espanhóis para o Desenvolvimento da Pesca na Guanabara,” *Revista Brasileira de Geografia* 20, no. 2 (1958): 55.

³⁸ Alencar, *Relatório 1907*, 56.

³⁹ Frederico Villar, *A Missão do Cruzador José Bonifácio - Os Pescadores na Defesa Nacional: A Nacionalização da Pesca e a Organização dos seus Serviços (1919-1923)*, ed. V. Benício da Silva, Biblioteca Militar (Rio de Janeiro: Gráfica Laemmert, 1945), 106.

[bringing] great harm for the conservation of the coast and the public health.”⁴⁰ To the Navy’s horror, one disaster followed another: the solution proposed by the municipalities for these damaged lagoons and inlets was not the education of the fishermen or the enforcement of the law against corrals, but new embankments.



Fig. 11 - Fish corral, Guanabara Bay, 2000. Photograph by Pepe Schettino, in Bia Hetzel, *Baía da Guanabara* (Rio de Janeiro: Manati, 2000), 192.

The Rio de Janeiro Port Captaincy was even unsure whether fish corrals, when far from the main ports, and illegal as they might be, were within its jurisdiction. As there was no other agency that could enforce such laws near or far from the Rio de Janeiro Port, the Captaincy’s lax enforcement meant that in the political map of Guanabara Bay,

⁴⁰ Alencar, *Relatório 1907*, 55. Corrals had been under scrutiny by the federal government since 1861, when a series of restrictions were placed on this particular fishing technique—but to little avail. Every Minister complained of the danger they represented to navigation. Barbosa, *Relatório 1897*. Outlawed since 1888, the fish traps were simply moved to less visible areas, such as the back of the bay. Eventually, they survived well into late twentieth century.

what was illegal here, was tolerated there. To add insult to injury, at the same time the Navy destroyed 100 to 500 fish corrals per year, municipalities sold licenses to the fishermen who wanted to build them.⁴¹

The creation of fishermen colonies in the 1920 resulted from the Navy's efforts to reach out to and regulate this evasive population. Fishermen colonies were established as a legal entity by Captain Frederico Villar, in a famous mission aboard the Cruiser José Bonifácio, when he visited fishermen communities from North to South of Brazil. Villar, a veteran from the Rebellion of the Fleet, founded over 800 colonies and almost 200 elementary schools. Colonies so established could count on training for the adults and education for the children.⁴² Membership in the fishermen colonies was then carefully controlled and every male enrolled.⁴³ However, the system was far from inclusive at any time. The official fishermen colonies in Guanabara Bay, founded by Villar in 1923, were located in Copacabana (ocean beach), Jurujuba (Niterói), and Caju (near the port of Rio de Janeiro). Many other smaller fishing communities surrounded the Bay without legal acknowledgement, or the subsidies and aid that followed such acknowledgement.

The creation of the fishermen colonies was also one of the last attempts by the Navy to regulate and promote modern fishing. The project was at once nationalist and modernizing. Within the larger spectrum of nationalizing the fisheries, the campaign promoted by Captain Frederico Villar stated that only Brazilians, naturalized or native,

⁴¹ Silva, *Os Pescadores na História do Brasil*, 109.

⁴² The concept of fishermen colonies fit very well with the corporative mentality of the Getúlio Vargas administration fifteen years later, and these colonies were incorporated in new labor legislation.

⁴³ At as late as 2002, scholars cannot agree on a figure for independent fishermen in Guanabara: sociologist David Zee estimates that over 18,000 fishermen work in the Bay, while a COPPE/UFRJ study sets a figure around 5,000. Silvio Jablonsky, "Monitoramento da Atividade Pesqueira na Baía da Guanabara como Subsídio para a Avaliação de Impactos Ambientais e a Gestão da Pesca - Relatório Preliminar," (Rio de Janeiro: IBAMA/ Fundação de Estudos do Mar, 2001); Zee, "Baía da Guanabara," 15.

could participate in the profession.⁴⁴ If fisheries were assumed as the first line in the defense of the large Brazilian littoral, as Minister Gomes Pereira stated, it followed that only Brazilians, not foreigners with split loyalties, had an inherent right to these national resources. The main goal was efficiency and modernization of fisheries.⁴⁵ For Villar, it was a national scandal that Brazil had to import fish in the early twentieth century, especially when the country had a huge littoral and an extensive network of interior waters.⁴⁶ Although his report focused on the creation of fishermen colonies in more remote areas of the Republic, he often referred to Guanabara Bay as an example that modern fisheries planning should avoid. For Villar—and his voice resonated through the Navy—Guanabara Bay was an example of the country's disregard for national marine resources. Wasteful fishing techniques, ignorant fishermen, and the arrogance of the municipalities were the enemies to fight. Land reclamation, either irregular or proposed by the municipality, was part of this destruction:

We ruin our water resources with the most damaging process: with dynamite, with poison, with tight fishing nets; we allow for minuscule alevines to be freely sold in the markets. There is an actual massacre of turtles. The lagoons and bays, precious nurseries and havens for reproduction, unlimited mines of our fishing abundance, are destroyed by the municipalities which litter them indiscriminately. The same is true even for the

⁴⁴ The insistence on the naturalization of foreign fishermen had already caused a small diplomatic incident in 1909. Most of the fishermen in the Caju were Spanish or Portuguese and showed little interest in acquiring Brazilian citizenship. Presented with the dilemma of either naturalization or being prevented from professionally fishing, they protested loudly, supported by the Carioca journalist Luiz Edmundo. Those who thus chose were repatriated, all expenses paid by the Brazilian Government. According to Frederico Villar, most of them returned to their jobs six months later, “after visiting friends and family in Portugal.” The Brazilian Government, weakened by the previous public row, just ignored the situation. Villar, *A Missão do Cruzador José Bonifácio*, 19.

⁴⁵ Born and raised in Rio de Janeiro, Villar was strongly influenced by positivism, as evident in his report of the campaign. “Fatherland and Duty,” the motto aboard the Cruiser José Bonifácio, was as seriously observed as “Order and Progress.”

⁴⁶ Sérgio Cardoso de Moraes, *Colônias de Pescadores e a Luta pela Cidadania* [webpage] (DFE/ UFPA, 2001 [cited March 23, 2004]); available from <http://sindicalismo.pessoal.bridge.com.br/SergioCarSbs2001.rtf>.

Guanabara, that is being invaded by landfills in the Capital and in Niterói, and will end up definitively buried in waste.⁴⁷

If Machado de Assis ironically proposed Guanabara Bay to be filled in, creating a glorious metropolis from Niterói to Rio de Janeiro, Villar feared that this was a real possibility, and litter, rather than real estate, would cover the bay from shore to shore.⁴⁸ Although Villar's expedition went far beyond the limits of Guanabara Bay, his concerns regarding landfills and littering echoed heavily in the activities of the Navy regarding Guanabara Bay. Returning from the Cruiser José Bonifácio expedition, Villar was put in charge of the connection between the fishermen colonies of Rio de Janeiro state and Federal District and the Navy. He was also the inspector of Fisheries and Coastal Sanitation, as health and education were just two aspects of the same modernization project. Villar fought for the nationalization of the fish industry and for support to the fishermen colonies until his death in 1965. He represented the Navy in the Game and Fish Division from 1934 to 1938, and though he protested ardently against the transference of fishing from the Navy to the Minister of Agriculture's jurisdiction, he lost that fight. The Navy that emerged from the Vargas administration lost much of its control over the fishing colonies, although the Port Captaincies still required enrollment. Regardless of such changes, Villar rose to the stature of hero among fishermen, and his reports were the

⁴⁷ Villar, *A Missão do Cruzador José Bonifácio*, 22. Actual data corroborating Villar's accusation were not found. Other than sporadic newspaper articles pointing to the shortage of fish in urban markets, until 1950s there were few complaints of declining fisheries within Guanabara Bay. The sardine industry had instead become more important on the Fluminense shore of bay. Fish catch increased with the industrialization of the activity, which compensated potential fish declines with new techniques and off-bay fishing. See Chapter 5 for a discussion on the relative importance of non-industrial fishing in Guanabara Bay, and the impact of pollution in fisheries.

⁴⁸ Joaquim Maria Machado de Assis, "A Semana - 20 de Agosto de 1893," in *Obra Completa*, ed. Afrânio Coutinho (Rio de Janeiro: Editora José Aguilar, 1962). For a more complete reference to the chronicle, see Chapter 2 of this dissertation.

first systematic denunciation of the impact of landfills and engineering projects on the environment of Guanabara Bay.

Oil, Water and Diplomacy

The First Vargas Era changed the Navy's relationship with Guanabara, one of the many aspects of its long-lasting impact on the Brazilian state. To begin, the lottery draft was deactivated in 1933—fishermen and non-military sailors no longer were pressed into naval service.⁴⁹ In the following year, Vargas' Fishing and Game Code put fishing regulations under the jurisdiction of the Ministry of Agriculture and civil navigation under the Ministry of Transportation and Public Works. The strong and centralizing state fostered by the Vargas administration discouraged legal disputes by municipalities or states against branches of the Federal Government such as the Navy. Additionally, Brazil's participation in the World War II in support of the Allies put a heavy burden on the Navy resources, with little room left for internal disputes or long-term projects. The Ministerial reports of 1940s and 1950s reveal a Navy overstretched, allowing only incremental reforms in its domestic facilities, while investing heavily in national defense. The Navy was still responsible for navigation, naval justice and regulation, mainly through the Port Captaincies and still is to this date. But the 1940s and 1950s were a period when Rio de Janeiro and Guanabara Bay lost much of its primacy for the Navy. Besides ordinary reports of the activities at the Rio de Janeiro Port Captaincy, and the usual maintenance work at the military port and arsenal in Guanabara Bay, the Bay is

⁴⁹ Despite the end of the lottery draft, sailors and fishermen were still considered part of a national defense strategy until at least the end of the World War II. The relatives of a crew in a ship sunk by German submarines, during the second war, were still awarded veteran benefits by law. Naval historian Max Guedes also argued that changes in naval technology changed the needs of the Navy: fishermen, with their hands-on, empirical and traditional knowledge, were no longer good enough. The Navy needed trained sailors and it was ready to invest on them. Guedes, interview.

rather absent from ministerial reports, in stark contrast with the previous period.⁵⁰

Absence of data, of course, does not prove that change was not taking place—but it does imply that the focus of the Navy was elsewhere.

However, in 1954 a new role opened up to the Navy: diplomatic representative of Brazil during treaty negotiations on sea pollution. The first convention on international sea pollution was drafted in 1926, although it was not open for signature. In 1954 the problem had become serious enough that England hosted the London Convention for Prevention of Pollution of the Sea by Oil. Brazil was represented in this conference not by a diplomat, but by Navy officer Captain de Sá.⁵¹ The conference was little more than symbolic. It simply recognized that “states enjoyed substantial freedom to pollute the oceans, moderated only by the rights of others”—a position that was ratified by the 1958 High Seas Convention.⁵² The Brazilian delegation was in perfect agreement, and de Sá reported back that it was in Brazilian interest if little was approved in such conferences, as coastal oil pollution was not a major problem for the country. Other than a couple of highly trafficked ports, wrote de Sá, most of the Brazilian coast was sorely underused, and the establishment of expensive anti-pollution facilities could unnecessarily hurt its incipient naval industry.⁵³ One of the two “highly trafficked ports” mentioned by Captain de Sá was Guanabara Bay. Just four years later, biologist Lejeune de Oliveira would

⁵⁰ See Navy Ministerial Reports from 1945 to 1952. James Simon, *Marinha* [website] (May 19 2004 [cited June 12, 2004]); available from <http://brazil.crl.edu/bsd/bsd/hartness/marinha.html>.

⁵¹ Sá claimed in the Conference that “the solution for pollution of sea [is] in the instruction of shipmasters and seamen,” in some senses repeating Villar in his educational mission. Secretary, “Final Act,” (London: Convention for Prevention of Pollution of the Sea by Oil, 1954), annex 3.

⁵² Alan Boyle and Patricia Birnie, *International Law & the Environment*, Second ed. (Oxford: Oxford University Press, 2002), 351.

⁵³ Carlos Paraguassú Sá, letter to Navy Chief of Staff, Rio de Janeiro, September 14, 1954. Departamento de Hidrografia e Navegação.

publish his first striking article on the impact of pollution in the Guanabara Bay ecosystem.⁵⁴

Brazil's participation in the 1954 Conference on Sea Pollution was perfectly in tune with its general policy of obstructionism on environmental issues and active defense of sovereignty in coastal waters that characterized Brazilian diplomacy in the following decades.⁵⁵ Within the international arena, the Navy embraced this recalcitrant position as a symbol of nationalism—even well after the United Nation Conference in Stockholm in 1972. In 1973, for instance, the Brazilian representatives at the first session of the Global Investigation of Pollution in the Marine Environment (GIPME) wrote in their report that representatives of the industrialized countries were “almost hysterical about sea pollution” and the idea of combating pollution:

is one of the several excuses/pretexts used by developed countries to do research within coastal seas that belong to developing countries, in order to get to know their potential and conveniently exploit them in their benefit, with loss for the main interested, since the technological gap (...) prevents these countries to take part efficiently in so-called cooperation programs with developing countries. [The position of Brazilian representatives in these meetings was characterized by the] intransigent defense of the sovereignty and interests of the coastal States.⁵⁶

In an attachment to the same report, a fellow officer concurred:

⁵⁴ Lejeune Pacheco Henrique de Oliveira, "Relatório Anual 1958 - Atividades, Programas e Ocorrências da Estação de Hidrobiologia do Instituto Oswaldo Cruz" (Report, Rio de Janeiro, 1958).

⁵⁵ In the United Nations Conference for Human Environment, the Brazilian position became famous when its delegate claimed that the worse sort of pollution was poverty, and that the only solution for it was more economic development. For an analyses of Brazilian foreign policy regarding the environment, see Roberto Pereira Guimarães, "The Ecopolitics of Development in the Third World," (Boulder, CO: L. Rienner, 1991), 24-43; José Lutzemberger, "Environment and Development: A View from Brazil," in *Environment and Diplomacy in the Americas*, ed. Heraldo Muñoz (Boulder, CO: L. Rienner, 1992).

⁵⁶ Luiz Fernando da Silva Souza and Ialdo Carvalho dos Santos, letter to Division of Hydrography and Navigation Department of Geophysics, Rio de Janeiro, April 26, 1973. "Confidential."

I suggest that the main guidelines for the Brazilian position ought to be to prevent the approval of resolutions that could impact countries' domestic affairs, more specifically: international monitoring within national territory; autonomy of research of foreign and international institutions; programs connected to sea pollution that imply the use of the scarce national resources.⁵⁷

Two years later, Admiral Rezende Rocha wrote to the Navy Chief of Staff that most meetings at UNESCO's International Oceanographic Commission had "been characterized by the tendency that, under the cover of studies and defense against sea pollution, from the great powers to obtain permissions for sea research, with the least of restrictions."⁵⁸ Rocha proposed preempting foreign initiatives that sought to analyze pollution indicators in Brazil by publicizing domestic initiatives in this direction. One of these potential initiatives was the studies on contamination levels observed in living resources and the presence of heavy metals and oil derivatives carried out by the Oceanographic Institute at Universidade de São Paulo and the National Institute of Space Research, also in São Paulo. Both these institutions offered enough scientific credibility for the position Rocha proposed Brazil should take with the International Commission. Rocha's communication traveled all the way up the chain of command to Navy Minister Geraldo Azevedo Renning, who basically repeated Rocha's words in his own dispatch. Renning indeed worried that "national interests close to the continental border [might be] violated under the pretense of defense against sea pollution by the developed maritime

⁵⁷ Orlando Augusto Amaral Affonso, in Souza and Santos, letter., attachment B – "Confidential."

⁵⁸ Álvaro de Rezende Rocha, letter to Navy Chief of Staff, "First Dispatch N. 0073." Rio de Janeiro, May 9, 1975. Departamento de Hidrografia e Navegação.

states – which are constitutive members of the GIPME (Global Investigation of Pollution in the Marine Environment).”⁵⁹

Neither Renning nor Rocha needed to use the Oceanographic Institute in São Paulo or the National Institute of Space Research if they wanted to provide pollutions studies. In fact, they could have looked within the Navy itself. At about the same time that Captain de Sá represented Brazil in the 1954 conference, the Navy’s journal “*Anais Hidrográficos*” published the first articles by Captain Paulo Moreira da Silva on pollution in Guanabara Bay. As Captain Souza and Captain Santos complained about the “almost-hysterical-about-pollution” rhetoric at international meetings, Captain Hilton Berutti Moreira, at the Department of Coasts and Ports in Rio de Janeiro, invested heavily in bringing together biologists, sanitary engineers, and businessmen to fight pollution in Guanabara Bay.

From the cabinet level down to the Rio de Janeiro Port Captaincy, water pollution control thus entered the Navy’s agenda without much debate on whether it belonged there or not. If it was in national waters, the Navy had a duty to protect it. What is ironic is that different agencies within the Navy had very different understanding of what this “duty” meant. The ambiguity of the navy’s position—one side the diplomatic body deflected efforts by international institutions to control pollution, and on the other side, technical staff mobilizing human and political resources to do exactly this—sprung from a similar logic: if anyone was to protect Brazil’s maritime resources, it must be the Brazilian Navy. At the end, what tilted branches to one side was the interest of individuals within the

⁵⁹ Geraldo Azevedo Renning, letter to Chief of the Estado Maior da Armada Guater de Magalhães, “H50-11-15 - Second Dispatch N. 0236.” Rio de Janeiro, RJ, May 14, 1975. Departamento de Hidrografia e Navegação.

Navy, as in the case of offices such as Captain Hilton Berutti or Captain Paulo Moreira da Silva.

(b) Pioneers in Pollution Control: within the Navy, beyond the Navy

The Department of Hydrographic and Navigation, located since 1914 in the Ilha Fiscal of Guanabara Bay, was a type of research center within the Navy. The department was responsible for publishing navigation charts, annual updates to these charts, signalization, the journal *Anais Hidrográficos* (Hydrographic Annals), and since the 1950s, oceanographic research reports.⁶⁰ As in the cases of creating fishermen colonies or the permanence of the military port in Guanabara Bay, the Navy's renewed interest for oceanography owes much to the agency of one of its officers, Vice-Admiral Paulo Moreira da Silva. Moreira da Silva connected with Frederico Villar in that both were passionate about hydrobiology, and they met frequently at the Brazilian Oceanographic Institute.⁶¹

If Villar's envisioned mission for the Navy was one of education and sanitation, as a scientist Moreira da Silva hoped to see the Navy at the cutting edge of marine science research. Moreira da Silva had an uncanny talent to connect with many different institutions.⁶² He chaired the Navy Research Institute, which was created on his initiative,

⁶⁰ Oceanography in Brazil began in the 1940s when the French researcher Wladimir Besnard was invited with other French scholars to establish the basis for the Universidade de São Paulo. After the Oceanographic Institute of São Paulo, the Department of Hydrographic and Navigation at Ilha Fiscal was the first to do oceanographic research.

⁶¹ Villar founded the Institute in 1943, together with other Navy officers. Its goal was to coordinate efforts of the several scientific institutions, such as the Fisheries Research Department at Ministry of Agriculture, the Instituto Paulista de Oceanografia, the Faculdade Nacional de Filosofia and the Hydrobiology Station at Pinheiros Island. Despite its best hopes, the institute did not fare for long, and it interrupted its irregular meetings in 1952. See Chapter 2, and Lejeune Pacheco Henrique de Oliveira, "Histórico da Biologia Marinha" (Typed notes, Viña del Mar, Chile, 1949).

⁶² Moreira da Silva served with the American Navy during the World War II, as a liaison to the Brazilian forces. He paid for his own studies on oceanography in France and Wales, obtained funds from UNESCO

as well as his own Sea Studies Foundation in the north of the Rio de Janeiro state.⁶³ In the Department of Hydrographic and Navigation's archives, there is surprisingly little information about Captain Moreira da Silva's activities in Guanabara Bay in the 1950s and 1960s. The silence in the Navy archives stands in stark contrast to his ubiquitous presence as the Navy representative for any and every forum on pollution in Guanabara Bay. For example, biologist Lejeune de Oliveira's reports in 1958 point to a collaboration between the Navy and the Instituto Oswaldo Cruz, orchestrated by Moreira da Silva, that provided ships and funded personnel for biological research in the Hydrobiology Station at Ilha dos Pinheiros, documenting pollution indicators in Guanabara Bay.⁶⁴ Moreira da Silva also helped organized the Institute of Sanitary Engineering in Guanabara State, together with health scientist (sanitarista) Fausto Guimarães, and Moreira da Silva was definitively involved with installing the submarine outfall in Guanabara Bay in the early 1960s. In 1961, a round-table promoted by Petrobrás again brought together Guimarães and Moreira da Silva, as well as Lejeune de Oliveira and others, to discuss current and future oil pollution in the Bay.⁶⁵ Paulo Moreira was also cited as oceanographic expert by the Ministry of Public Works' 1962 Working Group on pollution in Guanabara Bay.⁶⁶

to turn an old training ship for Navy cadets into a well-equipped oceanographic vessel, taught at the University of California, and created the Navy's department of Geophysics and meteorology. He represented Brazil at the Food and Agriculture Organization, UNESCO, and in the fisheries disputes with France—the 1962 Lobster War, when the Brazilian Navy captured French Guyana fishing boats poaching lobster on the Brazilian continental platform. Since France did not recognize the Brazilian rights to the resource, the French president de Gaulle send his own Navy to protect the fishing boats, and the diplomatic incident dragged for much of 1962. Urban legend goes that in this occasion de Gaulle declared that “Brazil was not a serious country.” Fitting as it seems with the French general's character, the myth was debunked long ago.

⁶³ Newton Righi Vieira, *Vice Almirante Paulo de Castro Moreira da Silva* [webpage] (Turma Cruzeiro do Sul / ESG-1997, 1999 [cited July 20, 2002]); available from <http://www.geocities.com/turmaesg1997/patrono.htm>.

⁶⁴ Oliveira, "Relatório Anual 1958". See also Chapter 4.

⁶⁵ In this occasion, Captain Moreira da Silva made a long presentation of his plan to prevent pollution in Guanabara Bay, supposedly by creating an agency in which residents, fishermen, industrials, government

As late as 1969, when Moreira da Silva was already at the helm of the Navy Research Institute, he was still interested in pollution in Guanabara Bay. In July 1969, a NASA airplane flew over the Guanabara Bay region, together with Brazil's National Commission for Space Activities, taking pictures with remote sensing to study marine pollution in the bay. Moreira da Silva obtained a license from NASA to use these pictures and employed ships from the Navy Research Institute to collect biological samples from critical areas. This time, his initiative caused some jealousy, or perhaps his star was declining in the Navy. Since 1967, oceanographic research in Guanabara Bay had been carried out exclusively by the Division of Hydrographic and Navigation. Because it had overstepped its boundaries, Moreira da Silva's institute was officially warned by the Minister to "avoid duplication of efforts."⁶⁷

Moreira da Silva's record confirms the relevance of individual initiatives to develop a network of agencies that would eventually manage environmental issues in Guanabara Bay. Even when the Navy was not directly interested in pollution, it offered an institutional base for its officers to articulate and pursue the issue. Moreira da Silva had a somewhat odd career for a naval officer. His personal prestige was greater outside the Navy than among his fellow officers. His maverick character not only probably marginalized him among the rank and file, it may have also spurred him to establish

officers and scientists could participate. The project was lost, but I found references to it in A. C. Barbosa Teixeira, "Poluição da Baía de Guanabara e Áreas Circunvizinhas -Relatório da Mesa Redonda de Poluição, Realizada em 15-6-61," *Boletim Técnico da Petrobrás* 7, no. 4 (1964): 503.

⁶⁶ Secades, "Relatório do Grupo de Trabalho," 34. See also Chapter 5.

⁶⁷ Augusto Gurnewald, "Off. 45, N. 799" (Memorandum, Rio de Janeiro, November 6 1970). The episode seems to confirm that Moreira da Silva was somehow of a maverick officer within the Navy. His admirers said that he was shamefully neglected by the Navy out of jealousy for his brilliance. In this version, he only received the patent of Vice-Admiral at the time of his retirement, after scientists and former collaborators in Brasil and abroad protested a promotion long overdue. Detractors said that his love for self-promotion and politics caused friction with rank-and-file officers, and that he paid little heed to boundaries and courtesies that are the basic in military life.

larger and more complex networks with similar-minded technical scientists in other institutions.

Either independent of Moreira da Silva's activities, or perhaps partially due to his high profile, it was more or less agreed in the 1960s that sea pollution was within the Navy's responsibilities. When in 1963 Rio de Janeiro Senator Vasconcellos Torres wanted action from the federal government regarding pollution in Guanabara Bay, he sent an inquiry to the Ministries of Public Works, Health... and to the Navy.⁶⁸ The Navy Ministry was the only one to answer the senator in detail. In 1969, the president of the Brazilian Foundation for Nature Conservancy, Wanderbilt Duarte de Barros, complained to the Navy Minister about source point pollution in the Jequiá river basin. Barros advocated removing the slums that surrounded the river on the grounds it was a crime against nature preservation, a danger to national security, a hygiene risk to the slum population, and damaging to the landscape.⁶⁹

Therefore, as politicians and early conservation organizations perceived the Navy as a natural actor to address pollution concerns in Guanabara Bay, and international politics pressed the Brazilian government to take concrete steps in this direction, pollution control slowly left its marginal position as a private, individual project among some officers, to assume a more central position in the Navy's agenda.

⁶⁸ Vasconcelos Torres, letter to Poder Executivo através dos Ministérios da Viação e Obras Públicas de Saúde e da Marinha, "Requerimento 788 de 1963." Rio de Janeiro, November 14, 1963. Centro de Documentação da Marinha.

⁶⁹ Jequiá river is a tributary of the Guanabara Bay. Walderbilt Duarte de Barros, letter to Navy Minister Radmaker, Rio de Janeiro, October 21, 1969. Departamento de Hidrografia e Navegação, Ministério da Marinha.

The 1972 Pollution Control Agreement

By the 1970s, sea pollution had become an integral part of the Navy's institutional mission. As a number of well publicized oil spills heightened international concern over sea pollution, domestic actors also demanded a more active role for the Navy in combating water pollution.⁷⁰ In addition, a military dictatorship provided remarkable authority to the Navy over civil government and other sectors of society. Finally, to prevent possible criticism at the forthcoming United Nations Conference on Human Environment, the government hastily addressed critical pollution problems. Guanabara Bay was on the top of this critical list, not only because of its unprecedented pollution levels, but also for its very visible profile.

The first and most obvious obstacle to a comprehensive plan to combat pollution in Guanabara Bay proved to be no challenge at all. In the military government, the Navy could present itself as *supra-parti*, and demand the collaboration of both states of Rio de Janeiro and Guanabara. Because the waters of Guanabara Bay separated the two states, the 1934 Water Code defined them as “federal waters”, and therefore under jurisdiction of the Federal Government.⁷¹ The Agreement for Pollution Control of the Guanabara Bay Waters was issued with some fanfare in July 1971, the governors of both states signing it aboard a Navy ship in the middle of Guanabara Bay.⁷²

The second but equally important step was to invite different stakeholders to the process, not only for technical expertise, but also political commitment. Vice-Admiral

⁷⁰ The 1967 Canyon Torrey oil spill, which released over 850,000 barrels near Plymouth, England, was often cited in the Navy documents.

⁷¹ *Código de Águas*, Decree N° 24.643.

⁷² Convênio do Contrôlo da Poluição das Águas da Baía de Guanabara, *Relatório de 1972* (1972).

Hilton Berutti Augusto Moreira, director of the Ports and Coast Division, was the main supporter of the project. Berutti was a career officer who understood the importance of a well-publicized campaign. He decided to use shock treatment to launch the project: Berutti invited politicians, government staff, biologists, industrials—and journalists—aboard of one of the Port Captaincy's ships for a tour around Guanabara Bay. He stopped at the most critical areas: the airport Santos Dumont; the Favela da Maré (Slum of the Tide), a shantytown made of palafitte dwellings placed on the water (see Fig. 12); the Mangrove Channel (Canal do Mangue), a dirty and sludgish channel where the city's gas company released effluents; Ramos Beach, "where children played and swam among the stench of the nearby garbage dumping site;" Niterói's Icaraí beach, where huge pipes released raw sewage onto one of the most beautiful spots of the East shore; and finally, the area around two large oil refineries.⁷³ After the tour, state senators from both states were ready to stand behind the agreement by promising political and technical support.



Fig. 12 - Palafitte dwelling in Praia de Ramos, 1970. Photograph by CEASM in Relry, Barbosa, and Ximenes 2002.

⁷³ O Globo, "Deputado: A Poluição na Baía Já Não Tem Remédio," September 1, 1971.

The next and most critical steps were funding and enforcement. On the Guanabara side, pollution control projects in the past consistently failed to properly monitor and enforce regulations. The Agreement put the Port Captaincy in charge of monitoring and enforcing. Though chronically under-equipped and understaffed, the Captaincy actually received extra funding for its new duties, including the use of a helicopter from the Institute of Sanitary Engineering. Fines for polluters, instead of reverting to a common federal or state budget, were almost totally applied to funding the activities in the Agreement.⁷⁴ The Port Captaincy assigned one of its officers, Captain Moss Goulart, to spend the next two years almost exclusively dedicated to enforcing the agreement.⁷⁵ The Captaincy also enlisted the help of Yacht Clubs in Niterói and Rio de Janeiro for police tasks. The Navy received collaboration from the Ministry of Health, UNESCO, and even entered in negotiations with the United States' Peace Corps.⁷⁶ Captain Moss Goulart would later recall the best contribution of the agreement was not in securing new funding, but in optimizing the resources already existing—but unconnected—among the participants.⁷⁷

Berutti's plan was not much different from the network proposed by Captain Moreira da Silva ten years earlier at the Petrobrás-sponsored round table. It is true that if the purpose of that 1961 Petrobrás meeting was to assure that the new Petrobrás refinery would not increase pollution in the Bay, it had failed spectacularly: Pollution was now

⁷⁴ The agreement did not discuss reparation or restoration.

⁷⁵ Interview with Captain Moss Goulart, Rio de Janeiro, January 2002. I owe a debt of gratitude to Captain Goulart. He kindly made available for this research his news clipping book referent to the two years he chaired the executive committee of the Agreement for Pollution Control.

⁷⁶ Convênio do Contrôlo da Poluição das Águas da Baía de Guanabara, *Relatório de 1972*.

⁷⁷ Except for wages, the Agreement used circa Cr\$901,605.27 (or US\$152,041.36) in 1972. Convênio do Contrôlo da Poluição das Águas da Baía de Guanabara, *Relatório de 1972*, 26-27.

much worse.⁷⁸ But the earlier meeting did establish the list of actors that Berutti used in the 1972 agreement—the Navy, Rio de Janeiro state, Guanabara State, Instituto Oswaldo Cruz, Petrobrás, yacht clubs, industrialists, and news agencies. More important: What had been basically a network of individuals in 1961 was now an institutional community.⁷⁹ As pollution expanded within Guanabara Bay, and environmental awareness advanced internationally, pollution control was no longer a personal agenda for like-minded individuals. Instead, that time was ripe that the state had to at worst pay it some lip-service, and at best actually implement pollution control programs.

There was unfortunately a remarkable absence in the new agreement about the resident population. During the two years of actual activity under the agreement, there was no attempt to involve the developing neighborhood associations or similar organizations in the process. Beyond awareness campaigns aimed at the general public about water pollution, the issue was very much seen as a technical problem, demanding technical solutions and command-and-control mechanisms.

The success or failure of the Pollution Control Agreement is difficult to measure. Except for the 1972 report and Captain Moss Goulart's clipping book, there are no records left at the Navy archives, nor the FEEMA archives (the institution that inherited

⁷⁸ For the impact of the Petrobrás' Duque de Caxias refinery on Guanabara Bay, see Chapter 5 and Victor M. B. Coelho, "Aplicação de Modelos Matemáticos de Qualidade de Água e Econômicos para a Baía de Guanabara - Brasil" (paper presented at the Simpósio sobre Ambiente, Saúde e Desenvolvimento nas Américas, México, 1974).

⁷⁹ Although they kept a low profile, the three main articulators of the anti-pollution studies in the 1960s were consulted for this agreement—but they were, all three, in low standing with their own institutions. Fausto Guimarães, as we see in Chapter 5, had been removed from the Institute of Sanitary Engineering—although he return to the political scene would take place in the following year, when he went to Stockholm as the Brazilian representative. Biologist Lejeune de Oliveira, as we see in Chapter 4, was surviving a bureaucratic upheaval within the Instituto Oswaldo Cruz. He worked as unofficial consultant for the agreement, although his student, Dr. Dirce Lacombe, was more involved in the project. Finally, Captain Moreira da Silva presided the Navy's research institute, and it would be advised to leave oceanographic studies of Guanabara Bay for the Hydrographic and Navigation division.

most of the Agreement's Executive Committee files).⁸⁰ Fortunately, the 1972 Report had a very complete evaluation of the state of the environment, with detailed recommendations that ranged from eliminating dumping sites near the Bay, monitoring coal and minerals shipments with the potential for pollution, and requiring treatment stations for the fishing industry. According to the report, during the first year of activity, the executive committee met weekly and carried out at least ten site inspections. The report also revealed the inequality in funding and structure that distinguished a wealthier Guanabara State from its counterpart, the Rio de Janeiro state. The conflicts that arose from their collaborative work here were only a prelude to the difficulties these two bureaucracies would face some years later when the two states merged.⁸¹

The newspaper clippings do not go much further in assessing the impact of the agreement on Guanabara Bay. The reports in obvious press-release language claimed that from 1973-1974, somewhere between 40-60% of the oil pollution in the Bay had been eliminated. There was no explanation of the indicators used to obtain these numbers.⁸² The clipping book ends when Captain Goulart Moss was transferred to another Port Captaincy in December 1973. Although the clipping book indicated a replacement was appointed, the merger between Rio de Janeiro and Guanabara states had already been decided, and the original premise of the Agreement—collaboration between two states—became outdated. Moreover, both the 1972 UN conference Stockholm and the 1972

⁸⁰ Unfortunately, these documental gaps are not uncommon. For a discussion on the archival sources for this dissertation and its limitations, see Introduction.

⁸¹ Convênio do Contrôlo da Poluição das Águas da Baía de Guanabara, *Relatório de 1972*. For a longer analysis on the merger and its impact on the technical staff of both states, see Chapter 5.

⁸² See, for instance, O Globo, "Poluição da Baía Cai in 60%," January 24, 1973. Although I take these numbers with more than a grain of salt, engineer Victor Coelho and Captain Moss Goulart, both members of the Agreement's Executive Committee, confirmed that the results were visible and fast. Coelho said that they used sampling and mathematical models for these estimates, but I could not obtain corroborating documents.

London Conference on Prevention of Marine Pollution by Dumping of Wastes and Other Matter had become accepted as international law, and both had the effect of producing urgency to create a strong pollution control project in Brazil. If international pressure played a crucial role in driving the Navy to initiate pollution control programs, the Navy was most likely to lose its interest as this pressure faded with time.

Regardless of the lack of continuity with the Pollution Control Agreement, it is clear that by 1972 the Navy was strongly involved not only in environmental management, but also explicitly in environmental protection. Updated regulations for its traditional divisions incorporated the new guidelines. For example, the 1972 regulations for the Coastal Patrol assigned the Navy “protection of marine fauna and flora, in collaboration with the Game and Fish Division at the Ministry of Agriculture.” The Guanabara Bay Agreement itself was supposed to be part of a nationwide campaign against water pollution promoted by the Navy, with similar agreements signed with several other states.⁸³

* * * * *

At the national level, the Navy developed an overarching definition of its defense roles that perhaps hampered its ability to fulfill these same roles. Locally, it was its long and diversified presence in Guanabara Bay, its encompassing understanding of the bay

⁸³ In 1973, the Navy signed water pollution agreements with the governments of Guanabara, Rio de Janeiro state, Bahia, Sergipe, Rio Grande de Sul, and it was negotiating similar terms with the governments of Maranhão, Alagoas, Espírito Santo e São Paulo. Eduardo Pacheco Jordão, letter to Conselho Nacional de Pesquisas, "Ofício IES-Dat - N. 3/73." Rio de Janeiro, November 29, 1973. Biblioteca Fausto Guimarães-FEEMA.

that allowed the institution to present itself as a reliable broker that brought together stakeholders to discuss pollution in Guanabara Bay in the early 1970s. It was not a role totally foreign to its capabilities or institutional mission; neither was it a purely opportunistic stunt to fend off international criticism on environmental degradation. Since the early decades of the twentieth century, the Navy had protected environmental management measures that were initiated either by individual officers (such as Frederico Villar's project for fishermen colonies, or Moreira da Silva's oceanographic studies) or due to institutional interests, such as its diplomatic activities on sea pollution. Particularly in Guanabara Bay, long before the republic the Navy had been collaborating or competing with different institutions to manage the bay, including its environment. At different moments, the Navy offered financial support, technical expertise, enforcing authority and means (certainly its forte), or it acted as political and institutional umbrella for organizations or individuals involved in the environmental management of Guanabara Bay.

Depicting the Navy as an environmental institution (though not necessarily environmentalist) does not presume this role was natural or without conflict. Its claim over the waters of Guanabara Bay (and its fisheries) was fiercely disputed by the municipalities in the early decades of the twentieth century, but was taken for granted by the 1960s. Even within the Navy, pollution control was cause for ambiguity: at the national circles of the Navy Ministry, pollution control was often feared as a pretext to infringe upon national sovereignty, an extra burden that would encumber national development. At the same time on the local level, the Coast and Port Division, the Port

Captaincy, the Navy Research Institute, all embraced pollution control campaigns as a necessary project to protect navigation and natural resources.

Beyond Guanabara Bay, stressing the environmental aspects of the Navy's activities proposes a new approach to its history. Studies on the military in Brazil typically focus on the Army for its importance in the political arena. Furthermore, most studies focus on the military's structure or its political influence, neglecting the multiple roles the military, and the Navy in particular, exercised in Brazilian society. Even the Navy's own historians have failed to acknowledge the adaptability of the Navy to new challenges, and have focused on what it recognized as its basic mission: the defense of Brazilian waters.⁸⁴ The Navy and the Banco do Brasil have probably been the most constant presence of the state (sometimes the only one) in the more remote villages of the Amazon rainforest, in the last eighty years, and yet little has been written on the consequences of this presence, for the Navy, or for Brazilian society.

It was this multifaceted dimension of the Navy that shaped its incursion into environment management. Because of the high profile of Guanabara Bay and the levels of pollution it reached in the mid-twentieth century, the Navy found itself at the center of the debate over pollution. It might not have been an arena it would have chosen to enter— nevertheless it did.

Was it peculiar for a military institution to enter a debate on pollution? Perhaps. It is important to consider the political context in Brazil was equally peculiar. While the Navy tested the waters in its efforts to protect the environment, in Europe and the US this

⁸⁴ This narrow view of the Navy's history is true also for the most complete work by a Naval scholar, Martins, *História Naval Brasileira*. Although very detailed, the series sorely needs outside reviewers, as well as an update for the history of the Navy after the World War II.

role was being performed by a burgeoning environmental movement. A mass movement of this type was not an option in Brazil because the same military dictatorship that placed the Navy in a privileged position to propose environmental agreements also violently suppressed public participation in political life, and curtailed many of the civil liberties crucial to the development of such movements. The first popular movement strong enough to fight (and win) some legal protection for the Bay was in 1978, when the military regime began to open up—the so called “abertura” (political distension).⁸⁵

There is one final consideration regarding the role of the Navy in environmental management. If the Navy found itself debating water pollution from the 1950s on, it had then almost completely abandoned the previous water-related issues that were the obsession of Navy ministers in the first Republic: fisheries and navigation. There was little conflict with municipalities over the destruction of mangroves, alterations of the shoreline, rapidly increasing siltation, and other those issues so dear to Villar, although all these processes continued to increase in Guanabara Bay during most of the twentieth century through the action of both the state and private initiative. The only dispute regarding public works in which the Navy was involved was the Rio-Niterói bridge. Built in 1973, the battle over the bridge was with the Air Force. This huge, pharao-like engineering accomplishment, funded by the federal government, named after the military president Arthur de Costa e Silva, fulfilled the old dream of connecting the two shores of Guanabara Bay. The Navy wanted the bridge high enough that large ships—especially oil tankers—could pass unhindered. The Air Force wanted the bridge low enough that

⁸⁵ In that occasion, the last area of extensive mangrove forests was declared Area of Environmental Protection. Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 245.

airplanes could take off from Airport Santos Dumont without risk.⁸⁶ They argued over the blueprint at every inch. Eventually, the two parties reached a compromise— today cars, airplanes and ships safely circulate on the bridge, over it, and under it.

⁸⁶ Henrique Sabóia, interview to Lise Fernanda Sedrez, February 20, 2002. Admiral Henrique Sabóia, former Ministry of the Navy, was the port captain at Rio de Janeiro from 1972 to 1974.

Chapter 4

Scientists, Mangroves and Pollution, 1937-1973

In 1958, the biota of the Ilha dos Pinheiro (Pinheiro Island or Island of the Pine) faced a challenge of Darwinian proportions. Environmental conditions had changed fast and radically in the previous decade: oil and chemical effluents, changes in the water currents regime, siltation due the nearby landfilling, and floating garbage from the largest urban dumping site in Guanabara Bay, all contributed to it. Some populations just looked for greener pastures—mulletts, crabs and catfish could easily find more hospitable areas in the other mangrove coves in Guanabara Bay. They migrated. Mangroves trees and blue crab dwindled—the oil brought in by the tide was bad enough, but siltation was the real killer. They perished. The leader of the human population at the island, biologist Lejeune de Oliveira, wondered about his options. He was in charge of the Hydrobiology Station on the island, and he certainly did not want the Station to perish—although it could no longer fulfill its original purpose of providing marine fauna to the Oswaldo Cruz Institute. He could not move the station to another island, either—he tried, but the mother institute was deaf to his appeals. So he adapted. His next article was a shattering analysis of the effects of water pollution in the bay. Lejeune then reinvented the purpose of the Hydrobiology Station: instead of a pure-science research lab, the Ilha dos Pinheiro became a center for monitoring water pollution.¹

¹ Lejeune Pacheco Henrique de Oliveira, "Poluição das Águas Marítimas: Estragos da Flora e da Fauna no Rio de Janeiro," *Memórias do Instituto Oswaldo Cruz* 56, no. 1 (1958).

Lejeune de Oliveira worked at the Hydrobiology Station of Pinheiro Island for 40 years, from 1937 to 1977. His wife and fellow biologist, Luiza Krau, did the same for 30 years. During this time, they wrote scores of articles about the biology of Guanabara Bay, which they published in the Oswaldo Cruz Institute's journal, *Memórias do Oswaldo Cruz* Institute. Their work transformed Pinheiro Island into a unique experience for hydrobiology in Brazil, and certainly a crucial landmark for understanding changes to Guanabara Bay. Their activities, monitoring and studying pollution in Guanabara Bay, constitute two of the necessary elements of environmental management, in our broad sense, although they had no power to regulate, propose or enforce regulations.

Lejeune and Luiza's work was unique. They were the first to propose biological indicators for measuring pollution in Guanabara Bay. The extent of their work was by itself remarkably long in a context where discontinuity was the norm, as we have seen in the previous chapters. Some of this constancy derived from their efforts to keep alive the Hydrobiology Station. Some has also to do with the precarious independence and autonomy that the Oswaldo Cruz Institute had wrestled from the Federal Government. The particular location of the island—in a secluded cove, near the area to which the city would soon expand upon—made the environmental changes they monitored even more dramatic and more noticeable than in the rest of the bay. (See Fig. 3, page 28).² For those studying these changes, they were highly symbolic of the potential fate of Guanabara.

Their employment by a world-class science institute, as well as their long presence at Guanabara Bay, made Luiza and Lejeune the authoritative references in pollution in Guanabara Bay—and the island, a place for political and strategic discussion.

² The location of Pinheiro Island is marked by the small red rectangle. Based on a drawing by Lejeune de Oliveira (1952) kindly provided by Luiza Krau from her personal archives.

Everyone with a stake in the current or future management of Guanabara Bay docked at the island at some point, as a visitor, student, or researcher. A good deal of networking and contacts among institutions took place at Pinheiro Island, and Lejeune de Oliveira registered most of this activity in reports he sent to the Oswaldo Cruz Institute every year.³

Lejeune and Luiza were thus central to the larger history of environmental management of Guanabara Bay because of their long term activities, of their scientific contributions, the sensitive location of their island; because of the terrific sources they left behind in their articles and reports and, finally, because they trained, taught and connected with virtually everybody that worked with pollution in the Bay from 1950s to 1970s. Their story is one of formation of scientists in twentieth-century Brazil, and how these scientists—even if affiliated to one of the most prestigious institutions in the country—had to adapt to contingencies, to underfunding, and to shifting institutional priorities.

The Oswaldo Cruz Institute and the Formation of its Scientists

Lejeune de Oliveira's forty-year trajectory at the Oswaldo Cruz began as a typical career move for an aspiring scientist in the 1930s. Admittance to the Application Course of the Oswaldo Cruz Institute (Curso de Aplicação de Manguinhos) was exclusively by invitation, which meant that a student in the School of Medicine had to catch the attention of a professor already working at the Institute. Only one third of the twenty or so students

³ Oliveira was a particularly prolific writer, keeping detailed research notebooks of the activities at the Island. Few of his annual reports survived. Those that did survive offer a tremendous insight on the practice of science in Brazil during these decades.

passed to the next step as unpaid laboratory assistants.⁴ Olympio da Fonseca, an important researcher at the Institute, invited Lejeune de Oliveira, then a med student, to attend the course. Lejeune stayed there from 1935 to 1937, working as technical assistant to Fonseca.

The Oswaldo Cruz Institute was a child of the twentieth century. Inspired by the Institute Pasteur, it was the most important center for scientific research and training in Brazil. In the nineteenth century, Brazilian scientific activity was rather isolated, sometimes disconnected. It had little continuity or visibility. The Institute change this situation, by establishing a scientific network with no precedent in Brazilian history.⁵ Government support for the Institute was linked to the practical accomplishments of its founder Oswaldo Cruz and his team in the area of public health: the elimination of yellow fever in Rio de Janeiro in 1904.⁶ The Institute obtained further international recognition in the first three decades of the twentieth century by identifying endemic diseases in Brazil, such as the Chagas disease.⁷ The Oswaldo Cruz Institute also received the deep gratitude of the positivist Republican government, always in the hunt for new avenues to

⁴ Jaime Larry Benchimol, *Manguinhos do Sonho à Vida: A Ciência na Belle Époque* (Rio de Janeiro: Casa de Oswaldo Cruz, Fiocruz, 1990), 73; Schwartzman, *A Space for Science*.

⁵ The Institute published a scientific journal since 1908, with abstracts in three languages. As the science historian Nancy Stephan wrote, "it was also the first nationally known institution with an international recognition in science." Stepan, "Scientific Institution-Building", 16, 98.

⁶ For Oswaldo Cruz's activity in Rio de Janeiro, contemporary to the urban reforms by Pereira Passos, see Chapter 2 and Chalhoub, *Cidade Febril*.

⁷ Most historical studies on the Institute focus on this period that goes from its foundation to the 1940s, while little has been written in the later decades. In the last decade, however, the Casa Oswaldo Cruz has developed a project on Oral History about the more recent period. Most of the interviews are available to researchers, but nobody has yet written a comprehensive monograph about the Institute after 1940s. See Nara Britto and Wanda Hamilton, "Introduction," in *Memória de Manguinhos: Acervo de Depoimentos*, ed. Nara Britto, Rose Ingrid Goldschmidt, and Wanda Hamilton (Rio de Janeiro: Casa Oswaldo Cruz, 1991), xxi. I must thank the staff at the Casa Oswaldo Cruz for their patience in answering my questions, and in disclosing their ongoing research to me. I hope that studying the relationship of the Hydrobiology Station with the Institute, thus, may help to understand the workings of scientific research in a very eventful period of Brazilian history.

celebrate the Brazilian science and national pride. Gratitude translated into unusual administrative and financial autonomy the Institute enjoyed until the Vargas Era.

In 1937, the same year that Lejeune was hired by the Oswaldo Cruz Institute, a coup d'état by President Getúlio Vargas inaugurated a new authoritarian era. Changes in public service were less noticed than the coup, but the changes had a deep effect on the Oswaldo Cruz Institute. Gustavo Capanema, Vargas's all-powerful Minister of Education and Health, to whom the Oswaldo Cruz Institute was subordinate, had his own plans for a radical reformulation of the Institute, especially regarding its financial autonomy. Until 1937, the Institute could manufacture and sell vaccines, serums and veterinarian products. This would change. The Institute transferred from the National Department for Education (Departamento Nacional de Educação) to the National Department for Health (Departamento Nacional de Saúde), and its income—the selling of vaccine and medical products—was incorporated into the nation's global income. Worse yet, the federal government, formerly its major costumer, no longer paid for any product provided by the Institute.⁸ The Institute's funding now depended on the Ministry's budget instead of its own production. Financial autonomy was crucial to the Institute. As Nancy Stepan argues, “one reason for Oswaldo Cruz' success in founding and maintaining a research institute in 1900's was his ability to free the Institute from close government scrutiny and financial accounting in the early years of the Institute's life, during a time of expansion and experimentation with institutional organization, while yet maintaining harmonious

⁸ Benchimol, *Manguinhos do Sonho à Vida*, 73.

relations with Congress, the Institute's patron."⁹ Capanema and his reformulation of the public administration now compromised this frail balance.

This was just the tip of the iceberg: the Institute was now subject to the rules of the new Public Service Administration Department (Departamento de Administração do Serviço Público-DASP). According to the new rules, nobody could be hired without an open competition (concurso público), and only after the Ministry approved a budget for each hire. The new rules made it very difficult for the Institute to renew its staff.¹⁰ Last but not least, public servants could no longer hold functions in different public offices, and the Institute lost several professionals in its staff who had to choose between careers in the state-owned School of Medicine and the Oswaldo Cruz Institute.

Lejeune de Oliveira's advisor Fonseca was one of these cases, as he left the Institute temporarily.¹¹ Lejeune's new supervisor, Henrique de Beaufaire Aragão, was an enthusiast of hydrobiology, and took young Lejeune with him on field research trips to the Lagoa Rodrigo de Freitas and the Guanabara Bay in 1939. It was Aragão who proposed the creation of the Hydrobiology Laboratory at Pinheiro Island.¹² When he took office as the director of the Oswaldo Cruz Institute, Aragão invested in the expansion of marine biology at the Institute with the hope of giving it an international profile.¹³

⁹ Stepan, "Scientific Institution-Building", 37.

¹⁰ Benchimol, *Manguinhos do Sonho à Vida*; Jaime Larry Benchimol and Luiz Antonio Teixeira, *Cobras, Lagartos & Outros Bichos: Uma História Comparada dos Institutos Oswaldo Cruz e Butantan* (Rio de Janeiro: Editora UFRJ, 1993), 206. For the impact of the Capanema Reform on other academic and scientific institutions, see Schwartzman, *A Space for Science*, 245-50.

¹¹ Fonseca later he returned to the Institute and was its director from 1950 to 1954.

¹² Lejeune Pacheco Henrique de Oliveira, "Curriculum Vitae" (Typed notes, Rio de Janeiro, 1958).

¹³ Aragão had visited several hydrobiology centers in France, before he became the new director of the Institute. His former assistant and new coordinator of the Hydrobiology department, João Carlos de Nogueira Penido, had done extensive research in the Biological Marine Station in Woods Hole, Massachusetts. Oliveira, "Histórico da Biologia Marinha".

Hydrobiology had been indeed part of the initial design for the Institute. From 1908 to 1922, the Institute (then Instituto Soroterápico de Manguinhos) had a department of hydrobiology, coordinated at a certain point by Olympio da Fonseca—the same scientist who invited Lejeune to the Institute. The founder Oswaldo Cruz had helped create in 1916 the ambitious and short-lived Station of Marine Biology on Urca beach, near the Sugar Loaf Mountain, in collaboration with the National Department of Fisheries (Inspetoria Nacional de Pesca), under the Ministry of Agriculture. It was the first research center of its kind in South America.¹⁴ The station's mission was to study the introduction of exotic species of commercial fish in the waters of Guanabara Bay. The station kept the interest of the Ministry of Agriculture for a little more than three years, and it left few documents. Without support from the Ministry for the project, the Institute decided that it needed its scientists for more immediate and critical research on other fronts. Besides, the Urca Station was too far from the Manguinhos library, a critical necessity for scientific research, and the maintenance of its oceanographic boat was too expensive for the Ministry of Agriculture. In fact, the National Department of Fisheries itself would be extinguished a few years later. Basically, the experiment died from political starvation.¹⁵ The hydrobiology department kept a low profile over the next fifteen years, limited to

¹⁴ Other coordinators of the department of hydrobiology were Gomes de Farias and Marques da Cunha. For the Marine Biology Station, the National Department of Fisheries contributed with the building and a boat; the Institute offered his staff and laboratories. Lejeune Pacheco Henrique de Oliveira, "Contribuição ao Conhecimento dos Crustáceos do Rio de Janeiro," *Memórias do Instituto Oswaldo Cruz* 34, no. 2 (1939): 8.

¹⁵ Not everything was lost; the experience provided Faria and Cunha with an impressive collection of marine specimens, and the publication of a remarkably detailed inventory of Guanabara Bay's microplankton. The Urca station was part of a larger partnership with the National Department of Fisheries, which also planned a tourist and scientific aquarium to be built in the campus of the Institute. In 1913, they built a small aquarium at the Institute, fed with waters from the Inhaúma cove. That was all that ever happened. "Today," Lejeune wrote in 1958, "there are only the ruins of the aquarium building, as the National Department of Fisheries was extinguished before its construction was completed." Faria and Cunha, "Estudos Sobre o Microplancton," 69; Oliveira, "Poluição das Águas Marítimas."

some odd collecting field trips in Guanabara Bay, until it was resurrected by Henrique Aragão.

Despite Capanema's reforms, the Henrique Aragão administration (1942-1949) was a reasonably prosperous period for the Oswaldo Cruz Institute because of Brazil's participation in the World War II. As part of the war effort, the Oswaldo Cruz Institute received significant funding, enough to modernize labs and build new installations. It was enough to provide Pinheiro Island with electric energy and to build new aquaria.¹⁶ Furthermore, in the best tradition of the Oswaldo Cruz Institute, Aragão used his international connections to invite the French biologist Pierre Drach for a six-month stay in 1948. Drach was vice-director of the Station Biologique de Roscoff, Finisterre, France. While in Brazil, Drach trained several scientists, introduced new techniques for observing marine life and advised on the reformulation of the Hydrobiology Station. In 1950, the Station was in full activity and Lejeune listed 100 species of marine invertebrates as available to the labs of the Oswaldo Cruz Institute.¹⁷

¹⁶ Benchimol, *Manguinhos do Sonho à Vida*, 74.

¹⁷ Oliveira, "Curriculum Vitae"; Oliveira, "Histórico da Biologia Marinha."

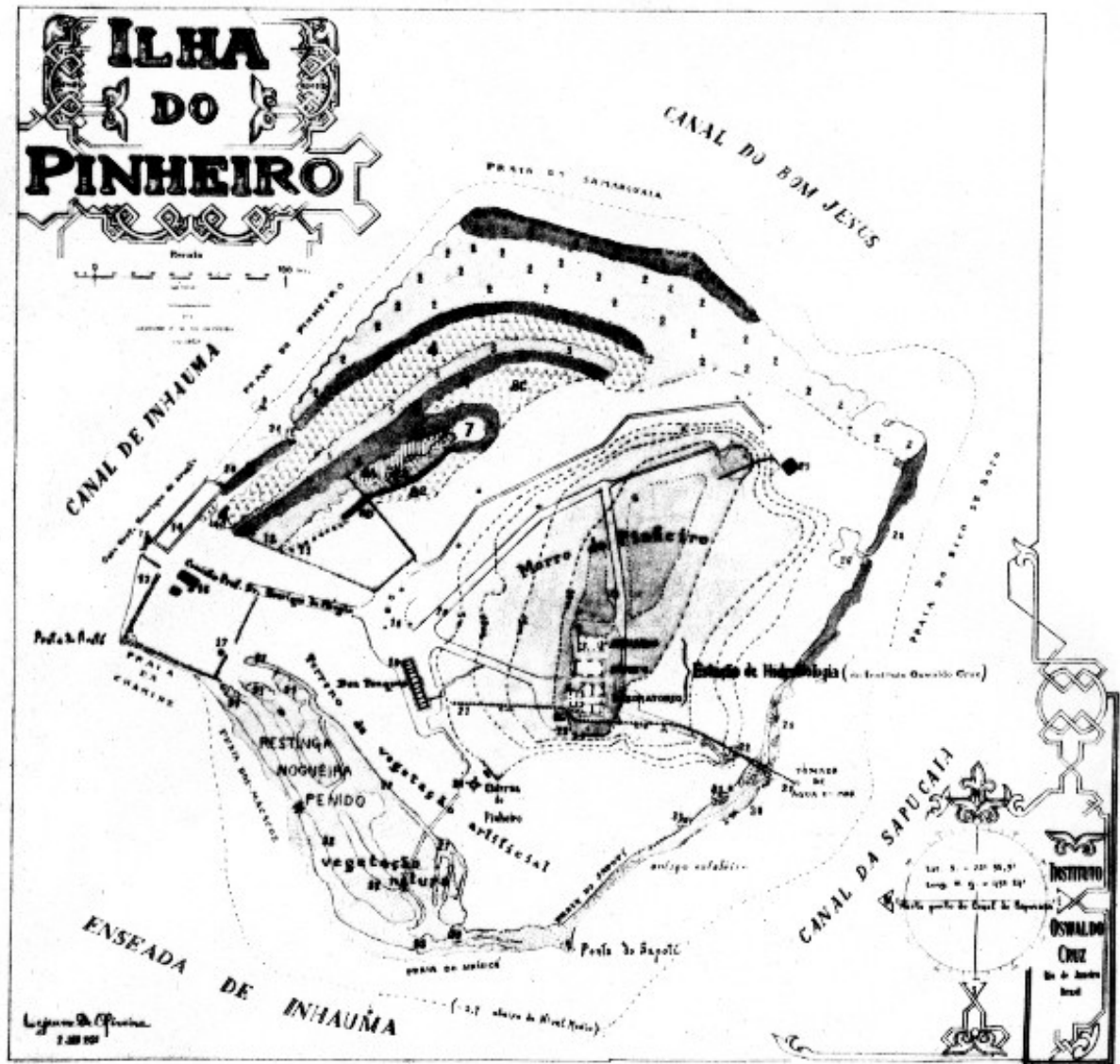


Fig. 13 - Facilities at Pinheiro Island, 1952. Personal archives of Lejeune de Oliveira.

Biologist Luiza Krau joined the Institute during this high period. A high-school teacher and recently graduate in natural history, she wanted to work in research rather than teaching.¹⁸ However, there were very few venues for biologists in Brazil other than teaching, and even fewer for women biologists. The Oswaldo Cruz Institute was one of

¹⁸ After graduating in Natural History from the University of the State of Guanabara, Krau taught biology for two years in two prestigious schools in Copacabana and Ipanema. Because she wanted to work in research, she kept attending biology classes in the School of Natural History, well after her graduation in 1946. Luiza Krau, interview to Lise Fernanda Sedrez, May 29, 2001.

the only other possibility, and beyond its prestige as a center of research and science (the dream of any biology student) the Institute also had a tradition of hiring female scholars.¹⁹ Therefore, when her college friend (and Henrique Aragão's assistant) Mello Leitão invited Luiza Krau to attend the course of Pierre Drach, Luiza did not hesitate to cut short her vacation and run to the Institute. At the end of Drach's course, Aragão interviewed Luiza, and invited her to work for the Institute as a "funding source three" (Verba Três) employee.²⁰ This was a position with little pay, no union-like benefits and no job security—basically, an internship. Because of Capanema's draconian regulations regarding new hirings, a regular position was practically impossible: there had been few if any open competitions since the end of the war.²¹ Luiza was designated as an assistant to Lejeune de Oliveira at the renewed Hydrobiology Station on Pinheiro Island.²² Luiza's

¹⁹ Bertha Lutz, famous biologist, suffragette and politician, started her career in the 1916 at the Oswaldo Cruz Institute, as translator for her father, Adolpho Lutz, before assuming the coordination of batrachians at the National Museum of Natural History. Other female scientists in the Institute in the 1940s included Arlete Ubatuba, Maria Isabel Mello, Pedrina Cunha de Oliveira. Even in hydrobiology, Helena Pais de Oliveira assisted Nogueira Penido in the 1930s in the study of echinoderms. For Luiza Krau, it was a welcome change from the almost all-male faculty at the School of Natural History. According to Delir Freire, another female scientist who attended the School of Natural History of the Guanabara State University in the late 1950s, there were four female students within a 30-student cohort, and but one female faculty, Heloísa Alberto Torres. The situation at the Institute was better, certainly, although women scientists at the Oswaldo Cruz Institute noted that there was a veiled embarrassment among their colleagues about their presence in the Institute, if not open antagonism. Few women attained deciding positions at the Oswaldo Cruz Institute until 1960—they were usually assistants. See Delir Corrêa Gomes Maués da Serra Freire, interview to Anna Beatriz de Sá Almeida and Magali Romero Sá, Rio de Janeiro, 2001. *Memória das coleções científicas do Instituto Oswaldo Cruz da Fundação Oswaldo Cruz: acervo de depoimentos*. Questions about gender and science are just beginning to draw the attention of Brazilian historians. The Casa de Oswaldo Cruz is developing a project in oral history with women scientists, still in progress; I thank the researchers at the Casa for giving me access to their interviews, most of them still in process of transcription and matching verification.

²⁰ The name "Verba Três" derives from the item in the Institute's budget for such temporary hirings.

²¹ Luiza Krau would be an intern for almost fourteen years. In 1962, a movement led by Dyrce Lacombe pressed the Institute to regularize the situation of its 44 interns, some of them working there for more than twenty years. Luiza was finally hired on this occasion. Dyrce Lacombe, interview to Cristina Fonseca, Rio de Janeiro, 2000. Fundação Casa Oswaldo Cruz.

²² Luiza met Lejeune in September 1948. In her first day in the job, the 24-year-old biologist went to the small dock in Inhaúma to catch the boat to the Hydrobiology Station at Pinheiro Island, Guanabara Bay. She had received careful instructions on how to get there, by taking a horse-powered carriage from the nearby Institute to the docks, in a mangrove forest. She was then to wave a scarf, calling the boat to pick

work status within the Institute as an intern and later her personal association with Lejeune led her to orient her career around Lejeune's. They published together, traveled together and taught together. Lejeune's expertise in crustaceans took them both traveling to the north and south of Brazil, from Fortaleza to Paraguay, in the 1940s and 1950s. They were also making field trips to the Lagoons of Itaipú, Ilha Grande and others, either with salt or fresh water.²³ But their main research site was Guanabara Bay, and more particularly Pinheiro Island.

While the war effort—and the extra funding it brought to the Institute—delayed the crisis that the Capanema reforms had put in motion, the democratization and the end of the dictatorial regime in 1946 did not mean exactly better times for the Institute. The Institute did not regain the financial autonomy that it held before the Vargas Era, and, as the situation of Luiza Krau illustrated, lack of autonomy reflected very directly on the routine and research needs of the Institute. Moreover, as one of the many governmental institutions being reformulated in the new period, the Institute was now vulnerable to external political pressure. In fact, Henrique Aragão had to fight hard against plans to merge the Institute with the recently established Universidade do Brasil.

From the moment of its foundation to the struggling years of the 1950s, and passing through the administrative reforms of the Vargas Era, the Institute Oswaldo changed its personnel policies, its income sources and lost much of its autonomy. Its

her up and take her to the island, where she would take another carriage to the Hydrobiology Station. Luiza, somewhat wary in the unfamiliar dockland, set among few fishermen's houses, did as she was directed. When the boat arrived, a man strode in a hurry along the same docks, carrying a briefcase. Without a glance to her, he jumped into the boat and told the boatman to take off. Before Luiza could say anything, the boat was gone. More than a little upset, she thought the man was the most impolite person she had ever met. The man was Lejeune de Oliveira, and he would be her immediate—and only—superior in the Hydrobiology Station. In the next 30 years, they would work together in the Pinheiro Island, marry, have a daughter and develop the first biological indicators for water quality in Guanabara Bay. Krau, interview.

²³ Oliveira, "Curriculum Vitae."

directors often debated how to proceed, how to recover the lost prestige. The quest to return the Oswaldo Cruz Institute to the glorious times of its creation would haunt all future administrations.²⁴ During this process, the Institute did establish a number of different projects, among which was the Hydrobiological Station on Pinheiro Island. With an assigned research staff, aquaria, reasonably adequate facilities, technical consulting, the Hydrobiology Station by the 1950s became a defined institutional place—and it reflected the changes undergone by its mother institution. These changes, however, paled in comparison to the changes that took place in the physical place where the Station was located during the same period.

The Pinheiro Island

In the 1930s, the Oswaldo Cruz Institute needed an isolated place, where it could keep and observe in total freedom inoculated animals used for vaccine research. The Institute also wanted to start a breeding program for Rhesus monkeys (*Macaca rhesus* or *Macaca mulatta*), which were very expensive and coveted for medical research. The Instituto settled on Pinheiro Island, practically uninhabited and not far from its headquarters. It was a small island (no more than twelve hectares) with an irregular shape, and extensive mangrove forests. The island was located in the Inhaúma cove,

²⁴ Benchimol, *Manguinhos do Sonho à Vida*, 75. Or, as Britto and Hamilton argued, “conflicting evaluation followed the first idealistic view: for some, the institutional model created by Oswaldo Cruz misfired after 1930s, with crisis and difficulties which plunged the Institute into a state of scientific and technologic backwardness. They therefore considered that the crises would be overcome by the resumption of the original model. Others criticized the direction that the Institute had followed during the period, but disagreed with the catastrophic vision. They say that in the late 1930s, the main researchers of the first generation disappeared, and their own professional careers began and ensured the continuation and vitality of the Institute on a new scientific basis tuned with the knowledge acquired in World War II.” Britto and Hamilton, “Memória de Manguinhos,” xxi.

surrounded by nine other islands. It was isolated from the mainland by a narrow channel and was accessible only by boat from the very primitive docks of Inhaúma. (See Fig. 14.)

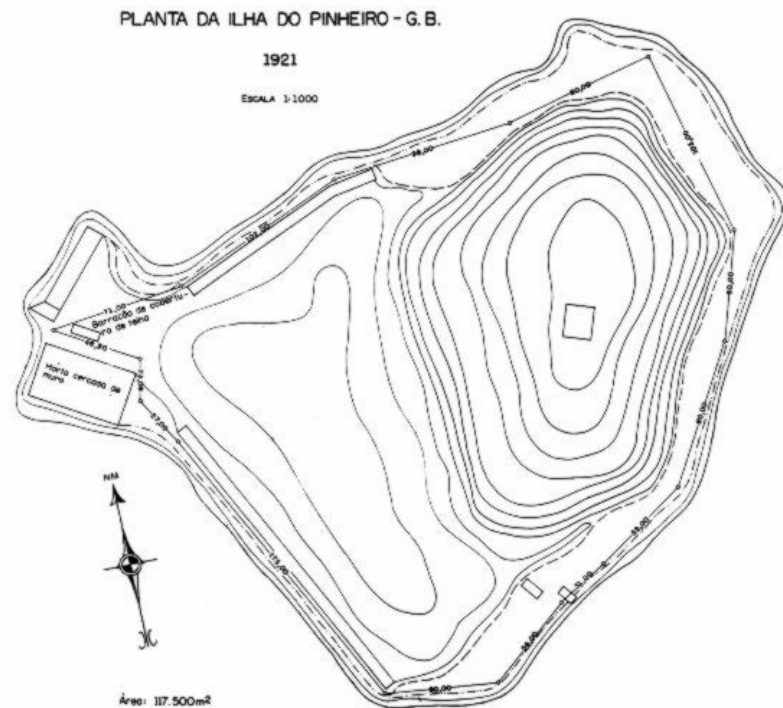


Fig. 14 - Pinheiro Island, 1921. Personal archives of Lejeune de Oliveira.

The choice of an island to breed the Rhesus monkeys had a secondary advantage for the Oswaldo Cruz Institute. Although the Institute's primary objective was to study disease vectors and medicine, it also supported research on physiology, bacteriology, parasitology, pathology, mycology hygiene, zoology and others. Virtually all of its departments needed maritime material for their experiments. Pinheiro Island was an optimal location to collect this material. "The Inhaúma cove," wrote Lejeune in 1939, "is close to the mouth of three rivers flowing into the bay, has a low salinity, and several wetlands and marshes, a perfect site for reproduction of crustaceans."²⁵ The island

²⁵ Oliveira, "Contribuição ao Conhecimento."

belonged to the federal government, and could be obtained by the Institute at a very low cost. It was perfect for the Institute's needs.²⁶

In October 1932, the Institute's director of the Oswaldo Cruz, Carlos Chagas, requested the island from the Government. Once he secured the location, he placed an order for a hundred Rhesus monkeys, which arrived along with thirty-three donated by the Rockefeller Foundation. The Oswaldo Cruz Institute then built the biotério—a small building where the Institute kept sick animals and carried on some zoological experiments—and an aquarium. This was the beginning of the Hydrobiology Station at Pinheiro Island.²⁷

Besides the aquaria and the biotério, the island already had two small artificial lakes for shrimp culture, made in sandy soil, with very rustic floodgates.²⁸ The Oswaldo Cruz Institute used the lakes for shrimp until 1934 when the scientists first noticed that changes in areas close to the island would have a direct impact on their activities. The creation of the Manguinhos airport nearby reclaimed a huge tract of land from the Guanabara Bay and its mangrove marshes (a total of 380 hectares), very rich in crab and other edible crustaceans for the local population. The new regime of water circulation

²⁶ The Federal Government had bought Pinheiro Island on October 4 1921, as part of a huge project of sanitation of the Fluminense lowlands. The Government had paid 350:000\$000 (US\$ 45,920.00) for the island, mainly in titles of federal public debt. It then passed the title to the Company for Improvements of the Fluminense Lowlands (*Empresa de Melhoramentos da Baixada Fluminense*), that had been founded by urban reformer and former mayor Paulo de Frontin. At the end of the sanitation project, Pinheiro Island reverted to the Union's ownership. Instituto Oswaldo Cruz, "Ilha dos Pinheiros - Histórico," (Rio de Janeiro, DF: Ministério da Saúde, 1944), 2. See Chapter 2 on Paulo de Frontin and sanitation works in the Fluminense Lowlands.

²⁷ The expensive primates cost US\$15.80. The biotério was the most relevant investment in the island, and it cost 194:000\$000 (US\$13,812.80). The aquarium cost less than half it, or about 85:000\$000 (US\$6,052.00). Instituto Oswaldo Cruz, "Ilha dos Pinheiros - Histórico," 4.

²⁸ The former owner had built the floodgates in 1914, and filled them with the water from Inhaúma cove to keep captured fish and shrimp for his restaurant, in downtown Rio de Janeiro. Lejeune Pacheco Henrique de Oliveira and Luiza Krau, "Levantamento Biogeográfico da Baía de Guanabara II - Crescimento do Manguezal na Ilha do Pinheiro," *Memórias do Instituto Oswaldo Cruz* 51 (1953): 505.

created by the landfill pushed solid debris and garbage dumped near the airport back to Pinheiro Island, right in front of the floodgates. In this only slightly polluted water, the shrimp died as soon they entered the lake.²⁹

There was still plenty of fauna and flora left to satisfy the most demanding biologist. In 1939, the hydrobiology laboratory was finally constructed, and the island became headquarters for many collecting field trips in Guanabara Bay. The Rhesus monkeys roamed free on its grounds. In fact, the monkeys adapted very nicely to the island, as they could be seen diving at the beaches from the mangrove trees into the bay to catch mussels and small invertebrates.³⁰ Inhaúma cove, in Guanabara Bay, became the major source for maritime material for the Institute: crabs, seahorses, fishes, poisonous fishes for the study of toxicology and jellyfish for the physiology department.³¹ Prevented from using the shrimp lakes, the Institute ordered ten more aquaria and renovated the island's facilities in 1942. Although there was no energy on the island until 1947, both the biotério and the aquaria were regularly used for research, if not yet as a full-functioning laboratory. A second restructuring of the Station took place in 1947 under the Henrique Aragão administration. The French consultant Pierre Drach estimated that, based on the pollution rates in Rio de Janeiro between 1900 and 1947, pollution would not damage the ecosystem of Pinheiro Island for the next hundred years. Thus,

²⁹ Oliveira, "Poluição das Águas Marítimas," 48.

³⁰ Lejeune Pacheco Henrique de Oliveira and Luiza Krau, "Estudos Aplicados à Recuperação Biológica da Baía da Guanabara," *Memórias do Instituto Oswaldo Cruz* 74, no. 2 (1976): 101.

³¹ Crabs were specially sought after, caught by the hundreds, for studies on blood biochemistry. Because of the presence of copper, instead of iron, in their blood, crustaceans have blue blood and a special system for the fixation of calcium when they change their shells. Among the species that interested the Institute, a close second was the Ascidians ("*maminhas de porca*" – *Tethium plicatum*). Hundreds of them found their way to the laboratory of physiology for studies of hypophysary hormones. Lejeune Pacheco Henrique de Oliveira, "Notas para Jornalista do Jornal do Brasil" (typed notes, Rio de Janeiro, 1973).

unconcerned with potential pollution, the Institute established the Hydrobiology Station in a large house, furnished with aquaria using seawater from the bay.

From 1937 to 1950, Lejeune's articles in the *Memórias do the Oswaldo Cruz* Institute journal described the Inhaúma cove as containing a healthy forest of red mangroves trees—*Rhizophora*—near the sea and a sub-ecosystem that he called *Rhizophoretum*. These early articles also described the colonies of *Alpheus* shrimp, which live in the mire, and hundred of tons of shellfish called *Samanguaí*. The fishermen loaded trucks of live *Samanguaí* crab captured at the Pinheiro Island beach in 1946, and sold them in Rio de Janeiro's markets. The bottom was covered with green algae ("alface do mar"—sea lettuce—and "macarrões verdes do mar"—sea green noodles), and scientists captured sea horses just behind the Pinheiro Island. The forest contained mangrove oysters and other mollusks living among its roots, including a large variety of crabs and barnacles. Yet another sub-ecosystem, the white or the tame mangroves may surround the red mangroves, with its own set of biota.³² The ecosystem at Pinheiro Island was highly productive, yielding enough specimens for the Station as well as for neighborhood fishermen. The Hydrobiological Station also thrived; its scientific production matched that of the island.

Pinheiro Island was however about to change deeply. A legal dispute over its ownership began in 1945 and lasted for most of a decade. It would leave scars on the island that, in comparison, made the impact of the Mangueiras Airport immaterial. Since the early 1930s the federal government was looking for a campus for the new University of Brazil (*Universidade do Brasil*), to merge the federal colleges scattered around Rio de

³² Lejeune Pacheco Henrique de Oliveira, "Aula 1917" (typed notes, Rio de Janeiro, [1967]).

Janeiro.³³ In 1945 the Ministry of Education and Health decided the institutional merging of the colleges warranted a physical merging of land. The small archipelago where Pinheiro Island was located was to become a single 480-hectare artificial island, the University City (*Cidade Universitária*), altering forever the water circulation regime in the Inhaúma cove.³⁴ (See Fig. 15).³⁵

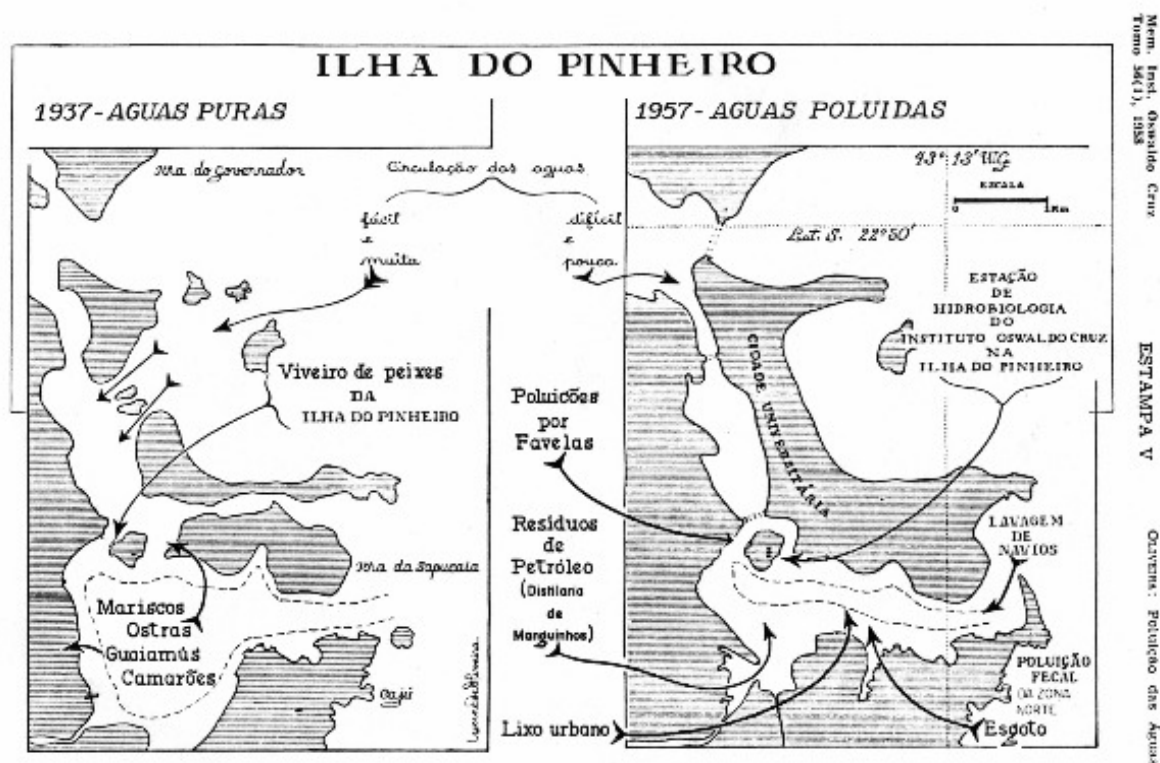


Fig. 15 – Changes in Pinheiro Island, 1937-1957. The two illustrations, “1937-Clean Waters” (left) and “1957-Polluted Waters” (right) compare the water circulation in Pinheiro Island before and after the creation of the artificial island for the campus of the Universidade do Brazil. Oliveira 1958, 47.

At first, Pinheiro Island was to have the same fate. In 1953, the director of the Oswaldo Cruz Institute was still writing to the Ministry of Health, requesting the Island

³³ The institutions were the Escola Politécnica, Faculdade de Medicina e Faculdade de Direito, at first, and later also the Faculdade Nacional de Filosofia, Escola Nacional de Belas Artes and other ten schools.

³⁴ Other than Pinheiro Island, the archipelago included the islands of Cabras, Pindaí do Ferreira, Pindaí do França, Baiacu, Fundão, Catalão, Bom Jesus, and Sapucaia.

³⁵ Oliveira, “Poluição das Águas Marítimas,” 46.

remain under Institute ownership.³⁶ A letter from the president of the Universidade do Brazil, Pedro Calmon, instead, confirmed that Pinheiro Island belonged to the “university’s reserved land.” It would remain its current status—“reserved land”—until the planned zoo facilities at University Campus were completed, and the Rhesus monkeys and other animals necessary for research were adequately installed. Calmon generously offered to share the future zoo with the Institute, but once the monkey issue was solved, bridges would link Pinheiro Island to the other former islands of the campus. In the meantime, Calmon wanted, in a more immediate threat to the research from the Island. the Oswaldo Cruz Institute to “sanitize” the mangroves at Pinheiro Island as soon as possible;

To promote as soon as possible the sanitization of the mangroves at the Pinheiro Island, by filling in the swamps with sand obtained from the dredging and regularization of the channel that currently separates the island from the others already connected to the University Island.³⁷

Lejeune hoped the Rhesus monkeys could save the Station—and for some time, they actually did. If there was a single thing politicians respected, he thought, was public health isolation requirements.³⁸ If he could convince federal officers that the Rhesus monkeys were needed for research in contagious diseases, Pinheiro Island may be excluded from any agreement between the Oswaldo Cruz Institute and the University. By 1961 there was no more mention in Lejeune’s reports on the idea of the island reverting to the University.

³⁶ Pinheiro Island had been mentioned in the decree 7563, on May 25 1945, that reserved the land for the campus of the Brazil University. Castro Miranda, letter to Ministério de Educação e Saúde, "Ofício 988." Rio de Janeiro, September 23, 1953. Instituto Oswaldo Cruz.

³⁷ Pedro Calmon, letter to Diretor do Instituto Oswaldo Cruz, "Número 4/600 - Resposta ao Ofício 808 de 4/8/53." September 10, 1953. Fundação Casa Oswaldo Cruz.

³⁸ Oliveira, "Relatório Anual 1958."

Though the island did not join its sisters in the new artificial island, it did not escape unscathed. The island's environment was changing—fast. It was changing in shape, in vegetation, in water quality, and in its relationship with the population living in Inhaúma Bay. At least until 1947, there were only few fishing communities, living in palafittes, in the Inhaúma Cove. After all, Inhaúma was considered unhealthy, because of the presence of swamps, mangroves,—and malaria mosquitoes.³⁹ Fishermen visited Pinheiro Island as they did the other islands, with little thought as to who was the current owner. As with most mangroves in Guanabara Bay, Pinheiro Island was constantly ransacked by fishermen, who used the tree to reinforce their fishing nets and for fuelwood.⁴⁰ Their harvesting kept mangrove growth before 1936 at practically null levels, as in all other islands in the same archipelago. Ownership by the Institute changed it. After 1935, the Institute left a security guard in the island, mainly for fear that the local fishermen would help themselves to the expensive Rhesus monkeys for dinner, in addition to the usual crabs. The Station kept a lookout to prevent what Lejeune called “invasions”—in fact, the mangrove harvesting that had gone on for ages. With less interference from its neighbors, the mangrove at Pinheiro Island grew practically undisturbed for the next sixteen years, all the new trees protected by the Institute, and thus showed exuberant vegetation in 1952. The mangrove growth helped increase the area of the island by almost 26.5% circa 1953.⁴¹

³⁹ Oliveira, "Aula 1917."

⁴⁰ Oliveira and Krau, "Levantamento Biogeográfico II," 503.

⁴¹ Oliveira and Krau, "Estudos Aplicados," 103. It is easy to imagine that the local population's extractive activities were responsible for keeping the siltation levels in check in the other islands, but Lejeune did not write on this subject, and there is not any comparison to area increases in islands where the population kept collected mangroves for fuelwood. Pinheiro Island was still increasing fast its area and elevation in 1977, but then the mangroves had little to do with it. The landfills to build the University City, the sanitary dumping site at Caju promontory, and other landfills in the Inhaúma cove caused higher siltation than any mangrove.

However, Lejeune was alarmed. Siltation and increased land area were not the only gifts from Guanabara Bay to the Pinheiro Island: he had only to observe the brown water to realize that pollution was pervasive. The fishermen called it the “Águas da City” (City waters), and it happened when the sewage company Rio de Janeiro Improvements City released its poorly-treated waters in the bay. The water had a dark color and fecaloid smell, with high concentrations of *Escherichia coli* bacillus, and the new water regime, altered by the landfills at the University of Brazil, allowed little dilution by seawater.⁴²

Pollution was also caused by refuse from Rio, dumped on Sapucaia Island, and the Oil Refinery of Manguinhos, which was soon joined by oil from the new Refinery of Duque de Caxias, in 1961. Since 1953 the Manguinhos Refinery released oil effluents in the water, and sometimes from its chimneys, an almost unbearable stench reached the Pinheiro Island. Additionally, the waters from the rivers Jacaré and Farias, which drained into the Inhaúma Cove, often appeared in all colors, courtesy of the textile industry upriver.⁴³ The scientists had some respite in 1959, when city hall passed a law to incinerate garbage instead of dumping it at Sapucaia Island. For a short period, there was a small improvement in the waters of Inhaúma. But it was literally a drop of water in a dirty ocean.

By 1960, everything had changed on Pinheiro Island. The location that had made it such a perfect place to observe crustaceans—with fresh water from three rivers, in a secluded cove, surrounded by other small islands—had now turned into one of the most

⁴² Lejeune Pacheco Henrique de Oliveira, "Levantamento Biogeográfico da Baía da Guanabara," *Memórias do Instituto Oswaldo Cruz* 48 (1950): 391.

⁴³ Lejeune Pacheco Henrique de Oliveira, "Prospecção Hidrobiológica da Baía de Sepetiba," *Memórias do Instituto Oswaldo Cruz* 69, no. 1 (1971): 18. Lejeune was specially bothered by this kind of pollution, because he used chromatic analysis to monitor the levels of organic pollution. Obviously, tons of green aniline arriving from the river tended to alter the results of the analysis.

polluted spots in Guanabara Bay—receiving industrial pollution from the same three rivers, trapped in a close cove where water barely circulated, hindered by landfills and a huge artificial island, drenched in oil and suffocated by garbage. The Rhesus monkeys no longer dove in the sea at Monkey beach, to fish and to eat the oysters and mussels—because there were no longer any mussels, and an unattractive film of oil now covered the water.⁴⁴ The mangrove mud had such a stench that any supposed therapeutic properties just were not enough to convince people to use it even on dogs or horses.⁴⁵

Finally, Lejeune in 1960 wrote to the Oswaldo Cruz Institute that, if they wanted to establish a first-class hydrobiology station, it had to be relocated outside of Guanabara Bay.⁴⁶ He still insisted on this idea in his last report to the Institute in 1977. He then wrote that “the waters [of Inhaúma Cove] in 1937-1957 were very good, worsening from 1957-1967, and eventually, after 1967, it was useless to have the Hydrobiology Station in Pinheiro Island.”⁴⁷

Fishermen, favelas and safety

If the island's natural environment was changing, so was the relationship between the island and the nearby human population, and between scientists and fishermen. Transformations in the landscape and in the population at Inhaúma cove and Pinheiro Island were a sobering metaphor for the changes taking place in all Guanabara Bay. Lejeune's reports, and his reaction to his new neighbors, showed an amazingly clear

⁴⁴ Oliveira, "Aula 1917."

⁴⁵ Oliveira, "Poluição das Águas Marítimas," 49.

⁴⁶ Lejeune suggested that the best location could be Guaratiba, in the Sepetiba Bay, which was more open to the ocean than Guanabara Bay. Lejeune Pacheco Henrique de Oliveira, "Conditions for Marine Biological Laboratory in Rio de Janeiro" (Unpublished article, Rio de Janeiro, May 4 1960).

⁴⁷ Lejeune Pacheco Henrique de Oliveira, "Relatório Anual 1977 - Laboratório de Hidrobiologia, Atividades Realizadas" (Report, Rio de Janeiro, March 3 1977).

picture of how the natural environment and the social environment were connected in the Bay, and how this connection had very tangible impact on the daily work of the scientists.

Fishermen, the traditional residents of the Inhaúma Cove, initially found Pinheiro Island even more attractive after the creation of the University's artificial island. Mangroves were a fundamental part of their lives and knowledge. Other than firewood, they also used mangrove mud for skin rashes.⁴⁸ Small Aratú crabs that lived on the mangrove trees or between the rocks were indications to fishermen of good waters, of abundance of fish.⁴⁹ Thus when the landfills of Manguinhos Airport and the Universidade do Brasil buried hundreds of hectares of mangroves, the remaining mangrove marshes—such as those of Pinheiro Island—became highly coveted.

Illegal mangrove and crab harvesting by the traditional fishermen population soon proved to be the least of the problems for the island. After the World War II, the federal government had sponsored new campaigns against malaria, which relied on heavy applications of DDT insecticide. The combination of DDT-based sanitization and landfills in Inhaúma cove attracted a new, impoverished and house-hungry population to the previously malaria-infested Northern suburbs of Rio, now turned into large shantytowns, the “favelas.” Lejeune estimated that over one million people lived in those suburbs, all without adequate sanitary facilities.⁵⁰ This new population added their organic pollution and untreated sewage to the pollution from the rampant

⁴⁸ Oliveira, "Poluição das Águas Marítimas," 49.

⁴⁹ Oliveira, "Aula 1917."

⁵⁰ Oliveira, "Aula 1917."

industrialization in Rio de Janeiro in the 1950s.⁵¹ More people and fewer mangroves in the nearby islands spelled trouble for Pinheiro Island.⁵² The security guard, himself a local, tried to prevent massive invasions and heavy tree harvesting, but he would close his eyes every now and then to fishing and mud collecting. After 1960, the island no longer risked invasions by either favelados or fishermen to catch *Uca* crab: pollution had eliminated most of them.⁵³

With the remarkable growth in the 1950s, the population in the Guanabara Bay basin went from 3.181 to 4.874 million inhabitants by 1960. Almost a million of these new residents were located in the municipality of Rio de Janeiro, then known as the Federal District.⁵⁴ In 1950 there were 169,305 living in shantytowns; by 1960, it was 335,063—a 98% increase in ten years—one third of which lived on the landfills and shores of Guanabara Bay and its lakes, many in palafittes.⁵⁵ (See Fig. 16).

⁵¹ For the impact of industrialization in Guanabara Bay, see Chapter 5.

⁵² In fact, until 1960, many “favelados” (favela dwellers) invaded the island to catch crab. Oliveira, “Aula 1917.”

⁵³ Crabfish, as well as shrimp, is very sensitive to pollution. In 1948, Drach decided to keep in the aquaria some crabs caught around the island to observe their exoskeleton change. He had created a cascade system to renew the water in the aquaria by pumping water from the Inhaúma cove. But he found out that sometimes a countercurrent brought polluted water to the pipe in front to the Sapucaia channel, and it contaminated the aquaria. The next day, the labs were fetid, the stink of dead or agonizing crabs heavy in the air. The student and lab assistant Arnaldo Miranda soon learned the translation for vivid French cursing against the location of a hydrobiology lab within a bay. New crabs were caught, new water pumped into the aquaria, but at the next new moon or full moon cycle, the animals would die again. Oliveira, “Poluição das Águas Marítimas,” 14.

⁵⁴ See Chapter 1 for population estimates. The population in Guanabara Bay increased an average of 5,32% per year during the 1950s, compared to 4,26% in the previous decade, and 4,14% in the 1960s. Secretaria de Estado de Planejamento Desenvolvimento Econômico e Turismo - SEPDET, *Anuário Estatístico do Estado do Rio de Janeiro - Volume 18* [webpage] (Governo do Estado do Rio de Janeiro, 2002 [cited June 20, 2003]); available from <http://www.cide.rj.gov.br/produtos/anuario02/principal.htm>.

⁵⁵ Abreu, *Evolução Urbana do Rio de Janeiro*, 167; Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 356.



Fig. 16 - Favela da Maré (Slum of the Tide), 1951. Photograph by Arquivo Nacional in Relry, Barbosa, and Ximenes 2001

In Lejeune's view, The population around the Bay had changed, both in quantity and quality. It is telling that until 1957, he referred to the local population as "fishermen" and after that, as "favelados." As he wrote in 1958, the new favelados were bolder, more aggressive young inhabitants, and more numerous than the fishermen he met in 1937. The favelados were equally aware of class differences between the residents of Pinheiro Islands (the scientists) and themselves, but showed less deference the scientists than the fishermen once did. According to Lejeune, the young population understood the biologists as "doutores," or wealthy, and therefore should practice what Lejeune ironically called "forcible income distribution."⁵⁶

The relationship between the scientists and local population was thus often full of conflicts. Initially, the Institute prevented the population from gathering fuelwood and

⁵⁶ Oliveira, "Relatório Anual 1958". *Doutor*, or doctor, is an honorific used by poor people to identify anyone belonging to the elite in Brazil.

shellfish from the island; by the 1960s the scientists sensed they had to protect themselves and their equipment instead. Security was enough of concern that Lejeune in 1961 asked the Institute to invest in a shelter for the equipment.⁵⁷ Also for security reasons, Lejeune requested a phone line, or a radio, to be installed on the Island. To justify the request, he explained the dangers for anyone arriving late at the Station. In the previous year, a visitor from the Institute arrived to the Island at night, with an urgent message to Lejeune. The visitor asked a young man to look out for his car and took a ride with a local boatman, the first one he met at the docks. The next day, Lejeune found out that his good Samaritan was the infamous gang boss, “Lavanca”, and that the visitor had left his car under the watch of the equally infamous thief, “Meloso.”⁵⁸

According to Lejeune, researchers and interns risked their lives and personal goods simply being in the wrong place at the wrong time—usually before dawn. In a 1958 report, Lejeune listed a series of personal objects stolen and injuries suffered by his team during field trips: watches, a car, wallet and documents, head trauma, threats of evisceration or castration, and more.⁵⁹ As dangerous Inhaúma Cove might have become for the scientists, it was even more dangerous when they left the known area to collect samples in places where the local population did not know the scientists. For instance, while collecting material from the Lagoa Rodrigo de Freitas, the sampling boat arrived too close to the kitchens of the Favela da Praia do Pinto, an infamous shantytown in the

⁵⁷ The shelter—with a lock—was for the water pump used for the aquaria at the Praia do Sapoti. It would be stolen otherwise, and the scientist found it would be impossible to use it if they had every day to mount it at the beach and then remove it at dusk. Lejeune Pacheco Henrique de Oliveira, "Relatório de 1961 - Cópia do Entregue ao Prof. H. Lent em 12 de Dezembro de 1961" (Report, Rio de Janeiro, 1961).

⁵⁸ Oliveira, "Relatório de 1961". The request for a telephone in the Island was never answered; the Institute itself had but one line until late in the 1960s. It took four years but Lejeune finally convinced the Institute to keep a night janitor at the Pinheiro Island, sleeping on the floor of the laboratory.

⁵⁹ Oliveira, "Relatório Anual 1958".

1950s. The biologists were threatened with stoning for two months “until the favela dwellers realized that we were not there to relocate them or to plot for their removal. After that we were like ‘pals’”.⁶⁰ The favelados’ fear was not unreasonable. Forcible removal of favelas was policy for several administrations in the Federal District and State of Rio de Janeiro. The Praia do Pinto favela was eventually removed during a major project of public sewage and drainage in the Lagoa Rodrigo de Freitas in the late 1960s.⁶¹

Addressing conflicts between scientists and the local population required some strategy and ingenuity on Lejeune’s part, and probably on the population’s part as well. For research at Lagoa Rodrigo de Freitas, Lejeune hired an old man, *Seu Leão*, well respected in the local community, to look after the equipment. If his frail appearance would not keep potential thieves away, his well-known divine protection would. Every night, *Seu Leão* prayed to Iemanjá of the lagoons, and lit candles to the Afro-Brazilian goddess. While this man was the night lookout for the Institute at Lagoa Rodrigo de Freitas, nothing ever disappeared or was vandalized in the Institute’s premises.⁶² Lejeune tried as much as possible to use local people in his field trips—probably because they knew better than anyone else the best sites for collecting fish and other biological samples, and also as a way to work out the relations with the local community. Sometimes it worked and sometimes, it did not, as the Institute’s bureaucracy was at

⁶⁰ Oliveira, "Relatório Anual 1958".

⁶¹ Licia do Prado Valladares, *Passa-se uma Casa: Análise do Programa de Remoção de Favelas do Rio de Janeiro* (Rio de Janeiro: Zahar Editores, 1980). The removal of the Praia do Pinto favela was a particularly questionable episode. According to the local witnesses, the favela caught fire and the firemen never arrived to help the residents, despite insistent calls. After the fire, the residents had no option but to relocate to the new and distant housing project called *Cidade de Deus* (City of God). See Janice Perlman, *O Mito da Marginalidade* (Rio de Janeiro: Paz e Terra, 1977), 105.

⁶² Oliveira, "Poluição das Águas Marítimas," 34.

times an obstacle to this practice of hiring locals.⁶³ The daily tribulations of doing research in a marginal, isolated lab had never been easy, but it worsened by the late 1950s, when the Oswaldo Cruz Institute suffered its own crises.

Making science in Guanabara Bay

By the mid-1950s, the Hydrobiology Station faced at once an environmental and institutional crisis. While pollution, siltation and population growth threatened its purposes, the financial crisis challenged the continuity of the station itself, requiring the scientists to be rather creative in their daily activities. After ten years of the Henrique Aragão and Olympio Fonseca's administrations, both good friends of Lejeune, the new directors had little to do with hydrobiology, and even fewer resources to invest in a Station that could soon prove impracticable.⁶⁴

Life on Pinheiro Island was an unenviable existence. Always poorly funded, by the 1960s most of the lab work was done by Lejeune de Oliveira and Luiza Krau. Personnel at the Station varied over time. Occasionally, they had interns and, in good times, one or two researchers. These researchers were usually in the same situation as Luiza's, that is, without a permanent connection with the Oswaldo Cruz Institute. During the 1950s, after the Henrique de Aragão administration, personnel at the Station were

⁶³ In 1958, Lejeune carefully planned a campaign to the Saquarema Lake. Lejeune and Luiza trained a local fisherman, Mario Manoel dos Santos, to collect samples for a fortnight in the lake, for a small pay. They then asked the Institute to assign their own janitor to accompany the fisherman with the necessary equipment. The Institute sanctioned the latter, but not the former. As a result, the janitor went alone to the Saquarema Lake with the precious equipment. As he was illiterate, did not swim, and did not know the lake, the trip was perfectly useless. Oliveira, "Poluição das Águas Marítimas," 18.

⁶⁴ After Olympio Fonseca left the office in 1954, his successors usually lasted for two or three years each.

particularly scarce.⁶⁵ Occasional interns could sometimes be more trouble than help.

Internships were badly paid, almost five times less than what an entry-level biologist at the Water Department could earn. However, the prestige of working for the Oswaldo Cruz Institute was a powerful incentive.⁶⁶ Besides the scientists and the lab assistants, the Hydrobiology Station also counted on a janitor and a fisherman.⁶⁷

They all worked far beyond any job description. Luiza and Lejeune arrived early on Mondays to the Island, and left on Fridays—that, whenever the nature of their job did not require weekend activities. To avoid paying extra to the janitor or the fisherman, they performed many tasks themselves, including driving the boat. Other than classifying and studying the samples, Luiza and Lejeune cleaned, cooked, typed reports, tallied numbers and expenses, and built research equipment. One of the fishermen soon learned to wash slides and to prepare echinoderms for analyses. Another learned to stitch plankton nets, to separate crustaceans from mollusks, to catch crabs and to read thermometers—even though he was illiterate.⁶⁸

⁶⁵ Maria Gloria Hermide, Aloísio Mello Leitão—the former assistant of Henrique Aragão—and Sebastião Silva had worked in creation of the station in 1948, and they were part of Aragão's plans for the future of station. The Oswaldo Cruz Institute dismissed all three in 1950. Oliveira, "Curriculum Vitae."

⁶⁶ In 1961, Lejeune complained that intern Leo Soares was accumulating the internship wages and a regular job at the department of water, plus the work of topographer at the city hall. He earned with these outside jobs the lump sum Cr\$35,000.00 (US\$187.26)—and did little of the work for which his internship paid. Soares did not care his stipend at the Island was less than one tenth of his total wages, as the internship at the Institute bolstered his status in the water department. Lejeune Pacheco Henrique de Oliveira, "Relatório Anual 1959 - Atividades, Programas e Ocorrências da Estação de Hidrobiologia do Instituto Oswaldo Cruz" (Report, Rio de Janeiro, 1959).

⁶⁷ The janitor was Jacinto Lopes (hired probably in 1958), and the fisherman was José Porcino da Silva, who worked for the station since the time of Penido, in the 1930s. José Porcino had a heart condition, and Lejeune insisted since mid-1950s that he needed help. In 1961, Ângelo de Rodrigues Pedro—Mestre Ângelo—was finally hired. He was good with engines, a necessary skill when the only boat in the island broke so often, and stayed with the Station until 1975.

⁶⁸ Krau, Interview; Oliveira, "Relatório de 1961."

Work hours depended on the tide. From July to September the nine-to-five system based on Oswaldo Cruz Institute rules could not possible work; they had to arrive earlier and leave later, because of high tides. The midday wind, arriving punctually at noon, required most collecting field trips to start early in the morning. When the janitors needed to get clean water for the aquaria, they had to leave at 4 a.m. and return at 7:30 a.m. As they took the only boat at the station, nobody could go to the island until they returned to the docks.⁶⁹

Sharing the island with the monkeys could also be trying. The monkeys were kept away from the lab roof with an electric net, installed in 1961. Before that, the roof was their favorite shelter against tropical rainstorms.⁷⁰ Everyone learned soon to keep all lab doors closed, lest they find a Rhesus monkey party the next day. Any daily activity had to consider their presence in the island. Schooled from this experience, the biologists were extremely careful when transporting anything in a package that could be mistaken by the monkeys as food.⁷¹

Equipment loss from regular use could jeopardize a study. Already badly outfitted, Lejeune knew the Institute could ill afford equipment replacement. In 1944, they were still using the same laminas and other equipment bought by Gomes de Farias in the 1910s.⁷² A precious Austrian dredge, a thermometer made in Switzerland (not well

⁶⁹ Oliveira, "Relatório de 1961."

⁷⁰ Oliveira, "Relatório de 1961."

⁷¹ For instance, until 1964, food arrived daily from the mainland, in huge metal containers of rice, beans, meat and vegetables. Early after her arrival, Luiza, who favored a natural diet and had not eaten red meat since her adolescence, decided to bring her own fruit and fresh vegetables. When she was arriving at the lab, a huge Rhesus monkey descended on her and all the fruit fell to the ground. Immediately, other monkeys came to investigate the turmoil, and soon seized all fruit. Luiza ate rice and beans that week. Again. Krau, interview.

⁷² Oliveira, "Poluição das Águas Marítimas," 8.

adapted to tropical waters), plankton nets, timers, all were treasured and jealously counted after every field trip. Luiza and Lejeune soon learned that they should improvise, if they wanted anything done. They manufactured Bunsen burners with small bottles, alcohol and a fuse made of rope; they replaced old plankton nets with new ones made of an old parachute silk.⁷³ The imported water bottle provided by the Institute, an expensive piece, was old and inadequate to tropical waters; Lejeune designed a model for a substitute himself and tried to convince the Oswaldo Cruz Institute to build and patent it.⁷⁴

Improvements in the facilities of the island were few and far between, and only after many insistent requests to the Institute. After the installations were inaugurated in 1949, no other renewals took place in the aquarium until 1962.⁷⁵ Many laboratory experiments were compromised by the increasing pollution, and the laboratory itself was sorely outdated to make up for the new conditions.⁷⁶ The boats' maintenance was more critical, and could not wait for the Institute's bureaucracy. The boat bought in 1951 by

⁷³ The Petersen dredge—to collect soil from the bottom of the bay—was a bigger challenge. In 1959, the lab has only one, Swiss-made, heavy, precise, and very expensive. Loosing a dredge at the bottom of the bay could be an unfortunate incident to most American or European researchers, but it was considered a normal risk in the fieldwork. For Luiza and Lejeune, it was a constant nightmare. They then hired a blacksmith in a suburb of Rio and for the price of a few dozen of pounds of iron, they had three new dredges made after the Swiss model. The original was kept under lock and key at the Pinheiro Island, while the homemade dredges were used in the field trips. Oliveira, "Relatório de 1961".

⁷⁴ Oliveira, "Relatório Anual 1958".

⁷⁵ The aquaria in cascade planned by Drach in 1949 were simple and inexpensive, but it became obsolete five years later. Its goal was to keep continuous water circulation in the aquarium. The water entered in the higher aquarium, fell into the next one and so on, until it reached the last aquarium. It was then discharged back into the bay. It relied on pumping water from the closest beach, continuously, which in 1953 was extremely polluted. If the scientists wanted live animals in their aquarium, water had to be obtained far away from the Inhaúma cove. Oliveira, "Poluição das Águas Marítimas," 51, 55.

⁷⁶ In the mid-1960s, a small house was built for the janitor José Porcino, so he would no longer sleep on the floor of the main lab. This house, plus the new aquaria designed by Lejeune in 1962, was the sum of the Institute's investment in the Station's facilities in the 1960s. Oliveira, "Conditions for Marine Biological Laboratory".

the Institute was intensively used, and broke often.⁷⁷ For some field trips, Lejeune used equipment borrowed from the Navy. On other occasions, he required transportation from the institution collaborating with the Oswaldo Cruz Institute. Sometimes, Lejeune just borrowed a boat from friends to work in Sepetiba Bay.⁷⁸

Creativity and friendship (or networking) were critical elements to Lejeune and Luiza's work at the Station. Indeed, it was their networking abilities that enabled them to propose a new path for the station, turning the pollution surrounding the island from a threat into their new research focus.

From Hydrobiology Station to Monitoring Pollution

Networking in Guanabara Bay

Networking—collaboration with outside institutions—was an old tradition in the Oswaldo Cruz Institute. It brought funding, equipment and opportunities for research; it also brought prestige, when the partners were well-reputed institutions in the country or even better, from abroad. Since its creation, the Institute had made a point of keeping up with the most advanced research centers in the USA and Europe. For Lejeune and Luiza, networking was part of their job description since the early years of activity at the Hydrobiology Station. They were well connected with the Navy and Rio de Janeiro's Water Department, and developed many joint activities with Captain Paulo Moreira da Silva and public health expert Fausto Guimarães. Particularly after mid-1950s, when they

⁷⁷ In 1961, when the boat helices broke, Lejeune—and the island personnel—could hardly wait the long administrative times of the Oswaldo Cruz Institute. The costs of reparation were split among interns and scientists, and they had the helices changed. When they broke again, a friend of Lejeune's just lent some used helices. Oliveira, "Relatório de 1961."

⁷⁸ Oliveira, "Relatório Anual 1958."

couldn't afford depending on the Oswaldo Cruz Institute to provide for many of the Station's activities, Lejeune and Luiza turned to these connections for help. To some extent, it was exactly their marginality on the Institute's agenda that allowed them the latitude to restructure the Station to face the new challenges of pollution, irrelevance to the Institute and underfunding.

International networking was a priority, for many reasons. First, it was what the Oswaldo Cruz Institute expected from Lejeune de Oliveira. Therefore, exchanging correspondence and collections with international institutes was as much part of the scientists' work as keeping the Monkeys away from the lab or cleaning the Bunsen burners. Second, international visitors gave visibility to the Station, whose purpose and utility to the Institute was permanently being questioned, especially when it was time to allocate funding to different departments.⁷⁹ Third, international visitors could mean grants. All departments in the Oswaldo Cruz Institute were strongly encouraged to find funding from domestic or international agencies. And if not grants, international visibility could mean access to international publications, which was also one of the Institute goals in the 1960s. These efforts paid, at least partially. The island hosted several scholars working on tropical hydrobiology, and the best aquaria in the world exhibited marine collections from Pinheiro Island.

However, it was the national partners that yielded more support to the Station's regular activities over the years: the Navy and the Water Department at Rio de Janeiro city. The Station's links with the Navy since 1945 were well documented. Lejeune was

⁷⁹ Lejeune's reports are, in this sense, a fantastic exercise in name-dropping. He kept careful record of every foreign scholar who ever visited the island, and even those with whom he exchanged correspondence or collections.

then one of the first members of the Navy-sponsored Brazilian Oceanographic Institute, and was a good friend of its director, the former Navy Minister Admiral Dodsworth.⁸⁰ Lejeune used his connections at the Brazilian Oceanographic Institute to borrow boats belonging to Hydrography and Navigation Division to his field trips. Moreover, the participation of Admiral Dodsworth was instrumental for the planning of the few oceanographic expeditions carried out by the Oswaldo Cruz Institute.⁸¹

This relationship proved to be more personal than institutional, as there is little evidence of institutional collaboration between the Navy and the Oswaldo Cruz Institute beyond the Hidrobiology Station. But in the meantime Lejeune struck a mutually profitable relationship with Captain Paulo Moreira da Silva, who would become one of the most important names in Brazilian oceanography.⁸² Moreira da Silva employed the Hydrobiology Station for his own research, and Lejeune used the ships and sometimes grants from the Navy to carry out his own activities. For example, in 1958, Lejeune obtained three fellowships from the Navy to analyze and classify some species collected by its oceanographic division—and used this funding to buy new equipment for his lab. Curiously, this was also one occasion when the relationship almost went sour. An incompetent intern, who also worked for the Rio de Janeiro's Water Department, was unable to classify the plankton and sent the species to the University of São Paulo's lab. Moreira da Silva found out about it and revoked the fellowships for the Pinheiro Island.

⁸⁰ Oliveira, "Curriculum Vitae." Dodsworth was a fellow officer of Frederico Villar in the 1893 Fleet Rebellion. For more information on the Instituto Oceanográfico Brasileiro and on Frederico Villar, see Chapter 3.

⁸¹ The scientific expeditions took place aboard the Navy's oceanographic ships *Lahmeyer*, in September 1945 and 1947, the *Aspirante Nascimento*, also in 1947, and the *Rio Branco* in 1948. Lejeune Pacheco Henrique de Oliveira, "Relatório Sobre as Excursões Científicas Feitas a Bordo do Navio Hidrográfico Rio Branco, Sob a Orientação do Professor Pièrre Drach, da Sorbonne," *Memórias do Instituto Oswaldo Cruz* 47, no. 1/2 (1949).

⁸² See Chapter 3.

Lejeune complained that this intern's thoughtless actions had "jeopardized a warm relationship that had taken him years to establish and that would take again more years of personal efforts to reinstate."⁸³ The episode is significant as it illustrates how Lejeune perceived networking as part of his scientific career, and how these relationships had to be carefully preserved.

As much as Lejeune could complain of the inept intern, his presence at the Station was indicative of Lejeune's other important partner, the Water Department. This partnership also resulted from a personal relation of Lejeune's, this time with Fausto Guimarães.⁸⁴ Guimarães' interest in hydrobiology was strictly linked to public health, and he had a vested interest in supporting Lejeune's studies in pollution. The collaboration between the Water Department and the Oswaldo Cruz Institute was not restricted to the Pinheiro Island Station, but this aspect was well developed. In 1958, Lejeune directed the first Brazilian Conference on Hydrobiology, co-organized by Fausto Guimarães.⁸⁵ Lejeune and Luiza's research at Lagoa Rodrigo de Freitas was also done in collaboration with the Water Department.⁸⁶

⁸³ Oliveira, "Relatório Anual 1958."

⁸⁴ Guimarães concluded the Application Course at the Oswaldo Cruz Institute by the same year Lejeune was admitted. But Guimarães had since focused on public health, including a gruesome participation in controlling a typhoid fever in Angra dos Reis, 150 miles south to the city of Rio de Janeiro. After this episode, Guimarães worked for the Water Department of the Federal District, which was subordinated to the Health National Department. Fausto Pereira Guimarães, Interview to Cristina Fonseca, Rio de Janeiro, June, 1997. Fundação Casa Oswaldo Cruz. For more on Guimarães and his role in addressing water pollution, see Chapter 5.

⁸⁵ The Conference also counted with the presence of other key hydrobiology research center, such as the National Museum and the São Paulo Institute of Oceanography (Instituto Paulista de Oceanografia.) Oliveira, "Curriculum Vitae."

⁸⁶ Oliveira, "Relatório Anual 1958"; Lejeune Pacheco Henrique de Oliveira et al., "Observações Hidrobiológicas e Mortandade de Peixes na Lagoa Rodrigo de Freitas," *Memórias do Instituto Oswaldo Cruz* 55, no. 2 (1957).

Turning point: embracing pollution

Eventually, Fausto Guimarães was responsible for opening a new door for Lejeune de Oliveira and the Hydrobiology Station. Guimarães's Water Department had several partnerships with the Institute of Inter-American Affairs, and in 1957 it brought Alfred F. Bartsch, a scientist from the U.S. Public Health System, to teach a course on polluted waters to the department's staff. It seemed natural for Guimarães to extend the invitation to the personnel of the Hydrobiology Station. The course gave Lejeune the idea he needed to reinvent the purpose of the Station.⁸⁷ After all, each year it became more difficult to make significant hydrobiology studies of fauna and flora in "normal" conditions, when the waters of Inhaúma cove were all but "normal."

In the following year, Lejeune published his first article on pollution in the Guanabara Bay's waters and its impact on fauna and flora. He also expanded on what he sensed was the only possible use for the Hydrobiology Station, and he did not spare the Institute from some pkes of irony. In stark contrast to his previous assessment of Pinheiro Island, "an enviable location to study crustacean," he wrote:

Regarding pollution in Guanabara bay, our goal is not to describe pessimistic aspects, or to criticize the location of the Hydrobiology Station at Pinheiro Island, neither is it to complain against embankments, or against the progress in the neighborhoods near Manguinhos, where the placid neglect of one time has been replaced by the hardworking rhythm of the factories; however, we want to publish some data that may be useful for those who want to study the biology of our bays and coves. (...) Many pollution-oriented hydrobiology labs [in the US] are located on the shores of the most polluted waterbodies, and their location is critical for the monitoring, and physical, biological and chemical observations. On this point of view, we should appreciate the location of our labs at

⁸⁷Oliveira, "Poluição das Águas Marítimas," 38.

Pinheiro Island, in front to the Sapucaia channel, where pollution increases every day.⁸⁸

Not only was the Station well located to monitor pollution; it could do little else. By 1961, the only thing scientists could observe in the Pinheiro Island's aquaria was the fauna and flora in meso and polisaprobic regimes, or in other words, in polluted and more polluted waters.⁸⁹

Clearly, studying pollution was not new for Lejeune or the Institute. Between their work in Guanabara Bay and the surrounding lakes, Lejeune and the Institute provided the most important references on hydrobiology for the Rio de Janeiro government. Lejeune had already done some earlier work on pollution. In 1953 he worked with the city government to study the causes of mass fish death at the Lagoa Rodrigo de Freitas. The phenomena of mass fish death had been registered in city documents since the eighteen century, and had become more frequent by the twentieth century. For this reason, the city government requested studies from the Oswaldo Cruz Institute. The Government officials were alarmed by the massive fishkill documented in August 1946 and April 1948, when the bay woke with a three mile strip of dead fish floating on its waters, two to three meters wide. The cause was the same as always (overpopulation of the dinoflagellata), but this time Lejeune suggested the formidable increase of nutrients in the bay from industrial and domestic sewage, had brought about the bloom.⁹⁰

⁸⁸ Oliveira, "Poluição das Águas Marítimas," 40.

⁸⁹ Oliveira, "Conditions for Marine Biological Laboratory."

⁹⁰ In these studies Lejeune just continued the work of another Oswaldo Cruz Institute's scientist, Gomes de Farias. Gomes de Farias had studied the red tides in Guanabara Bay in 1913 that caused an unprecedented fish kill. Gomes de Farias identified the overpopulation of *Glenodinium trochoideum* stein, a toxic dinoflagellata in the phytoplankton, as the culprit for the fish kill, but it was not clear what had caused that bloom. It was just clear that the dinoflagellata exhausted the oxygen in the waters, and the fish died asphyxiated. Oliveira, "Curriculum Vitae."

What was new was Lejeune and Luiza's full embrace of studying pollution as the main mission for the Station. Luiza abandoned her studies on Echinoderms to focus on Rotatoria, which were easier to find in the polluted waters of Guanabara Bay, and which were also better indicators of new pollution levels.⁹¹ The shift from pure scientific studies to pollution monitoring required some adaptation to the facilities at Pinheiro Island, as well as the relationship between Lejeune and the Oswaldo Cruz Institute. Thus instead of repeating his requests for better labs to study marine biology in a natural habitat, Lejeune personally designed and installed in 1962—sometimes taking the hammer himself—a larger aquarium for pollution tests.⁹²

Embracing pollution studies did not noticeably increase the Station's status within the Oswaldo Cruz Institute, but it gave Lejeune and Luiza even more visibility among their usual partners. The Station became the scientific reference for pollution studies in Guanabara Bay. At one point, anybody interested in pollution stopped by the island, and the island was probably the best place to find out about potential plans or policies for Guanabara Bay. Even the creation of the Institute of Sanitary Engineering (IES) by Fausto Guimarães appeared in Lejeune's 1961 report to the Institute.⁹³ Moreover, after the IES was created, Lejeune and Luiza taught marine biology and ecosystems to virtually all personnel of that institution.⁹⁴

Eventually, the biologists took their work beyond Pinheiro Island to wherever Guanabara Bay was discussed. Barbosa Teixeira, a safety engineer at the Petrobrás

⁹¹ Oliveira, "Relatório de 1961."

⁹² Oliveira, "Conditions for Marine Biological Laboratory."

⁹³ Guimarães told Lejeune his plans for the Institute of Sanitary Engineering in one of his long visits to the Pinheiro Island laboratory Oliveira, "Relatório de 1961."

⁹⁴ Krau, interview.

Refinery at Duque de Caxias, organized a round-table in 1961 to discuss potential pollution in Guanabara Bay. The refinery would begin work in that year, and Teixeira wanted to avoid blame for previous pollution as much know what could possibly be done to avoid further pollution. Among the eight participants of the roundtable, there sat our trio of friends: Guimarães, Moreira da Silva and Lejeune.⁹⁵ Lejeune's work influenced studies on Guanabara Bay even when he did not personally participate in the project. In 1961 the Ministry of Transportation and Public Works (*Ministério de Viação e Obras Públicas*) organized a taskforce on pollution in Guanabara, then reputed as the most polluted body of water in the country. Although Lejeune was personally present, his observations about the Pinheiro Island opened the report produced by the working group.⁹⁶

Developing Biological Indicators

The relevance of Lejeune and Luiza's work for Guanabara Bay derived from three main factors: the location of the Station, the duration of its activities, and their methodology. The importance of where and when is clear. From 1937 to 1977, the Hydrobiology Station's activities coexisted with the reoccupation of the northern area of Rio de Janeiro, an amazing demographic increase along the bay, through post-war industrialization boom, and the development of the chemical industry, and large landfills to the north. It was also located in a secluded cove, especially vulnerable to all these changes. Admittedly, all of Guanabara Bay not was changing at the same pace of

⁹⁵ Barbosa Teixeira, "Poluição da Baía de Guanabara." At a second roundtable organized by the same Teixeira, nine years later, the three were again invited and virtually every other attendee had been a student of Lejeune or Fausto Guimarães at one occasion or another. Lejeune Pacheco Henrique de Oliveira, "Relatório Anual 1970" (Report, Rio de Janeiro, 1970).

⁹⁶ Secades, "Relatório do Grupo de Trabalho," 4.

Pinheiro Island. But the island itself served as a textbook laboratory experiment of what could happen to Guanabara (see Fig. 17).



Fig. 17 - Healthy mangrove, Guapimirim, Guanabara Bay, 2000. Photograph by Carlão Limeira Rio de Janeiro (RJ). Secretaria Municipal de Meio Ambiente, *Manguezais do Rio de Janeiro* (Rio de Janeiro: Secretaria, 2000).

Methodology was also unique to the Hydrobiology Station for its emphasis on biological indicators to identify levels of pollution. The Water Department, and later its successor agency, the IES, was responsible for monitoring the quality of fresh water in the city and the quality of the beaches, and it had few if any biologists on its payroll. It mostly employed engineers, and the department identified pollution by chemical tests on biochemical oxygen demand, or the concentration of bacteria at recreational beaches.⁹⁷ This said little about the overall state of the bay, and could vary greatly from one tide to another. Instead, Lejeune argued that small animals such as the *Uca Lestodaty* (a small tidal crab) and the snail *Ceritium attractum* could be excellent pollution indicators,

⁹⁷ Victor M. B. Coelho, *A Poluição da Baía da Guanabara, Antecedentes e Situação Atual* (Rio de Janeiro: FEEMA, 1987), 24; Guimarães, "Interview." See Chapter 5.

because their presence would suggest good water, with no need for more expensive chemical analysis or equipment. Both species are dependent upon diatomaceous and worms that are very sensitive to pollution.⁹⁸

Measuring the gradual disappearance of species that were vulnerable to pollution as biological indicators had a special meaning to the existence of the Hydrobiology Station. Lejeune and Luiza first noticed the scarcity of these animals because they were needed for lab experiments at the Oswaldo Cruz Institute. Luiza's subjects, echinoderms, were particularly telling. In 1937 echinoderms had been described and analyzed in the Institute's laboratory; fifteen years later, they seemed to be scarcer than even the record suggested.⁹⁹

In 1958, Lejeune and Luiza published articles claiming pollution was changing the biota of Guanabara Bay, as more and more species were disappearing. These articles were published at the same time that Rachel Carson was writing her groundbreaking book *Silent Spring*. Lejeune and Luiza then developed a scale that described six degrees of pollution.¹⁰⁰ Lejeune was reporting more than the loss of biodiversity in Pinheiro Island (and by extension, Guanabara Bay); he was also reporting the loss of usefulness of the Station itself to the Oswaldo Cruz Institute. If the initial motivation for the Hydrobiology Station was to collect marine samples for studies at the different departments in the Institute, each new degree of pollution, each new set of species that disappeared, meant a

⁹⁸ Lejeune Pacheco Henrique de Oliveira, "Aula 1920.1" (typed notes, Rio de Janeiro, [1968]). Likewise, the Algae *Bostrichea*, easily identifiable, might be the most important biological indicator of pollution in mangroves marshes. Oliveira, "Relatório Anual 1970".

⁹⁹ Luiza Krau, "Observações Sobre os Equinodermas da Baía da Guanabara," *Memórias do Instituto Oswaldo Cruz* 48 (1950).

¹⁰⁰ Oliveira, "Poluição das Águas Marítimas." For a more complete description of the initial six grades of pollution, see Appendix D.

demand that it could no longer be met. It also meant a weakening of the links between the Institute and the Hydrobiology Station.

Grades of pollution, thus, indicated not only biodiversity loss, but also the slow awareness creeping up in Luiza and Lejeune's minds on the changes to come. In the first degree of pollution as described by Lejeune, the most sensitive organisms disappear, such as several echinoderms, starfishes and sea urchins. Echinoderms were Luiza Krau's field, and she was the first to notice that something was different. "We didn't think about pollution," Lejeune later wrote, "we just accepted the new reality that several starfishes and echinoderms had disappeared."¹⁰¹

At the second degree of pollution, the shrimp *Alpheus heterochelos*, an indication of ecosystem integrity, vanishes. The familiar "clicks" from the mangroves, a courtesy of the *Alpheus* shrimp faded to silence. Pinheiro Island reached this second degree by 1950. The night music of the mangrove forest had changed. There were fewer birds, unless you counted the occasional vulture flying over the garbage dump at Sapucaia Island.¹⁰² The absence of shrimp helped Luiza and Lejeune to understand that not only something was changing radically in the Guanabara Bay ecosystem, but that pollution was causing it. When they could no longer raise shrimp in the aquaria filled with Inhaúma Cove's water, they realized that organic or/and industrial pollution was killing the shrimp larvae.

¹⁰¹ Echinoderms were plenty in Pinheiro Island in 1937, and the Hydrobiology station provided two buckets full with the small animals twice a week for J. C. Nogueira Penido's laboratory. But in 1948 the fishermen Dario Lopes had to go beyond the island beaches to find them. The beautiful *Astropecten* starfish had vanished, while the *Enoplopatiria emarginata* starfish remained, noted Krau. Red and russet algae, very sensitive to pollution, were also among the first to disappear. Oliveira, "Aula 1920.1."

¹⁰² The *Alpheus* makes a very peculiar click when it moves, and indicates good fishing, according the local fishermen. Oliveira, "Aula 1917."

They later learned to identify pollution not only through the disappearance of species, but also in the irregular behavior of the biota. From the third to the sixth degree of pollution, more and more species perished or migrated, and other opportunistic species, such as beach fleas, multiplied. Depending upon how the tides brought polluted waters or good seawater to shore, the same island may have some beaches in the third degree and some in the fifth. Pollution changed the environment of the island faster than most populations could adapt. Sometimes, crabs such as the big guaiamús, which made their nests high in the mangrove trees, could remain above the water level and therefore safe from oil and other pollution. Not so safe, however, were a number of anomalies in shape and color not usually observed in the species.¹⁰³ But this strategy of living in the trees was not enough to support reproduction. The guaiamú larvae died hours after leaving the eggs. The guaiamús at Pinheiro Island, thought Lejeune, probably were not born there. They arrived with some good tide, when the seawater overcame the bad circulation of the narrow channels, and they would die there without reproducing. Other species just avoided Pinheiro Island altogether: catfish and pufferfish did not get close to the island waters. In the fifth degree, there were no longer fisheries, the waters were opaque, sometimes black and the bottom was a-biotic macroscopically. This meant the bottom had little or no dissolved oxygen, no animals, and a huge number of bacteria and protozoa, indicators of a polisaprobic regime—or almost absolute pollution. The Rhizophoracea were almost completely destroyed, and Lejeune could not find any specimen of marine invertebrate on the benthos.

¹⁰³ Guaiamús were once sought after by the physicians at the Oswaldo Cruz Institute because of its “dens”. They dig shallow holes, near the mouth of the rivers. These dens held almost fresh water, and were also inhabited by mosquitoes and other insects. Researchers would look for the Guaiamús whenever they needed a new batch of mosquitoes for analyzes. Absence of mosquitoes in the Guaiamús’ dens meant a successful DDT campaign in the site—too bad for the scientists. Oliveira, “Aula 1920.1.”

From 1968 on, Lejeune's grades of pollution surpassed the simple listing of disappearing of species to include the description of moonlike landscapes. He then identified what he called the sixth grade of pollution: the beaches were black and deserted of life. The mangrove trees could no longer survive, and their dead, dry trunks were just resting stands for the vultures living off the garbage at the artificial island of the University Campus.¹⁰⁴ This was the degree of pollution at the Pinheiro Island in 1973, when the Station was all but deactivated. Lejeune would later further develop the concept, breaking down this last stage into seven, eight, nine and ten.¹⁰⁵

Looking toward future pollution: the fate of Sepetiba Bay

Even a pollution monitoring center needed clear water to work, and to understand the behavior of living organisms in "normal," non-polluted waters. Even worse: considering how he had defined his "grades of pollution," Lejeune wanted to study not only chemical alteration in the water, but also the whole complex workings of the ecosystem. He thus needed more than clean waters; he needed a clean mangrove island.

Luiza proposed a partial solution in 1958. She was especially interested in historical series, and in 1950 published a study on the echinoderms at Guanabara, comparing samples collected in 1912, 1937, 1939, 1946, 1948 and 1949.¹⁰⁶ Eight years later, she published another paper, comparing plankton from those samples to what she

¹⁰⁴ The Rhizophoretum was destroyed; even the outer layers of the mangroves, the Laguncularietum and the Avicennietum, were also partially damaged. Oliveira, "Aula 1920.1."

¹⁰⁵ These new degrees only describe the further damage to the outer layers of the mangroves, as there is nothing left in the waters that is visible at naked eye. Lejeune Pacheco Henrique de Oliveira, "A Longa Convivência Com um Deserto de Seres Vivos," *Jornal do Brasil*, March 27, 1975, 5.

¹⁰⁶ Samples were collected in 1912 by Adolpho Lutz, in 1937 by Nogueira Penido, in 1939 by Helena Pais de Oliveira, in 1946 by Pierre Danseraue, in 1948 by Prof. Pierre Drach and in 1949 by Luiza Krau. In this first article there is no mention to any substantive difference over time. Krau, "Observações Sobre os Equinodermas."

could find in 1958. The changes were profound. For example, no more plankton with crustacean larvae survived.¹⁰⁷ In an expedition to Sepetiba Bay, she found plankton virtually identical to that described in the historical series about Guanabara Bay. She then suggested to Lejeune to find an island in Sepetiba Bay, similar in conditions, tides and size to Pinheiro Island, based on his 1930s notes. They found the Ilha dos Marinheiros (Sailors Island) in Sepetiba Bay. It offered a good idea of what the Pinheiro Island was like in the past. From then on, Ilha dos Marinheiros would be the “null-hypothesis” for Lejeune, in other words, the state of an ecosystem similar to Pinheiro Island without the pollution.¹⁰⁸

Visits to Sepetiba Bay continued for the next twenty years. In 1965, Lejeune wrote his first report on Sepetiba Bay for the Fisheries Research Department (*Departamento de Pesquisas de Pesca*).¹⁰⁹ Although few areas in Guanabara showed as much pollution as Pinheiro Island did, comparison with the cleaner Sepetiba Bay showed that the whole bay was affected, in more or less same degree. In 1960, Lejeune wrote that

some of the Guanabara Bay mangrove forests disappeared, and we do not find inside the bay the communities of Polysiphonatae, Vaucheriaceae and Bostrichiaceae on their roots. ... We can see dolphins swimming at Sepetiba Bay, frequently. They became fewer at Guanabara Bay, because the precarious conditions for their existence, and the intensive traffic between Niterói and Rio, expelled them from the Bay, as it happened to with many fishes.¹¹⁰

¹⁰⁷ Luiza Krau, "Modificações no Plankton da Enseada de Inhauma, Antes e Depois da Poluição," *Memórias do Instituto Oswaldo Cruz* 56, no. 2 (1958): 473.

¹⁰⁸ Oliveira, "Aula 1917".

¹⁰⁹ Sepetiba Bay had about 500 fishermen at its shores, but it accommodated most of the shrimp fleet from Guanabara—as the catch in Guanabara had decrease significantly after the installation of the second Petrobrás refinery. Oliveira, "Prospecção Hidrobiológica."

¹¹⁰ Oliveira, "Conditions for Marine Biological Laboratory."

In a 1972 private letter to a friend, Lejeune bemoaned the pollution process seen in Guanabara Bay was being repeated in Sepetiba. Still, Sepetiba had the advantage of a larger inlet to the sea, and a deeper circulation channel. Pollution was unavoidable, but maybe, just maybe, a hydrobiology station near the mouth of Sepetiba Bay, in the Guaratiba promontory, would not suffer so much from pollution as the station at Pinheiro Island did. Lejeune presented the same arguments when he proposed a location for a marine biology laboratory in 1960. He argued the selection of a new lab site should take into account the potential for future pollution. He had little expectations that Sepetiba Bay would fare better than Guanabara regarding pollution. “Perhaps more accelerated than any other regions of the State of Rio de Janeiro, the Guandú River [part of the Sepetiba basin] will be polluted futurely (sic) in the next years, by industrial development of its splendid valley.”¹¹¹

Lejeune’s work on hydrobiology in Guanabara Bay reached beyond the Pinheiro Island. Since 1944, his research included mapping the salinity from over 130 collection points in Guanabara Bay, as well as collection of microplankton and crustaceans from all over the Bay. He visited coves, beaches, lagoons, and lakes all over the Guanabara Bay basin¹¹² But the inclusion of Sepetiba Bay in his studies led him to expand his concerns on pollution as a localized, restricted problem to a ubiquitous aspect of urbanization, with implications beyond Guanabara Bay.

Despite spending almost two decades describing the impact of pollution on mangrove ecosystems, and usually in a very passionate language, Lejeune was very

¹¹¹ Oliveira, "Conditions for Marine Biological Laboratory."

¹¹² Lejeune Pacheco Henrique de Oliveira, "Renovação de Bolsa" (Proposal, Rio de Janeiro, October 1975). He later included biochemical oxygen demand, an indicator of pollution, in his mapping. The 1947 salinity map were very useful to show decrease in salinity in the bay, when compared to 1974 samples.

optimistic regarding the potential for the mangroves to regenerate. He observed, for instance, that good tides, with new water from the Atlantic Ocean, brought young mussel colonies. Young trees re-grew quickly, only to be again overwhelmed by the pollution at the next bad tide. But all things considered, mangrove forests grew back fast. Mud and sediments flowed continuously from the rivers, while seeds, eggs, and small marine animals circulated within the bay. Pollution did not pose as much a problem for the future of Guanabara Bay, in Lejeune's view, as landfilling did. When the pollution finally abated, species would return to Guanabara Bay. But if then they found a higher tide level, caused by the increased siltation and landfilling, the mangrove ecosystem would have difficulty adapting to the new conditions of the Bay.

Overall, Lejeune never lost faith the mangroves would survive. There was enough genetic material in the mangroves in Sepetiba, and other mangrove forests throughout the Brazilian and African coast to replenish whatever was lost in Guanabara Bay. Mangroves were fairly common in the region and there were few endemic species to Guanabara Bay. "Larvae pass and circulated in the sea," wrote Lejeune, "in a huge carrousel that all the intertropical zone, North and South, from the Brazilian south coast to the Amazon, Guyana, Central America, Florida and Africa. Barnacles described in Guanabara Bay, can be also found in trees in Congo, Africa."¹¹³ Mangroves just needed some place free from pollution, DDT and landfills—which was a problem, since humans needed DDT's action against malaria, as well as landfills and other activities that caused pollution.¹¹⁴ Pollution control could partially help the coexistence of these two communities, humans and mangroves. Eventually however humans would have to set aside areas where

¹¹³ Oliveira, "Aula 1917," 5.

¹¹⁴ Oliveira, "Prospecção Hidrobiológica," 2.

mangroves could grow undisturbed, reserved zones where nature could thrive without pollution and without hampering human potential. The idea of natural reserves was not new in Brazil—the country established its first National Park in 1937. What was new was the idea that common mangrove forest should be protected as an ecosystem as much as the more impressive Atlantic rainforest, rather than only managed as reserve for fuelwood and fisheries.¹¹⁵

Given half a chance, the stubborn ecosystem could thrive again. But it would be too late for the Hydrobiology Station. The degradation of the ecology in Pinheiro Island was also the degradation of the links between the Station and the Oswaldo Cruz Institute. The station could no longer provide marine fauna and flora for scientific studies required by the Institute. Pollution in the Bay made it impossible. Or, more to the point, it might also be that the science practiced in the Oswaldo Cruz Institute in the 1960s had changed, and it no longer needed such specimens. Decade after decade, Lejeune and Luiza saw the Station become irrelevant to this or that department at the Institute. They tried to reinvent a new role for the Station with the study of polluted ecosystem. As Lejeune saw it, pollution studies were within the research tradition of the Oswaldo Cruz Institute. Studying pollution offered the international visibility the Institute was so proud of and the studies had a definitive impact on public health. True enough, the 1958 gambit of refashioning the Station into a pollution-oriented laboratory had earned Lejeune and Luiza fifteen more years of support from the Oswaldo Cruz Institute—or at least of tolerance of the station's existence. By 1973, the gambit had worn off. The Institute was

¹¹⁵ Oliveira and Krau, "Estudos Aplicados," 133. Brazil had laws protecting the mangroves for fuelwood since the colonial period, in the sixteenth century. See Miller, "Fuelwood in Colonial Brazil." Eventually, the first mangrove reservation, the Area of Environmental Protection do Guapimirim, was created in 1984. See Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 257.

again struggling with its own identity and structure, and there was no room for the Hydrobiology Station at Pinheiro Island.

The Station and the Island Lose their Places

In 1953, a new change in the federal administration structure caused yet another upheaval for the Institute. The Ministry of Health and Education was split into two, and the Oswaldo Cruz Institute remained attached to the ministry of Health. In the view of some of the Institute's researchers, this new structure threatened the practice of basic science, which was, as much as the production of vaccines, as the study of epidemics, the mission of the Institute. To add insult to injury, the Institute had to fight with other agencies for very limited funding, as the Ministry of Health's portion of the overall national budget declined in the 1950s. Part of the Oswaldo Cruz Institute staff began to mobilize politically for the creation of a Ministry of Science. All departments complained about the lack of funding, and the scientists pursued personally funding for basic science, either by applying for grants from the National Research Council or from international institutes.¹¹⁶

New funding cuts were a hard blow for Lejeune de Oliveira. He had invested heavily in contacts with international institutions in the previous decade, and it was finally paying off. Invited to a number of international meetings, this was to be the opportunity to secure the status of the Hydrobiology Station within the Oswaldo Cruz Institute. He had to decline every invitation due to lack of funding.¹¹⁷ Budget cuts also

¹¹⁶ Benchimol, *Manguinhos do Sonho à Vida*, 75.

¹¹⁷ Lejeune was invited to attend classes at the Virginia Fisheries Laboratory, Gloucester Point, Virginia, in 1954; to participated at the International conference in Limnology in England, in 1953; to go to the Third

meant that even ordinary expenses were more complicated: acquisitions had to be requested to his superior at the department of Medical Zoology, and then pass through the entire Institute's bureaucracy.¹¹⁸

Things could and did get worse. In 1964, after the military coup, the new government designated the researcher Rocha Lagoa the director of the Oswaldo Cruz Institute. A mediocre researcher, Rocha Lagoa was a fierce anti-communist, and he had some personal quarrels to settle.¹¹⁹ His nomination definitely shifted power relations within the Institute. For some, daily life in the labs continued as usual, for others, things did not go so smoothly.¹²⁰ Analyzing thirty interviews with the Oswaldo Cruz Institute staff at that period, Britto and Hamilton wrote:

Within the statements, the drama of Walter Oswaldo Cruz, who was Oswaldo Cruz's son, stood out as an example. He and his assistants suffered harassment by the direction. They were denied funds that he had personally obtained from national and international organizations, forcing him to interrupt his work. Walter Oswaldo Cruz, who was accused of political proselytism against the direction of the Institute and the military regime, had his laboratory closed. His premature death in January 1967 filled his colleagues with consternation.¹²¹

Rocha Lagoa took office as Health Minister in 1970, for the Medici administration, during the harshest phase of the military government. This was the period of the Institutional Act 5 (AI5), a much-feared instrument of the military regime to curb

South American Botanic Conference in Bogotá, in 1955; to visit the Gulf and Caribbean Fisheries Institute in 1955. Oliveira, "Curriculum Vitae."

¹¹⁸ Oliveira, "Relatório de 1961."

¹¹⁹ Wladimir Lobato Paraense, Interview to Rose Ingrid Goldschmidt and Wanda Hamilton, Rio de Janeiro, January 14, 1987 to January 10, 1991. *Memória de Manguinhos: Acervo de depoimentos*. See also Raquel Aguiar, *Perfis - Referência Mundial em Doença de Chagas Herman Lent Foi um dos Dez Cientistas Cassados no 'Massacre de Manguinhos'* [webpage] (July 1 2001 [cited December 23, 2003]); available from <http://www.uol.com.br/cienciahoje/perfis/lent/lent1.htm>.

¹²⁰ Britto and Hamilton, "Memória de Manguinhos," xxi.

¹²¹ Britto and Hamilton, "Memória de Manguinhos," xxi.

terrorist and anti-patriotic activities. The act specified that public servants suspected of subversive activity could be forced into compulsory retirement, and some of their constitutional labor rights suspended if the President of the Republic so decided. Another institutional act, the AI10, ruled that those targeted by the AI5 could not work in any teaching institution that received governmental funding—in practice, all of them. At least ten of the most important researchers at the Institute found themselves under investigation for subversive activities according to the AI-5: Masao Ogoto, Domingos Arthur Machado Filho, Augusto Cid de Melo Perece, Fernando Braga Ubatuba, Haity Moussatché, Tito Arcoverde de Albuquerque Cavalcanti, Moacir Vaz de Andrade, Hugo de Souza Lopes, Sebastião José Oliveira and Herman Lent were all dismissed, or forced to retire.¹²² They could not do research, they could not teach, and “they were charged with criminal offences involving acts of subversion and corruption.”¹²³

Lejeune de Oliveira was not directly touched by this persecution. He had worked with Rocha Lagoa some twenty years earlier, and they did not seem to have any unsolved issues between them. Lejeune kept his political views strictly to himself, and there is some evidence that these views would lean to the right rather than the left.¹²⁴ It is hard to say if the “Massacre de Manguinhos”—as this political intervention was later dubbed—had an immediate impact on Lejeune’s island, but it did have an impact on the autonomy, prestige, and quality of research of the Institute.

The modifications in the structure of the Oswaldo Cruz Institute in the 1970s had more immediate consequences for activities on Pinheiro Island. First, the transformation

¹²² Lent was Lejeune’s supervisor at that time. Instituto Oswaldo Cruz, “Relatório das Atividades Desenvolvidas pelo Instituto Oswaldo Cruz,” (Rio de Janeiro, GB: Ministério da Saúde, 1970), 5.

¹²³ Britto and Hamilton, “Memória de Manguinhos,” xxi.

¹²⁴ Krau, interview.

of the Oswaldo Cruz Institute into the Oswaldo Cruz Institute Foundation (Fundação Instituto Oswaldo Cruz) in 1970 meant a change in institutional guidelines. The new Foundation would concentrate on endemic diseases, on production of vaccines, and other projects more likely to receive private and public funding. As a result, most research on what was called basic science (*ciência pura*), that is, with no short-term impact on human health, was to be interrupted or at least relegated to a non-priority status; this surprisingly included hydrobiology research. Second, the legal aspects of the institutional change required employees to choose between two labor contracts. Many veteran researchers did not want to change to the new contract, as the retirement conditions in the former contract were more generous.¹²⁵ The difference between the two labor contracts was not clear to Lejeune. He did not know well what to do, and when he made up his mind, the decision was out of his hands. He did try to adapt by presenting his “basic research” on pollution as “applied medical science” on public health.¹²⁶

In 1976 Lejeune and Luiza were informed that the Station was to be closed. The administration of the Oswaldo Cruz Institute described a series of potential programs in which their work could be incorporated, but it was all very vague. The Hydrobiology Station would be completely deactivated within the year, the island would remain only as an isolated habitat for the Rhesus monkeys, and Lejeune and Luiza were to be relocated

¹²⁵ The staff had to choose between the Consolidation of Labor Legislation (*Consolidação das Leis Trabalhistas-CLT*) and the Statutory (*Estatutário*) regimes. Statutory regime conformed to the Oswaldo Cruz Institute’s older labor contract. Anna Kohn Hoineff, interview to Laurinda Rosa Maciel, Magali Romero Sá, and Nathacha Regazzini Bianchi Reis, Rio de Janeiro, June 14-July 5, 2001. Memória das coleções científicas do Instituto Oswaldo Cruz da Fundação Oswaldo Cruz: Acervo de depoimentos. Although it was described as a choice, there was a fair amount of pressure that could be exercised on the researcher—as for instance, by denying funding for basic lab material to any researcher who had refused to opt for the new labor regime. Pedrina Cunha Oliveira, interview to Lúcio Flávio Taveira and Rose Ingrid Goldschmidt, Rio de Janeiro, June 6, 1991. Memória de Manguinhos: Acervo de depoimentos.

¹²⁶ Oliveira, “Notas para Jornalista do Jornal do Brasil”.

to another area in the Institute, still undefined. In other departments, the upheaval was no less significant. Some biology collections were donated to other institutions, others, less fortunate, just piled up outside as garbage.¹²⁷

Lejeune's 1977 activities report—his last—was a frantic attempt to convince the administration that hydrobiology research could still be in the interest of the Institute. He mentioned his own contacts with Nuclebrás and Sudepe, and their interest in collaboration with the Institute on studies of pollution and fisheries in Sepetiba Bay.¹²⁸ He suggested collaborations with the new Environment State Agency, FEEMA, with the Federal University, with companies that used water on a large scale; he presented very practical ways for the Institute to make the hydrobiology lab self-sustainable. Regardless, the forty-year relationship between Lejeune, the Institute and Guanabara Bay was doomed.

In August 1977, Lejeune was informed the Institute was proposing his transfer to the Cancer Hospital, also affiliated with the Ministry of Health. Lejeune would share this fate with all other physicians in the Institute who did not opt for the new CLT labor contract—despite the fact that he had not practiced medicine since leaving college, in 1937.¹²⁹ Only then did Lejeune ask for his retirement and he began to work full-time as a professor at the Universidade Federal do Rio de Janeiro, on the artificial island created at

¹²⁷ The Institute sent full collections of helminths, an invaluable patrimony organized since the foundation of the Institute, to the National Museum of Natural History. See Hoineff, interview. According to Luiza, the Lauro Travassos' Lepidoptera collection and Adolpho Lutz's batrachians collection stayed for almost four months literally on the streets, against the wall. Krau, interview.

¹²⁸ Nuclebrás was a state company developing nuclear research at Baía de Sepetiba; SUDEPE (Superintendência de Desenvolvimento de Pesca) was the new Fishing Department, founded in 1960 by Lejeune's old collaborator Captain Moreira da Silva, Oliveira, "Relatório Anual 1977".

¹²⁹ Hoineff, interview.

the side of Pinheiro Island.¹³⁰ Luiza, whose future in the Institute was even more nebulous, was able to negotiate her “cession” as public servant from the Ministry of Health to the Ministry of Education, and followed Lejeune in his new career. Lejeune created the chair of Limnology at UFRJ, and Luiza was his assistant. They would keep these positions until Lejeune’s death in 1979, when Luiza took over the chair. She eventually retired in 1984.¹³¹

Pinheiro Island was the last island left from the original archipelago in the Inhaúma Cove. After the Hydrobiology Station was deactivated, in 1977, it did not last much longer. The Rio Project, from 1979 to 1983, finally buried it. The Rio Project was in fact the execution of a 1960’s plan, many times postponed since, designed to landfill the Inhaúma Cove, to urbanize the favelas (then with over 250,000 dwellers) located near the Brasil Avenue highway, and to sanitize/eradicate the mangroves in the area, still associated with hazardous environment. The project, executed at the end of the military regime, marked the first time that civil associations effectively mobilize against extensive landfills in Guanabara Bay. Their activism included the participation of scholars—another first—represented by the faculty from the Universidade Federal do Rio de Janeiro, and their efforts actually changed the final design. Thus the Bay lost only 450 hectares, instead of the 2,300 hectares initially planned. Pinheiro Island was however one of the casualties. It was an island no longer.¹³² The Rhesus Monkeys, after 50 years roaming free on the island, were penned up on a big coop in the Oswaldo Cruz Institute

¹³⁰ He had been literally volunteering for the University since 1972, as a strategy to recruit underpaid but willing interns to work at the Hydrobiology Station. Oliveira, “Renovação de Bolsa.”

¹³¹ Krau, interview.

¹³² Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 357.

campus.¹³³ The island was incorporated into urbanization projects, and renamed Pinheiro Village (Vila Pinheiro) in 1989.¹³⁴ The exuberant vegetation on the top of the Island was preserved as a park for the new residents of Pinheiro Village. It is still possible to see some of the ruins of the laboratory when one drives along the Yellow Line highway, but there are at least two highways between the former island and the closest seawater.

A long way even for the most daring guaiamú crab.

* * * * *

Monitoring pollution is an essential part of environmental management. By monitoring environmental changes caused by pollution and by sharing their knowledge with regulatory agencies, Lejeune de Oliveira and Luiza Krau participated actively in the environmental management of Guanabara Bay during the twentieth century.

Moreover, their trajectory and that of the Hydrobiology Station in Guanabara Bay raises key questions about pollution monitoring and the development of pollution as a concept. What was pollution? What was being measured to indicate pollution? For Lejeune, pollution was first measured by the loss of utility that it could offer the Institute: the more the waters got polluted, the less he could find the marine fauna that the Institute demanded for its labs. Pollution was thus measured in terms of loss of biodiversity. Later,

¹³³ Guimarães, interview.

¹³⁴ Fanny Relry, Aguinaldo Barbosa, and Emerson Ximenes, *A História da Maré - Século XX* [Internet resource] (Centro de Estudos e Ações Solidárias da Maré – CEASM, 2001 [cited March 23, 2004]); available from http://www.ceasm.org.br/abertura/03onde/m_hist.htm.

he added biochemical indicators, such as the biochemical oxygen demand, basically because the more “objective” indicators could be used to study other ecosystems, while the biological indicators were endemic to the mangrove environment. This second version resulted largely from contact with his students from the Water Department, and it was quite unsatisfactory for his goals. Eventually, Lejeune created his 10-degree pollution scale, in which he measured pollution according to “landscapes”. It was not so much the absence of certain species, it was the whole ecosystem that mattered. Sea pollution created distinguishing landscapes, by promoting overpopulation of some opportunistic species while others withered, or perished.

If pollution was one of the reasons the Hydrobiology Station drifted away from its mother institution, it was also a crucial glue to connect it to outside contacts and other institutions. The pattern proposed in the previous chapter, in which personal choices and networks slowly consolidated in projects and collaborations that might or might not be adopted later by institutions, is repeated here. In this case, the Oswaldo Cruz Institute had the opportunity to incorporate pollution control in its institutional agenda: it had the facilities, a history with the Bay, and the technical expertise. It chose not to do so, due to funding and political constraints. The networks cultivated by Lejeune and Luiza assured that the experience accumulated by the Institute in Pinheiro Island would benefit other institutions that could carry on their work.

If the Pinheiro Island Station left a legacy other than the remarkable year after year record of the changes in Guanabara Bay, it rests not so much on the Oswaldo Cruz Institute’s role in the management of Guanabara—which remained always marginal among its activities. Instead, this legacy originates from the long-term relationships that

Lejeune and Luiza established with outside institutions, such as the Universidade Federal do Rio de Janeiro, the Institute of Sanitary Engineering (IES) and the Navy. Lejeune's last report to the Institute, where he laid out for the Oswaldo Cruz Institute's administration all the potential developments for activities in hydrobiology and pollution, was a testament of how by the time the Institute was considering terminating its Hydrobiology Station, Lejeune's personal networks with institutions managing Guanabara Bay were stronger than ever.¹³⁵

The Hydrobiology Station, thus, did not exist only around crustaceans, echinoderms, algae, and mangroves. This "biological bay" overlapped with a "social bay" in which crustaceans and mangrove were food and fuelwood, a bay made of the fishermen communities who threatened to invade the island and its no-so-well organized scientific boundaries, who read the biological indicators for pollution everyday when they went out to fish, who were hired by the Institute to pilot their boats and to guide the scientists in sampling expeditions. It was also a social bay made of arrogant young favelados who moved into the landfill areas, releasing their untreated sewage into bay waters, who feared forcible removal from their homes by the civil authorities, and who worked in the new factories installed on the shores of the Bay. In a third and equally important layer, there was an institutional bay, composed of the Water Department, the Navy, the Oswaldo Cruz Institute, all with their political disputes, lack of funding, and internal issues of gender and power. In addition to this, these overlapping bays suffered the influence of international and national tides—new international studies on pollution, national regime changes, or transformations in the bureaucratic apparatus.

¹³⁵ Oliveira, "Relatório Anual 1977."

In the interplay of these multiple layers, Luiza Krau and Lejeune de Oliveira found themselves at an impasse: how to produce science when the political, natural and social conditions needed for such work suddenly shifted to the point that their previous scientific practices could no longer apply? They answered this question by reinventing their own understanding of what it meant “to produce science,” and proposing new terms of legitimacy for their Hydrobiology Station. By registering their doubts, their creative solutions to every challenge, their plans and frustrations, Lejeune and Luiza offered a remarkable basis for studying the everyday challenges for scientists in twentieth-century Brazil.

Chapter 5

Pollution Control:

From Public Health to Public Environment

When Brazilian composer Tom Jobim wrote the song, “Waters of March” in 1972, he must have been thinking about Guanabara Bay. Actually from December to March, summer storms strike the city of Rio de Janeiro, bringing down, “the stick, and the stone...and the car that got stuck,” and the mud, and more mud.¹ When tropical rainstorms poured over the mangrove forests and villages, as those that once surrounded all of Guanabara Bay, it was an expected and welcomed respite from the heat. When these tempests soaked the city during the nineteenth century, it was simply an annoying inconvenience that forced emperor and slaves alike to walk with waters up to their knees. But when the waters of March inundated a flood-prone city of over three million residents, with a sewage system that was over a hundred years old, it became a public-health disaster. Torrents ran down deforested hills, washing out debris and slums, clogging runoff galleries and sewers. Rectified, shallow rivers overflowed. Residents abandoned their cars and waded for shelter. With the aftermath of the storm then came the *ressaca* (hangover). The high tide brought huge waves, and the polluted waters of the Bay spilled into the streets with a vengeance, bringing back the raw sewage it had already

¹ From Tom Jobim’s lyrics: “A stick, a stone,/ It’s the end of the road,/It’s the rest of a stump,/It’s a little alone (...) The plan of the house,/The body in bed,/And the car that got stuck,/It’s the mud, it’s the mud.” Antônio Carlos Jobim, *Águas de Março* (Rio de Janeiro: O Pasquim, 1972), Music.

swallowed. Water supplies were then at risk for contamination and waterborne diseases were an ever-present threat.

This was how authorities of Rio de Janeiro city understood pollution by the mid-twentieth century: as a sanitary problem. There was more than health at stake though. Guanabara Bay “was one of the most visible elements of [Brazil’s] large national patrimony ...a benchmark of our image in the foreign world.”² The State had to respond to the problem and, in the early 1960s, it did. In fact, different government agencies struggled with the Bay’s pollution. The Ministry of Transportation and Public Works created a Working Group in 1962 to study industrial and domestic pollution in Guanabara Bay and possible investments to limit the problem.³ Petrobrás, the state-owned oil company, gathered its own team of experts to study the possible impact of pollution by its new refinery facility on Guanabara’s shores, or more likely, to make sure they would not be blamed for pre-existing pollution.⁴ Lejeune de Oliveira, from the Oswaldo Cruz Institute, wrote several articles beginning in 1958 on the impact of pollution on Pinheiro Island and Inhaúma Cove, a rapidly deteriorating sector in Guanabara Bay.⁵ And the Navy’s Institute of Hydrographic and Navigation carried out studies on water circulation to observe its behavior as a receptor body for industrial and domestic waste.⁶

These initiatives had two characteristics in common. They all included a small but well-connected network of public officials and technicians visited in previous chapters:

² Délio Bravo Duarte, “Estudo da Poluição da Baía de Guanabara” (paper presented at the Congresso Brasileiro de Engenharia Sanitária, Rio de Janeiro, 1960), 3.

³ Secades, “Relatório do Grupo de Trabalho.”

⁴ Barbosa Teixeira, “Poluição da Baía de Guanabara.”

⁵ Oliveira, “Poluição das Águas Marítimas.”

⁶ Silvio Borges de Souza Motta, Letter to Exm. Sr. Primeiro Secretário do Senado Federal, “Resposta ao Requerimento de Informações N. 788/63, do Senado Federal, de Autoria do Senador Vasconcelos Torres.” Rio de Janeiro, January 13, 1964. Centro de Documentação da Marinha.

Lejeune de Oliveira, Paulo Moreira da Silva, and Fausto Guimarães were directly or indirectly connected. Second, these initiatives highlight the central role Guanabara Bay played in the study and subsequent creation of policies on pollution control within the public administration, both at the local and national level.

Public administration was never straight and easy in twentieth-century Guanabara Bay. As seen in Chapter 1, the bay was split in two different jurisdictions since 1836. And as argued in Chapter 2, uneven access to political power and capital had created an uneven map of Guanabara Bay, underlining the gap between these two jurisdictions. This chapter picks up where Chapter 2 left off, that is, how public administration, through federal, state and city governments, committed resources, personnel and political capital to the management of Guanabara Bay. In this case, water pollution, more than dreams of modernity, mobilized public officers. In the first years of the Republic, Guanabara's exuberant beauty sheltered miasmas and dreadful diseases, and required the orderly beauty of progress. Progress, however, proved to be less orderly than expected. Now in the mid of the twentieth century, Guanabara Bay's beauty was more frail than threatening, and the main menace to this national symbol was a by-product of modernity: pollution.

As pollution in Guanabara Bay became more visible, it gained more attention in the press and the government's agenda. It also created a dilemma for policy-makers—why be concerned with marine pollution? Until then, most concern about sewage and water pollution in the world focused on the health risks it posted to the population in terms of contamination of the water supply, which was not the case for Guanabara Bay.⁷

⁷ McNeill, *Something New under the Sun*, 143-47.

Fisheries in the bay declined, but large fishing companies easily adapted by pursuing oceanic fishing just outside the Bay on the continental platform. Considering the scarcity of resources, it was hard to justify funding to monitor Guanabara Bay's seawater when, for example, the Paraíba do Sul river, which provided the city's water supply, was also heavily affected by pollution. If pollution control in Guanabara Bay was to get a share of the public budget, water pollution needed to be redefined legally and institutionally beyond the limits of health and sanitary risks. Guanabara Bay needed a better and stronger statement on how its beneficial uses were being damaged by garbage and refuse.

At this same time, the alliance of physicians and engineers discussed in Chapter 1 had now converged into a new group of health professionals as knowledge in the twentieth century became more specialized: the sanitary engineers. This new class of specialists would come to define, locate, measure, and regulate pollution. On both sides of Guanabara Bay, sanitary engineers would establish their own institutions within the state, the Institute of Sanitary Engineering (IES-Instituto de Engenharia Sanitária, in Rio de Janeiro city) and the Sanitary Department of the State of Rio de Janeiro (SANERJ-Saneamento do Estado do Rio de Janeiro). In 1975, these two agencies would merge to become the first explicitly environmental agency in Brazil, the State Foundation of Environmental Engineering (FEEMA-Fundação Estadual de Engenharia Ambiental), but not without conflict on the way.

Attempts to build a space for technical expertise promoted by sanitary engineers sometimes disguised the political aspects of urban planning and policies, including pollution control. Institute of Sanitary Engineering reports are amazingly political in what they refuse to acknowledge, that is, the weight and interests of the population that lived in

the Bay. In these reports, the population either had the role of “polluters” or “users.” Technical expertise was dominated by one concept of technology: the transformation and taming nature. The lay population had little to add to this. Technical reports did not generate much public debate partly because they reflected a degree of authoritarian technocracy in an already authoritarian political state. There was also little public debate because the population, fishermen, or beach-goers found it easier to simply ignore the rules imposed by technicians than to challenge them: enforcement was often feeble and easily evaded.

This chapter focuses on two trends: as pollution increased, the awareness of pollution also increased, and so did the public investment in mechanisms to control pollution such as the IES. There is a success story of how institutions negotiated political power, developed knowledge, and established international connections. They redefined pollution legally, measured it, elaborated environmental cost-benefits, and developed tools for controlling pollution. But they also failed to control it. Shadowing this success story, there is a declensionist narrative in which pollution advanced on Guanabara Bay, changing landscapes and ecosystems, and altering the relation the population had with the bay.

By studying the creation and the evolution of pollution control agencies, this chapter closes the circle of personal relations that inspired institutional alliances. For example, Captain Paulo Moreira da Silva, introduced in Chapter 2, gained in stature not within the Navy, but in participating in forums on Guanabara Bay’s pollution. Likewise, Fausto Guimarães, a frequent visitor to Lejeune de Oliveira’s Hydrobiology Station as seen in Chapter 4, created a technical agency for water pollution control in the Guanabara

state. In this chapter, these characters meet again to help build an institutional space where pollution was no longer a marginal and unexpected contingency, as in the case of the Navy or the Oswaldo Cruz Institute, but the focal point of the new institutions.

Legal Environment

Pollution had a legal history before it made its way into the political vocabulary of Guanabara Bay of the twentieth century. The first laws against water pollution in Brazil date from the period of Portuguese colonial rule. The Ordenações Afonsinas e Filipinas, based upon the needs of water-thirsty Portugal and Spain, protected fresh water flows from organic effluents. Local authorities however saw little reason to enforce them to the letter in the presence of abundant water. Governments always made provisions to preserve fresh water for the population. For example, the new Republican Penal Code in 1890 mandated prison for those who, “poisoned fresh water, of common or private use, making it unfit to drink or health threatening.”⁸ Sea water legislation was less frequent or forceful. A 1619 law prevented whalers from throwing whale guts and other wastes into Guanabara Bay, but more because of the offensive smell and appearance.⁹ Other local ordinances followed in the seventeenth and eighteenth centuries, mainly to regulate the runoff from pig farms and sugar mills.¹⁰

Polluted waters in Guanabara Bay in this context were thus something that bothered the majesty of the colonial capital, but not considered life-threatening. By the

⁸ Francisca Neta A. Assunção and Maria Augusta A. Bursztyn, *As Políticas das Águas no Brasil* [webpage] (III Encuentro de Las Aguas, 2001 [cited June 21, 2003]); available from http://www.aguabolivia.org/situacionaguaX/IIIEncAguas/contenido/trabajos_azul/TC-127.htm.

⁹ Victor M. B. Coelho, interview to Lise Fernanda Sedrez, June 25, 2002.

¹⁰ Laws for protection of natural resources located in sea waters were more frequent. See Shawn William Miller, "Stilt-Root Subsistence: Colonial Mangroves and Brazil's Landless Poor Source," *Hispanic American Historical Review* 83, no. 2 (2003).

nineteenth century however, what was merely annoying became an intolerable risk, source of miasmas, and public health menace. Tanneries and slaughterhouses located on the beaches soiled prime real estate, and tainted the waters as well as the aspirations to make Rio de Janeiro an European city. Although politicians, health experts and public officials railed against these dangerous elements, the Imperial government failed to create consistent legislation regarding water quality. Rather, the government dealt with coastal pollution on a case-by-case basis, issuing local ordinances with specific targets and portarias (low level rulings) rather than laws.¹¹ The result was that enforcement agencies did not have a clear directive on how to deal with pollution in general, and these isolated portarias did not carry the same sense of high priority that a full-fledged law could have.

Only in the Republican era with the 1934 Waters Code (Código das Águas) would matter change. After the 1930 Revolution, President Vargas wanted to establish a consistent body of law that would strengthen the Brazilian state. The new 1934 Constitution gave the government powers to override previous obstacles to comprehensive legislation. The government at once issued a series of laws regulating the uses and exploitation of natural resources, such as the Forest Code, the Game and Fish Code, and the Waters Code.¹² The Waters Code was the first national effort to regulate

¹¹ William Weber, ed., *Ambiente das Águas no Estado do Rio de Janeiro*, PLANÁGUA-SEMADS/GTZ 10 (Rio de Janeiro: SEMADS, 2001), 180. Indirectly, thus, the definition of the *terras de marinha* (shoreline land), that placed the shoreline under the Navy's jurisdiction, and the regulation for sewage company The Rio de Janeiro city Improvements were the most important pieces of legislation for Guanabara Bay in the nineteenth century. See Chapter 1.

¹² Legislators had first drafted the Waters Code in 1906, but it conflicted with properties laws protected by the 1891 Constitution, and it failed to address specific dilemmas for the drought-ridden Northeast—it was strongly inspired in water legislation from fairly well-irrigated Italy and France. In 1934 version eventually included an article to incorporate a division to overview initiatives against the drought [Inspetoria de Obras contra a Seca], as well as a Waters Department (*Diretoria das Águas*), to apply and enforce the code in the humid Brazil. Assunção and Bursztyn, *As Políticas das Águas no Brasil*.

the use of waters. It defined jurisdiction over rivers, lagoons, coastal waters, and bays, as well as sanctions for damages to these public resources. Among its provisions, it expanded the Navy's ownership over *terrenos de marinha* (shoreline) that already belonged to the Navy.¹³ It also defined any "public waters that are limits between two or more States" as "federal waters" and belonging to the union.¹⁴ This made it official: Guanabara Bay, between the Federal District and the State of Rio de Janeiro, was now under federal control. Finally, the Waters Code also stated that landowners could dredge their swamps or marshes only when the administration declared them a risk to public health—a clear limitation on property rights that could have offered a strong protection of Guanabara Bay's mangroves, had enforcement in the peripheral areas of the Fluminense Baixada been reliable.¹⁵

Although much of the Waters Code focused on hydraulic energy and fresh waters, its articles were broad enough to offer some protection to coastal waters. The code declared that "no one is allowed to foul or to contaminate waters that one does not consume, with damage to others." There were protected "general interests" regarding water use, including "food and needs of riparian communities, public health, navigation, irrigation, flood prevention, fisheries conservation and circulation, water runoff and effluents."¹⁶ Culprits would pay for the recovery of the water body, and face criminal

¹³ *Código de Águas*, art. 11, title 2. In the absence of a legitimate title by a private owner, the *terrenos de marinha* belonged to the Navy, not only, as in previous legislation, to approve or to veto buildings in the area, but actually to explore its resources.

¹⁴ *Código de Águas*, art. 29, title 2, item E.

¹⁵ Limitations on property rights in Brasil were not uncommon, but this was the first time that swamps areas—and not only mangrove trees—received legal federal protection. Weber, ed., *Ambiente das Águas*, 180.

¹⁶ *Código de Águas*, art. 109.

charges. The code was silent on the distinction between fresh or sea waters and this ambiguity continued in future legislation based on the 1934 Waters Code.¹⁷

The Fishing Code, issued four years later, included more specific articles against water pollution. It forbade the discharge of oil into coastal or interior waters, and stated that the Game and Fish Department would control discharges of “solid waste and toxic effluent in water bodies.”¹⁸ Later versions of the Forest Code and Mining Code also contained provisions to protect water use, fauna and flora, but overall federal legislation silenced regarding seawater pollution.

In the 1940s and 1950s, the federal government issued some decrees regarding sea pollution, mostly allowing the Navy to control discharge of oil and debris from ships. After the Water and Fisheries Codes, the next large effort to regulate water pollution on several fronts occurred in the 1960s, when pollution was a visible challenge the public administration had to face.¹⁹ In 1961, the federal government issued its Health National Code. Well within the Brazilian tradition of framing pollution as health issue, the Code also provided for some protections of the environment.²⁰ The new code required industries to treat their effluents before discharging into water bodies, and it gave local authorities the duty of regulating and monitoring discharges. Industries also had to submit

¹⁷ The concept of “general interests” in the Waters Code provided the basis for the 1988 Constitutional concept of “diffuse interests”, i.e., rights that pertain to the community and that should be protected by the Union against public and private action, even when no one directly affected by such action filled formal complaint.

¹⁸ Motta, “Resposta ao Requerimento.”

¹⁹ See Chapter 4 on Lejeune de Oliveira’s studies on pollution in Guanabara Bay. Besides Rio de Janeiro, at state level São Paulo State, at this point the industrial center of Brazil, had created the State Council for Pollution Control, a basically educational project linked to the State Secretary of Public Health. See José Kalil de Oliveira e Costa, *30 Anos de Qualidade Ambiental no Brasil* Ecoambiental, July 18 2003 [cited January 12, 2004]); available from <http://www.ecoambiental.com.br/mpincipal/historia.htm>.

²⁰ In 1960s, the word use was *ecologia* (ecology). *Ambiente* (environment) became popular only in the 1970s.

their pollution control plans to the authorities, as well as carry out remediation and restoration projects for pollution caused before the National Health Code went into force. More generally, it stated that, “the discharge of residuary waters of any type, in receptor waters or territories, only is allowed when it does not harm human health or ecology.”²¹ In the same year, another decree stated that solid, liquid, or gaseous residues could be released in the waters, raw or after treatment, provided the operation did not cause “pollution of the receptor waters.”²² Effluent discharges were tolerated provided the receptor waters were large enough to allow fast dilution—as in the ocean, a large bay, or a fast flowing river. Pollution was thus defined in two different ways: either according to the impact of the foreign substance (harm to human health or ecology), or according to its concentration.

For all these laws and regulations, enforcement was always a crucial problem. Enforcement depended on the ordinary police and inspectors employed by the state. Assuming that corruption was not an issue, their efficiency was directly connected to which regulations they saw as a priority. If there was not pressure either from the top layers of the administration or from the public (via newspapers and legal action), chances were that new laws would remain disregarded. Environmental regulations were not an exception. In the lack of a clear directive, enforcement agencies were slow in incorporating them into their ordinary agendas—unless disaster, public or political pressure forced them to do so. As the administration was ambivalent on environmental matters, seen in many circles as a dilemma between conservation and progress, much of

²¹ *Código Nacional de Saúde*, Decree N° 49.974-A, art. 37.

²² *Decreto N.º 50.877*, art. 1.

this regulation paid little more than lip service to the internal demands for pollution-control programs.

Enforcement issues and lack of clarity aside, Brazil in the 1960s was in the process of creating fairly advanced legislation on water pollution control. In 1967 during military rule, the Fauna Protection Law (Law 5197) declared that wildlife, its nests, shelters and natural nesting areas were property of the Union, and could not be destroyed without express government permits, even when located in private areas.²³ In the same year, the Decree for Protection and Incentive to Fisheries replaced 1934 Fishing Code. More stringent, the new law actually defined pollution as “any alteration of the physical, chemical or biologic properties of the waters, that may constitute damage, direct or indirectly, to aquatic fauna and flora”.²⁴ While the definition of pollution in the legislation was broad and inclusive, the government was averse to expand on it or to invest more resources for the enforcement of these laws. This progressive legislation (and not so progressive enforcement) reflected the attitude of Brazilian representatives at the 1972 United Nations Conference on Human Environment in Stockholm. The Brazilian stance then was “based on the principle that the main pollution was poverty, and environmental protection should come only after economic development has dramatically increased per capita income to the level of Developed countries.”²⁵

Thus when the Lacerda administration took office of the Guanabara state, it had the legal tools and favorable political conditions to address pollution concerns in

²³ *Lei de Proteção à Fauna*, Lei 5.197, art. 1.

²⁴ *Proteção e Estímulos à Pesca*, DL-000.221, art. 37.

²⁵ Eduardo Viola, "Brazil in the International Politics of Global Governance and Climate Change" (paper presented at the International and Comparative Environmental Policy and Politics, Annual Meeting of the International Studies Association, New Orleans, LO, March 23-27, 2002), 5.

Guanabara Bay. From a bureaucratic point of view, when Rio de Janeiro city became an autonomous State by losing its capital status, this served as an important stimulus to overhaul public administration. From a political point of view, industrial and domestic pollution in the 1960s was a visible problem in Guanabara Bay and in other areas of the country—enough that politicians demanded for a solution from the federal government. And from a legal point of view, there was tentative legislation on pollution control being discussed at the federal and state level. These laws conceptualized pollution not only within the traditional framework as a public health issue, but also in terms of protecting fauna and flora, fisheries, navigation, and public resources. This was the right context for Rio de Janeiro city (now Guanabara state) to create its own pollution-control agency, the Institute of Sanitary Engineering (IES).

Sanitary Engineering: Uniting Sewage and Waters

Since 1857, sewage and water in Rio de Janeiro city were kept separated by pipes and institutions. Supplying good, abundant, and reliable water for the population was the responsibility of the city's public administration, while sewage was handled by a private company, The Rio de Janeiro City Improvements (The City), through a system of concessions.²⁶ This British company built and managed the sewage collection and treatment station in Rio de Janeiro from 1857 to 1947. At the end of its contract in 1947, the engineers of the City were incorporated into the Waters Department of the Federal District Administration (Prefeitura do Distrito Federal), and sewage and water supply were reunited again after ninety years.

²⁶ See Chapter 1.

In the nineteenth century, The City was the glory and joy of Rio de Janeiro. The company oversaw sewer construction and administration for one delimited area – from Penha to Botafogo. It helped to design the expansion of Rio de Janeiro towards the ocean beaches (Copacabana, and later Ipanema), by serving the area with a modern sanitary structure—in contrast to the precarious state that plagued the crowded and poor areas of the city. By the 1940s however, The City was a source of despair. Botafogo beach, in the noble part of Rio de Janeiro, stank to high heaven due to raw sewage released in Guanabara Bay. The old structure sorely needed investment to expand and renovate, more than just a few remedial treatment stations.²⁷

Compared to the rest of Guanabara Bay, The City Improvements, as old and defective as it was, still embodied progress. Beyond the limits of Rio de Janeiro city, in the areas that never interested The City Improvements, sewage systems were rare if not nonexistent. The federal government was mostly responsible for keeping the rivers clean, and also supplying water to communities around the bay. Concerns for pollution early in the twentieth century led the federal government to create the Federal Commission of Sanitization and Dredging of the Rivers. The commission's work from 1910 to 1916 focused on the mechanical aspects of rectification, cleaning, and dredging of Guanabara rivers—it prioritized uses such as navigation and housing. They sought to avoid having sewage and debris block the rivers: all of it would still end up in Guanabara.²⁸

²⁷ Coelho, interview. The company spent more in planning than in the actual facilities, and constantly postponed approved investments.

²⁸ Weber, ed., *Ambiente das Águas*, 104. From the 1930s to 1950, in a similar effort to clear the rivers from debris, the Comissão de Saneamento da Baixada Fluminense (Commission for the Sanitization of the Fluminense Lowlands) and the *Departamento Nacional de Obras de Saneamento* (DNOS, National Department of Sanitation Works) took a heavy toll on the forest cover around Guanabara Bay, by rectifying rivers and by cutting down riparian vegetation and mangrove forests in the estuaries. In 1912, the forest cover in Rio de Janeiro state was over 3,585,700 hectares—or 81.66%; in 1960, it was 973,900 hectares, or

By 1940s, sanitary management of the Rio de Janeiro city had lost much of its economic attraction. The fees for the services were fixed by the National Congress, instead of by the company's costs and the exchange rate.²⁹ At the same time, in 1945 the Ministry of Health transferred the water services of Rio de Janeiro, until then directly under control of the Ministry, to the Federal District administration. When The City Improvements' concession expired in 1947, all its facilities, equipment, and employees were incorporated into a single municipal agency together with the water services to become the Water and Sewage Service (SAE-Serviço de Água e Esgoto).³⁰

The fact that sewage was not under governmental control until 1947 meant the administration tended to view water monitoring from the perspective of water supply. Water quality was crucial to controlling the City's water supplies. Waterborne diseases, such as hepatitis or typhoid fever, were ever-present risks, and public health experts continuously strove to keep the waters safe. Pollution in water sources was bad enough, but contamination along the water pipes was also common. Droughts or low reservoir levels often caused low pressure in the pipes. Negative pressure then sucked up any fluid nearby, including wastewaters, which contaminated the fresh water. To avoid contamination, sanitary engineers recommended adding chlorine to the water supply in

22,16%. The rectified rivers carried the soil washed out from the cleared forest faster than ever, and in the process they accelerated the sedimentation of the Guanabara Bay itself. Weber, ed., *Ambiente das Águas*, 142.

²⁹ Hélio de Araújo Evangelista, "Uma Abordagem Geográfica à Reivindicação por Equipamento Sanitário: O Caso da Barra da Tijuca (RJ)" (Master's thesis, Universidade Federal do Rio de Janeiro, 1989), 29.

³⁰ Ten years later, riding a wave of considerable federal investments in the city, the mayor created the Superintendence of Sanitation (SURSAN), that included the department of sewage, but not the department of waters. Sewage and Waters would follow separate ways for five years, until the first Governor of Guanabara, Carlos Lacerda, turned the SURSAN into a large autonomous and very powerful agency. Then SURSAN had control over water, sewage, and everything else related to urbanization.

high enough quantities to resist contamination during the long trip through the water pipes to the end-user, even with low pressure.

Sanitary engineering was a new discipline in Brazil, and in the absence of specific training, it attracted a number of young physicians with an interest in public health. Although it seemed a natural consequence of the alliance between physicians and engineers so evident in the early Republic, engineers in the public administration looked with some mistrust at the practitioners of this new hybrid discipline. These health experts were not real engineers, they did not build things. Worse yet, they were encroaching on the territory of engineers.³¹

Fausto Guimarães belonged to the first generation of physicians trained specifically in public health.³² In 1935, he was recruited to a small division in the Services of Waters for chlorinization of the Federal District's water supply. The department was relatively marginal within the Service of Waters, partly because

³¹ Despite the strong influence of European, especially French engineers, on Brazilian engineers and physicians, in the twentieth century the model for science shifted from Europe to the United States. The concept of "sanitary engineering" was definitively part of this shifting. According to Fausto Guimarães, the influence of Augusto Comte's positivism prevented engineers from embracing certain scientific theories that had not been validated by the philosopher—even if such theories developed after his death. Guimarães, interview., tape 2, side A. For a discussion on Brazilian engineers and positivism, see Chapter 1. Guimarães' contempt for positivist engineers should be taken with a grain of salt. Although the Brazilian version of positivist military did resist to public health campaigns against yellow fever and for smallpox vaccination, I could not find evidence suggesting that "positivist engineers did not accept the microbe theory" or that Comte himself held this belief.

³² Guimarães was one of those new sanitary engineers *de facto*, although he had graduated in Medicine. Beyond his training at the Instituto Oswaldo Cruz, he attended a course on hygiene and public health at the newly created Universidade do Brasil, in 1935. Inspired by the public health courses at the John Hopkins University in the United States (originally for sanitary engineers), the course was coordinated by the physicians from the Instituto Oswaldo Cruz. His experience in battling typhoid fever in Angra dos Reis in 1934 deeply affected him, and convinced him of the benefits of adding chlorine to water supplies. Guimarães, interview., tape 3, side A. One of the founders of Instituto de Engenharia Sanitária (IES) and the FEEMA, he also served as Technical Consultant of the Brazilian Delegation to the UN Conference in Stockholm, in 1972. He created, breathed and lived in the FEEMA's libraries, until his eightieth birthday. Guimarães dedicated most of his life to the control of water supply in the Paraíba do Sul River, for the fresh water supply for the city, and complained that FEEMA was too much involved with the Guanabara Bay. Roberto D'Ávila, "Fausto Guimarães," *Revista FEEMA* 1, no. 1 (1991): 5.

chlorinization was not a process widely understood or accepted.³³ To win the trust of engineers in the service, Guimarães organized short courses on public health for staff members. As an unexpected consequence, the class soon attracted senior engineering students and others outside the public administration. This was the beginning of Guimarães' network beyond his own institution and one of the first informal and voluntary collaborations between technical staff from both sides of Guanabara Bay. Engineers came from Niterói to attend Guimarães's classes when the engineers in his own institution refused to do so.³⁴

When the Services of Waters incorporated The City Improvements in 1947, studies on water quality for sewage and water supplies became more important within the agency, and so did Guimarães's courses. One of The City's former engineers, Enaldo Cravo Peixoto, was also a strong believer in training and research. Peixoto and Guimarães were connected by family links and common interests, and worked very closely:³⁵ Guimarães was made director of the Water Treatment Division in 1955, while Peixoto coordinated the Sewage Services since 1953. Peixoto created the Commission of Planning of Sanitary Sewage (COPES), which would later become the national center for research on sanitary engineering. With Peixoto's support, Guimarães's courses gained support, and he also started to organize debates, conferences, further enlarging his

³³ São Paulo began chlorinization of its water supply in 1926; Rio de Janeiro did the same in 1934. Brazilian graduates from American universities championed chlorinization despite the serious reservations from the other engineers in the area of sanitation. Guimarães, interview, tape 3, side A.

³⁴ Guimarães was not the only one to suffer snubbing from engineers in the Service of Waters. His own superior, Mario Leal, a Harvard graduate, engaged in frank war. "Engineers despised Leal, and he returned the favor," recalled Guimarães. "He refused to speak to Engineers. (...) They thought he was an ignorant, when in fact they were the ignorant ones, (...) Thus what was there to speak?" Isolated from other offices in the Federal District, Leal and his team went about their duties of adding chlorine to the water supply and collecting samplings to verify the water quality for the final user. Guimarães, interview, tape 3, side A

³⁵ Cravo Peixoto was also a cousin to Fausto Guimarães by marriage.

already impressive network.³⁶ Together with the Institute of Inter-American Affairs, the Waters Department in 1958 brought in Dr. A. F. Bartsch, from the U.S. Public Health System, to teach a course on polluted waters. In the same year, Guimarães co-organized with Lejeune de Oliveira the first Brazilian Conference on Hydrobiology, co-organized by Fausto Guimarães, with the support of the National Museum and the Instituto Paulista de Oceanografia. Guimarães invited Captain Paulo Moreira da Silva, a long time friend with a strong interest in hydrobiology and water pollution, to talk to his students. He also sent several of them to take classes with Luiza Krau and Lejeune de Oliveira on Pinheiro Island.³⁷

By the early 1960s, Rio de Janeiro city, as much as São Paulo, was a center for studies on sanitary engineering. The city now had a twenty-year tradition teaching the new discipline, and a practice of exchange between personnel from different institutions. The ranks of the public administration included old-fashioned engineers from the formerly private-owned The City Improvements, physicians trained at the Public Health School or the Instituto Oswaldo Cruz, and a new generation of engineers who joined the public service after 1947 and learned to think of water and sewage in the same breath. This new generation would constitute the staff of the future Institute of Sanitary Engineering.³⁸

³⁶ Peixoto's career was on the rise, and he would later become the coordinator the SURSAN, the powerful agency above both the Department of Waters and the Sewage Services.

³⁷ Oliveira, "Poluição das Águas Marítimas," 16; Oliveira et al., "Observações Hidrobiológicas." See Chapter 3.

³⁸ Victor Coelho was one of these engineers. He started his career with an internship at SURSAN in 1957, ten years after The Rio de Janeiro city Improvements closed its activities. Born and raised in Rio de Janeiro city, he was used to long sailings in the Guanabara Bay waters from childhood. He would work with pollution control for 35 years, and serve as the first director of the future FEEMA. Coelho, interview.

The Creation of the Institute of Sanitary Engineering

The transition from a Federal District to statehood in 1960 brought important administrative reforms to Rio de Janeiro city. The new governor, Carlos Lacerda, was strongly committed to addressing the water supply crisis, and requested two large loans (\$36 million dollars) from the Interamerican Development Bank to invest in the Guandú watermain and on smaller scale, a new sewage system. His timing was perfect. As a strong ally of the new president Jânio Quadros, Lacerda was confident in Brasília's support for any international borrowing. Even the surprising resignation of the president played to his favor: a rabid enemy of the US-opposed Vice-President João Goulart, Lacerda received favored treatment from the Kennedy administrations for foreign loans directly to his state.³⁹

As local, national and international politics wove together, Fausto Guimarães thought it was the right time to push ahead his plan for an institute of sanitary engineering, a project long cherished and discussed in the courses offered by the Department of Waters and in the visits to Lejeune de Oliveira on Pinheiro Island. The goal was to create an autonomous and technical institute that would survive changes in administrations.⁴⁰ The Lacerda administration created the Institute of Sanitary Engineering (Instituto de Engenharia Sanitária – IES) in November 1961, the first

³⁹ Mauro Maulin, "Negrao de Lima," in *Dicionário Histórico-Biográfico Brasileiro*, ed. Alzira Alves Abreu (Rio de Janeiro: FGV-CPDOC, 2002).

⁴⁰ It took Guimarães some effort and some cajoling, but he convinced Cravo Peixoto to champion the project. Part of the attraction for the creation of the institute was to outdo São Paulo in sanitary engineering. "We will do it before São Paulo does," said Guimarães. To win support from other SURSAN engineers to a sanitary institute, Guimarães and Peixoto included in the statute that the only an engineer could direct the institute—but it had to an engineer with specialization in sanitary engineer. This way Guimarães cut himself off from the chair of director—the position went to Ataulpho Coutinho—but he hoped that it would keep the institute for the usual political grabbing for positions. Guimarães, interview, tape 5, side A.

institute for pollution control in Brazil.⁴¹ Under the control of the Superintendence of Sanitation (SURSAN), its major focus was on the water supply for the State. Pollution in the Paraíba do Sul river thus constituted a larger matter of interest than the disposal or final destination of the sewage in Guanabara Bay.⁴² The new agency was subdivided into pollution control, analyses, and training/divulcation divisions, and this last department was very much based on the classes taught by Guimarães since 1936.⁴³

Building the institution

When Peixoto, Coutinho and Guimarães collaborated to create the Institute of Sanitary Engineering, they wanted an institution that could support other institutions, help create policy, and monitor water, soil, and air pollution⁴⁴ Politically, its advisory role was its strength because it could connect to other institutions, and weakness because it could rarely take credit for its work. IES for instance did not build the sewage system, but planned it for the Secretary of Public Works.

In those first years, IES's main connection with Guanabara Bay was the project to build a giant submarine sewer that would collect sewage from Gloria, Botafogo, and Copacabana, then discharge the waterwaste into a submarine outfall in Ipanema, well outside Guanabara Bay.⁴⁵ Funded in part by the Interamerican Development Bank's 1961 loan, the submarine outfall was finally completed in 1975. During those years, the project absorbed a lot of the funding for the Institute. IES had to find alternative funding sources

⁴¹ São Paulo's State Council for Pollution Control, created in 1955, claimed the same honor, but it was rather an educational project.

⁴² Coelho, interview.

⁴³ Coelho, interview.

⁴⁴ IES was the first institution to monitor air pollution in the country.

⁴⁵ The submarine outfall had first been proposed by The City Improvements, in 1940, due to the complains of raw sewage in Botafogo Bay.

to fulfill the high hopes its founders had for it. New funding eventually came from an agreement with the United Nations Development Program (UNDP) in 1965. The agreement funded laboratory facilities, foreign consultants and other activities at the Institute for ten years. It gave the Institute the flexibility and resources to define pollution control beyond simply restructuring the sewage system. Finally, because one of the agreement's clauses was on pollution control in Guanabara Bay, the bay was brought to the forefront of the Institute's agenda.

Defining and Addressing Pollution in Guanabara Bay

In November 1963, Senator Vasconcelos Torres⁴⁶ wrote to multiple ministries (Transportation and Public Works, Health, and the Navy) asking for information on water pollution in Guanabara Bay. Concerned that Guanabara Bay showed “one of the highest levels of pollution in Brazil,” Torres asked what measures the federal government had taken to protect the bay including, “its fauna and flora, as well as for the control of the uses and benefits of these water, so vital for two States of the Federation.” He also demanded to know of “plans, studies or reports” about sewage discharges into the Bay from the State of Guanabara or the Fluminense cities of Niterói, São Gonçalo, Duque de Caxias and Magé, as well as studies on industrial discharges and oil spills. Finally, Torres asked about, “any study, research, survey—or even a visit—on the beaches of the States of Guanabara and Rio de Janeiro,” regarding contamination by bacteria, viruses, or parasites.⁴⁷

⁴⁶ Torres was senator for Rio de Janeiro state.

⁴⁷ The Ministry of the Navy answered every bit as thoroughly (see Chapter 4). Not as complete, but likewise revealing, was the reply from the Ministry of Transportation and Public Works. There was no such a thing as a national department of pollution or environmental control, and local agencies for this purposes were in their first steps. Motta, “Resposta ao Requerimento.”

Senator Torres' letter demonstrates that by the early 1960s, pollution had become an item on the political agenda. Guanabara Bay could count on incipient pollution control legislation, and an institutional framework for studying, monitoring and advising on pollution. The Bay also needed political interest for pollution control. Torres's letter sought to cover every aspect of water pollution on both sides of Guanabara Bay, fauna and flora, sewage, industrial waste, and public health. Torres asked what was being done about pollution control in Guanabara Bay, and who was doing it. Equally important questions that Torres failed to ask were what was perceived as pollution, and why should anyone care about pollution in Guanabara Bay.

Answering these four questions provides a powerful snapshot of how pollution issues were formulated in Brazil in the early 1960s, and which perspective would dominate the incipient agencies in the public administration. Replying to Senator Torres for the Ministry of Transport and Public Works, the National Department of Sanitation Works (DNOS-Departamento Nacional de Obras de Saneamento) officer Sidney Hesketh confirmed pollution was still relatively uncharted territory, at least in the formal structure of the public administration. At the same time, Hesketh acknowledged the existence of studies regarding water contaminations on the beaches, carried out by the administration of Guanabara state, of which the DNOS "was seeking to obtain a copy." The DNOS had "not yet taken upon itself the problem of sewage in Guanabara Bay," continued Hesketh, but it intended to do so eventually.⁴⁸

⁴⁸ Although the DNOS had been very active in sanitization projects in Guanabara Bay since its creation in the early 1930s, only after its conversion into an autonomous agency in 1962 the agency assumed among its duties the control of the water pollution. Sidney Campos Hesketh, letter to Senhor Subchefe de Gabinete do Ministério de Viação e Obras Públicas, "Ref 13 236/63." Brasília, DF, December 13, 1963. Departamento Nacional de Obras de Saneamento.

Both the DNOS and Senator Torres had good reason to show concern about Guanabara Bay. Pollution in the bay was evident and alarming. To the distress of Rio's public officers, pollution was particularly visible in the tourist areas, all along Rio de Janeiro city's shoreline from Sugar Loaf to Governor Island. It was worse at several points of the shoreline where landfills had affected the water regime by burying small rivers and preventing the influx of new seawater. Not all of Guanabara Bay was polluted—people could still enjoy swimming, scuba-diving and sailing in crystalline waters with fishes and dolphins, just a short boat ride away. But Guanabara's famous postcard image was definitively tarnished. Some authors used the term "repellent," especially in contrast with the beautiful setting of the bay. In 1960, Rio de Janeiro state's Délio Duarte urged for federal solutions for Guanabara Bay:

one of the most visible elements of our large national patrimony, after which was named the newest State of Brazil, and being, by itself, a benchmark of our image (propaganda) in the foreign world.⁴⁹

Pollution was thus a crime against Guanabara Bay, and a crime against Brazil. Duarte was among the first to propose that pollution control in Guanabara Bay required a coordinated effort for the whole bay. He probably calculated that enlisting the wealthier Guanabara state in a strong push for federal legislation was the best hope for the waters of his own poor state.

⁴⁹ Duarte, "Estudo da Poluição da Baía de Guanabara", 3. Duarte mapped with singular and precocious precision the most problematic areas for pollution in Guanabara Bay. His article underlines the ambiguities of the sanitation discourses when used in environmental management context. Duarte considered the mangroves in the back of the bay also as an "abandoned area," and therefore in need of some governmental measure to develop them. Located and visible pollution, such as that produced by the fishing ships and fish markets, is "repulsive", while a large project such as the landfilling of the Flamengo beach, with over 1,200,000 SqM and a strong potential to increase sedimentation, would cause mere "temporary disturbance in the waters." His concern was not impact of human action on any idea of "pristine nature:" it was exclusively the sanitary aspects of human action.

By the time of Senator Torres' letter in 1963, the gap between Guanabara state and Rio de Janeiro state was huge in terms of pollution monitoring, as well as pollution control. Guanabara state had a major sewage system with primary treatment for at least 60% of its population.⁵⁰ The state administration had identified the largest fifty industrial polluters on its side of the Guanabara Bay basin with a detailed database listing industry type, on which tributary river the pollution occurred, the number of employees, and volumes of daily discharge. It had also identified non-point sources of domestic pollution discharged directly to the bay, as well as other point sources: two large shipyards, warehouses, the Manguinhos Refinery, the municipal market, fish markets, and smaller shipyards in the Ponta do Caju.⁵¹ Since 1957 with the creation of the Superintendence of Sanitization (SURSAN), and later the Institute of Sanitary Engineering, Guanabara state had begun investing in pollution monitoring, and these initial studies were the result of those efforts.

Across the Bay on the Rio de Janeiro state' shore, pollution levels were anyone's guess. Its population was less than half than Guanabara's, but only Niterói had some kind of sewage system, quite inadequate, and with almost nonexistent treatment. Other municipalities discharged raw domestic waste into the bay and its tributaries via open ditches and irregular canalization. To make things worse, the population more than tripled from 1940s to 1960s, while in Guanabara state it doubled, with a proportional strain on the virtually nonexistent sewage system of Rio de Janeiro state. Pollution in

⁵⁰ Most of the sewage deficient area was located on the Sepetiba Bay basin, not included in the Guanabara Bay basin.

⁵¹ Secades, "Relatório do Grupo de Trabalho," 12-15. Other sources of pollution listed in the study included commercial and military ships and effluents from the Guanabara Bay's islands—often used as fluctuant gas stations for the commercial ships. Unfortunately, the database omitted references to treatment facilities, if there were any.

Icaraí, one of the most popular beaches of Niterói, was several times beyond any admissible pollution standard.

The level of absolute total industrial pollution in Rio de Janeiro state had to be lower than those recorded for Guanabara state, including the city of Rio de Janeiro, as the size of Rio state's industrial park was no more than half of its neighbor's. The Fluminense state lacked records that could be compared to Guanabara state's ones regarding the volume or type of industrial discharge, but approximate estimates suggested that everything from tanneries, canning industries, vinasse from cachaça (white Brazilian rum) factories, pulp and paper factories to textile industries was discharged as raw effluents in Guanabara Bay and its tributaries. Moreover, organic waste and oils from the canning industry (sardine) close to Niterói made part of the beautiful coves and beaches of the state capital beyond use.

Visible damage to the national postcard, Guanabara Bay, was, before anything else, a political problem. This was the reason why the Ministry of Transportation and Public Works called for a Working Group in 1961-1962 that gathered representatives from the two states and several ministries to discuss the matter, two years before Senator Torres wrote his letter. Formed at the same time the IES was created, and with the participation of several representatives of that Institute, the 1962 Working Group produced a comprehensive overview of what was known about pollution in Guanabara Bay at that time.⁵²

⁵² Secades, "Relatório do Grupo de Trabalho," 23. The working group listed several different projects at work at Guanabara Bay: Lejeune de Oliveira's hydrobiology studies—which definitively influenced the final version of the report; Paulo Moreira da Silva led the Navy's studies on the water circulation regime in the Bay, in the Department of Hydrograph and Navigation; the registering of all fishing colonies at the Bay, and hydrologic studies of the tributary rivers in the Guanabara bay basin by the National Department of

The rationales for pollution control in Guanabara Bay

The Working Group struggled with the dilemma that although pollution in Guanabara Bay was undeniable, the rational to spend scarce resources on pollution control of seawaters was not so self-evident. This was a struggle that the IES faced during its fifteen years of existence. According to the sanitary engineer Victor Coelho, several administrations sought to curtail funding for pollution control in Guanabara Bay because compared to clean drinking water it was not a priority. They sought to invest instead in the water quality of the city's watermain in Guandú. Funding-cuts were not deeper only because Guanabara Bay's pollution control was part of the agreement with the United Nations Development Program, one of the most important sources of funding for the IES.⁵³ Making the case for pollution control in coastal waters, and more specifically, in Guanabara Bay, was thus a constant need for IES's technical staff. Nobody could deny that pollution in the Bay was increasing and that it was a political problem, but was that enough to deserve a significant portion of the public budget?

The 1962 Working Group acknowledged that "pollution of the coastal waters and estuaries" was a new subject, and that there was more emphasis on interior waters.⁵⁴ But

Sanitation Works (DNOS). Except for the work of Lejeune de Oliveira and the Navy's surveys, I could not find evidence of any of the other projects in the archives.

⁵³ Coelho, Interview. I did not find corroborating evidence for this claim.

⁵⁴ Secades, "Relatório do Grupo de Trabalho," 21. They also argued that neglect of coastal pollution was not a problem exclusive to Guanabara, or even Brazil. Countries across the globe focused on pollution of interior waters, but gave relatively low priority to coastal waters in the hopes that the oceans would "magically" absorb everything. Most everyone conveniently forgot that, "tides brings pollution back to the coast, before its final dilution in the ocean," as the report of working group warned. It reviewed water legislation from every Brazilian state. The most advanced legislation, from São Paulo, Minas Gerais and Rio Grande do Sul, made little reference to marine waters. It reviewed also documentation of the United Nations, from England, Sweden, Netherlands, Norway and the USA. The exception was the 1954 London conference on sea pollution by oil, from "which Brazil was absent," by the International Maritime Consultive Organization. Secades, "Relatório do Grupo de Trabalho," 19. For more discussion on the participation of Brazil in international conferences on sea pollution, see Chapter 3.

if people did not drink from Guanabara Bay, they could still put their health at risk when they swam, dived, or sailed in its contaminated waters.⁵⁵ Another possible rationale for pollution control policies in Guanabara Bay was that beach-goers could acquire waterborne diseases such as typhoid fever or hepatitis from bathing in polluted waters. Such a possibility was particularly alarming in a tropical region where the population used the beaches all year around. Beach activities were also the most popular recreation: the metropolitan area of Rio de Janeiro contained fifty kilometers of beaches, used by over forty million people each year.⁵⁶ In fact, the Guanabara state's health department in 1970 suggested that contaminated beaches caused an outbreak of hepatitis. There was not however enough scientific evidence for this link according to an IES 1974 report that referenced both international literature on the subject and their own field studies.⁵⁷ Only in the late 1970s a link between contaminated beaches and health risks was confirmed, mostly for gastrointestinal diseases.⁵⁸ The absence of a known link between pollution and hepatitis was confirmed by a British consultant, Brendan Moore, who analyzed health risks of pollution in Guanabara Bay. "No study so far reported has indicated that bathing in sewage contaminated sea water is a serious health hazard," wrote Moore. According to

⁵⁵ Secades, "Relatório do Grupo de Trabalho," 4.

⁵⁶ According to 1974 figures. Instituto de Engenharia Sanitária - IES, "Diagnóstico de Poluição das Praias do Estado da Guanabara," (Guanabara, Brazil: Instituto de Engenharia Sanitária, 1974), 26.

⁵⁷ According to the report, studies in England and the United States, from 1904 to 1950, had found that there was not distinguishable risk for those bathing in polluted waters to those bathing in non-polluted waters. IES, "Diagnóstico de Poluição das Praias do Estado da Guanabara," 24.

⁵⁸ See James Charles Fox and Norinne E. Noonan, *EPA Action Plan for Beaches and Recreational Waters - Reducing Exposures to Waterborne Pathogens* (Washington, DC: Environmental Protection Agency - EPA, 1999), 20; G. Fred Lee and Anne Jones-Lee, *Public Health Significance of Waterborne Pathogens* [Internet resource] (California Environmental Protection Agency, December 1993 [cited October 25, 2003]); available from http://www.gfredlee.com/phealthsig_080801.pdf.

the biologist, one might find swimming among excreta ugly and unpleasant, but one was unlikely to die because of it.⁵⁹

Although not supported by contemporary evidence, the perception of health risk presented by polluted beaches still shaped policies and activities at the IES during its fifteen years of existence. It definitely helped to assure financial support for the submarine outfall at Flamengo beach. As one of its first regular activities, the IES began collecting information on fecal coliform, an important indicator of sewage pollution, at Guanabara beaches starting in 1962.⁶⁰ During the 1960s, the Institute added massive doses of chlorine to the beaches when coliform levels were too high. The health risk concerns were such that in 1968, the Institute was given the power to shut down contaminated beaches temporarily.⁶¹ Future reports discouraged this practice as everyone from beach-goers to hot-dog sellers resisted the measure by ignoring the prohibition, which was quite demoralizing for the Institute.

⁵⁹ Moore was a scientist from the Exeter Laboratory, in Great Britain, and was invited under the UNPD agreement with IES. He advised against closing recreational beaches that showed high levels of fecal coliform: "Nevertheless, lay public opinion has been very vocal and persistent in putting the opposite view. This is almost certainly in part due to aesthetic and psychological revulsion to excreta, since massive outbreaks of pandemic influenza do not give rise to a clamor that places of public entertainment be closed." Brendan Moore, "Report on the Bacteriological Condition of Bathing Beaches in Guanabara Bay and the South Zone of Rio de Janeiro and Their Possible Relationship to Communicable Disease in the Area," in *Environmental Control Program in the State of Rio de Janeiro*, ed. Pan American Health Organization (PAHO/WHO ZONE VI) (Rio de Janeiro: United Nations Development Program/ World Health Organization, 1975), 19.

⁶⁰ The study and analyses of beach waters for the presence of fecal coliform predates the creation of the institute—Guimarães's lab at the Tijuca analyze Copacabana's waters in 1956, and in 1960 SURSAN coordinated a comprehensive survey in all beaches of the state. IES, "Diagnóstico de Poluição das Praias do Estado da Guanabara," 26. See Glossary for fecal coliforme.

⁶¹ A 1974 IES report judged the closure of beaches a losing strategy. First, it was inaccurate; between the sample collection and the closure of the beach, at least three days would pass, and a change of currents or a storm could totally alter the concentration of coliform. Second, standards were inconsistent from one beach to the other. The report finished by suggesting that classification of the water quality in the beaches, rather than command-and-control policies, would be more efficient. IES, "Diagnóstico de Poluição das Praias do Estado da Guanabara," 27.

The Institute's reports curiously showed only a few references to health risks to fisheries posed by heavy metals or toxic discharge. One of the reports mentioned that fish caught inside Guanabara tasted so "oily, that it burned one's mouth," but it did not state it was a health risk.⁶² Contamination of shellfish, to the point of making it unfit for consumption, was however pointed out by the 1962 Working Group as one danger of sea pollution, a point probably influenced by Lejeune de Oliveira's work on the subject.⁶³ Loss of fisheries, on the other hand, garnered constant mention. Interviewing fishermen at the Caju fishing colony, Coelho found out that after the installation of the Duque de Caxias Refinery nearby, shrimp catch fell approximately 90%.⁶⁴ Sardine schools which used to stay within the bay for months, entered and left Guanabara Bay's waters after three or four days. Fishing was still possible, particularly in the central deep channel that renewed the bay with water from the Atlantic at every tide. But mostly, the fishing industry would head out to the ocean or to Sepetiba Bay, and traditional fishermen did the same.⁶⁵

Besides health risk and loss of fisheries, the most frequent reasons to justify pollution control for Guanabara Bay were recreation and aesthetics. Beach bathing, sailing, sport activities, and recreational fishing were threatened by pollution, and were

⁶² Coelho, "Aplicação de Modelos", 26.

⁶³ Lejeune Pacheco Henrique de Oliveira, "Estudos Higiênicos Sobre os Crustáceos e Moluscos da Baía da Guanabara (Rio de Janeiro)," *Memórias do Instituto Oswaldo Cruz* 40, no. 2 (1944); Secades, "Relatório do Grupo de Trabalho," 4. Shellfish contamination was not frequently mentioned in subsequent reports.

⁶⁴ Coelho, "Aplicação de Modelos", 27. Subsequent studies mentioned the fisheries loss of 90% in general for Guanabara. According to Coelho, however, this was an error: the figures for shrimp catch loss were transcribed as fisheries loss in one report, and the error was copied in the future. Technical reports often cannibalized previous documents from the same institution without citation, especially for data such as descriptions of the bay or the population—which may or may not be updated. It is just the identical wording that points to the common source. One particular well-crafted paragraph (and others not so well-crafted) can survive in technical reports year after year.

⁶⁵ Coelho, "Aplicação de Modelos", 26.

the industries that benefited from recreation, such as tourism and beach-related services. Early twentieth-century engineers evoked the beauty of Guanabara Bay as a reason to promote engineering projects that would give the bay a city worthy of its landscape. Sixty years later, the beauty of Guanabara was again evoked as a reason for engineering intervention, this time to save the bay from pollution. The 1962 working group concluded it was the state's responsibility to take remedial and long-term measures to protect the Bay because:

Guanabara Bay, a natural landscape of internationally celebrated beauty, is under protection of the [Federal] State. So asserted the article 175 of the 1946 Constitution: 'the works, monuments and documents of artistic or historical value, as well as the natural monuments, the landscape and the places distinguished with particular beauty, are under the protection of the public power.'⁶⁶

There were two problems with justifying pollution control based on the aesthetic value of Guanabara Bay alone. First, aesthetics are not easily transferable. In other words, why should one control pollution in any other landscape not as beautiful, visible, or symbolic as Guanabara Bay? Second, how much was Guanabara Bay's beauty worth in state investments for pollution control? Pollution control had a cost, and it had to compete with other projects for public funds.

To put forward the case for pollution control, in 1972 IES researchers developed a cost-benefit analysis to assess the monetary costs of pollution. They estimated the aesthetic uses of Guanabara Bay using a rough willingness-to-pay methodology or "pleasure currency." They asked the population if enjoying the beauty of Guanabara Bay

⁶⁶ Secades, "Relatório do Grupo de Trabalho," 53.

was worth, “one pack of cigarettes.”⁶⁷ Thus, for each one of its uses—primary recreation (which required contact with the water), secondary recreation (navigation and fishing), commercial navigation, commercial fishing, industrial use and waste, and aesthetical uses—the researchers attributed a currency value, and calculated its monetary losses due to pollution.⁶⁸ The total in 1974 currency, as outlined in Table 4, was Cr\$170,679,000.00 (circa US\$25 million). It was a remarkably low figure, and, because it was based on human uses and annual estimates, it underestimated potential long-term benefits of non-polluted waters. Yet, it made a powerful argument when compared to the costs of addressing pollution in Guanabara bay: the estimate value of building submarine outfalls, pumping and treatment stations was Cr\$817,023,000.00 (circa US\$120 million) in a twenty-year schedule.⁶⁹ According to IES, in five years the benefits of cleaning Guanabara bay would offset the total costs.

Table 4 - Annual estimates of benefits for main water uses, 1974

Waters Uses	Benefits (in 1974 Cr\$1,000.00)	Benefits (in 1974 US\$1,000.00)
Recreation (contact with waters)	81,600.00	12,017.67
Recreation (navigation and fishing)	4,314.00	635.35
Commercial Navigation	9,706.08	1,429.47
Commercial Fishing	3,978.00	585.86
Industries	1,746.00	257.14
Aeshtetic	69,334.92	10,211.33
Total	170,679.00	25,136.82

SOURCE: Data from Coelho 1974, 14.

⁶⁷ Coelho, interview.

⁶⁸ The monetary value of beach bathing, for instance, was estimated by adding up incomes of beach vendors, tourism operators, frequency to restaurants located close to the beach, etc.

⁶⁹ Coelho, "Aplicação de Modelos", 14-15.

How much pollution is tolerable?

Just before the creation of the IES, the state-owned oil company Petrobrás was on the verge of becoming a large player in the history of Guanabara Bay.⁷⁰ Already with one refinery at full capacity, and on the eve of activating three other facilities on the shores of bay, Petrobrás feared being blamed for pollution that already existed.⁷¹ The company called for a roundtable on pollution in Guanabara Bay. While the goal of the meeting was to highlight existing pollution as much as it was to prevent new pollution, the company invited public officials and technical experts from government agencies to answer one main question: “what should be the final destination of industrial waste that will yield maximum safety for humans but with a minimum economic burden?” Similar to the IES, Petrobrás was tentatively proposing a cost-benefit analysis of pollution in Guanabara Bay.

The roundtable included the usual suspects—Lejeune de Oliveira, for the Instituto Oswaldo Cruz, Paulo Moreira da Silva for the Ministry of the Navy, Fausto Guimarães, then at the Laboratory of Analyzes of Waters at the Guanabara state, as well as technicians from the Sanitary Superintendence, the Service of Meteorology of the Ministry of Agriculture, the Foundation Extraordinary Secretary for Public Health

⁷⁰ Petrobrás had the monopoly of oil exploitation since its creation in until 1990.

⁷¹ As said Barbosa Teixeira, a Petrobrás Engineer, “the pollution of the Guanabara Bay waters is a theme that has been largely discussed, either in professional journals, either in the newspapers which report it often, pointing the negative aspects that affect the most the populations of Rio de Janeiro and Niterói.” Barbosa Teixeira, “Poluição da Baía de Guanabara,” 497. Despite any good intentions that Petrobrás could have had by inviting its round table on pollution in Guanabara Bay, its Duque de Caxias Refinery (REDUC) did represent a benchmark, both for the industrial growth in the region, as for the installation of other petrochemical industries. Five years after the beginning of its activities, the shrimp catch in Guanabara Bay fell to 90%. By the time that FEEMA was created, in 1975, REDUC was the largest point source of pollution in the Bay. Victor M. B. Coelho, “Baía da Guanabara: Situação de Controle,” (Rio de Janeiro: Fundação Estadual de Engenharia do Meio Ambiente - FEEMA, 1983), 1.

(Fundação SESP) and the Air Force Ministry.⁷² Most of the participants were the same people who helped to build the IES, and who would participate in the 1962 Working Group for the Ministry of Transportation and Public Works. But important stakeholders—industry representatives or residents, final users of the Guanabara Bay, or even the technical staff from the sanitary agencies across the bay—were not present.⁷³

Moreira da Silva proposed a new direction for the meeting, framing the debate according to a larger concept of pollution control, instead of final destination of industrial residues. The real question, said Moreira da Silva, was “how much effluents may Petrobrás discharge in the Bay through the Iguaçu River, without leading it to prohibitive conditions for its biology and the other desirable uses of its waters? How much effluents can Petrobrás discharge safely in the Bay? ... Which concentration of each one of these effluents does bring disturbance to life?”⁷⁴ In other words, what was being debated was the carrying capacity for different effluents in Guanabara Bay, instead of an absolute concept of pollution. Pollution was defined not by a standard of integrity of the waters, but by how a certain concentration of effluents affected the “desirable uses of the water.”⁷⁵ Following the Petrobras’ round table, the 1962 working group elaborated on

⁷² The meeting itself—or at least its transcript to the Petrobrás’ own journal—vindicated the company in its hypothesis, i.e., that pollution problems at Guanabara Bay preceded its new installations. But the article also offers a glimpse of pollution control in the Bay in 1961. We learn, as Petrobrás wished, about other sources of non-point pollution in the Bay, such as oil from ships and domestic waste. We also learn about the lack of funding of the Meteorological Service, about collaborations between the Navy and the Sanitary Services of Rio de Janeiro, and about initial concerns on air pollution at Guanabara. Barbosa Teixeira, “Poluição da Baía de Guanabara,” 499. See Chapter 3 for more on Moreira da Silva’s participation at this meeting.

⁷³ The Petrobrás roundtable was one of the first initiatives to bring together participants of all public agencies working on the waters of Guanabara Bay—and yet it did not include representatives of SANERJ, from the Rio de Janeiro state.

⁷⁴ Barbosa Teixeira, “Poluição da Baía de Guanabara,” 503. (Emphasis added).

⁷⁵ This debate brought to Guanabara Bay the same dual definition on pollution that was foreseen in the legislation.

this concept, and so would the IES in the future.⁷⁶ The working group conceptualized water pollution as “any change of its biologic, chemical, and physical characteristic, caused by human activities, that may damage the uses intended for the waters”.⁷⁷

Because pollution control was related to water use and carrying capacity, it was site-specific. Successful policies in other regions may fail to yield the same results in Guanabara Bay because its water circulation regime and its water uses were unique to each body of water. The 1962 Working Group thus analyzed how physical characteristics of Guanabara Bay, such as the deep central channel or the secluded coves, might hinder or encourage dilution of liquid waste. Pollution sources were also site-specific. Both the Petrobrás roundtable and the 1962 working group identified several causes for Guanabara Bay’s pollution: population growth, industrial growth, oil industry expansion, increases in ship traffic, and pollution carried in from tributaries. Especially damaging was the inordinate growth of favelas, sanitary landfills, and industrial waste from tributaries (particularly tanneries and slaughterhouses).⁷⁸ The working group report also included a survey of the pollution sources of Guanabara Bay’s tributaries, river by river.⁷⁹

Locating pollution sources was the first step. But to address current pollution conditions in Guanabara Bay, the report stated, “the basic question is to know the index of tolerable pollution. ...The waters of a receptor body should have quality standards compatible with its most beneficial uses. There might be no economic justification to

⁷⁶ Surprisingly, I could not find a reference to the 1962 Working Group report in any of the FEEMA or IES documents. Some of the data, however, were clearly from the same sources, with very similar if not identical wording and concepts. I attribute it to the fact that technical reports within the institution often fail to make internal reference, and eventually the link to an original document may be forgotten.

⁷⁷ Secades, “Relatório do Grupo de Trabalho,” 3.

⁷⁸ Just Matadouro da Penha (a slaughterhouse) and Curtume Carioca (a tannery) together produced organic waste equivalent to a city of 120,000 people, not considering toxicity.

⁷⁹ Secades, “Relatório do Grupo de Trabalho,” 12-38.

keep water more pure than the level required by its different uses.”⁸⁰ A river that was used only for navigation or irrigation did not require the same standards as a river that supplied water to a city.

The idea that pollution mattered only when it affected water use was at the center of all the pollution control strategies developed by the Institute of Sanitary Engineering. The concept was that while developed countries could afford a policy of no tolerance for any pollution (or so IES engineers assumed), developing countries had to accept some degrees of pollution because of the high costs of pollution control. Thus pollution control policies in Guanabara had “to set standards compatible with the Brazilian physical and economic reality.” Towards this goal, the IES was “to define the current and future beneficial uses of water, and to estimate the economic and ecological impact of these uses, ... [which imply] accepting to renounce to some [of these] uses for some time [if the costs to preserve them are too high].”⁸¹

How to deal with pollution

Once it was decided there were reasons to combat pollution, and once the goal was defined—tolerable and affordable levels of pollution—the next step was to propose policies to address the problem. Although documents from 1960 to 1975 were consistent for the first two steps, they vary considerably with respect to policy. Again, many of the possible solutions adopted later by IES had been discussed by the 1962 Working Group. One key recommendation, later adopted, was that pollution control policies should “not distinguish between private industry and public activities regarding the pollution they

⁸⁰ Secades, “Relatório do Grupo de Trabalho,” 27.

⁸¹ IES, “Diagnóstico de Poluição das Praias do Estado da Guanabara,” 21.

cause.”⁸² In other words, the state-owned Petrobrás was just as much subject to pollution control legislation as were the fifty private industries listed by IES as the largest polluters in the region.

A second key recommendation was the zoning of Guanabara Bay. Considering the different uses of the bay (recreation, fisheries, industry and navigation), governments should set different standards for pollution. Fig. 18 illustrates the division of Guanabara into four basic uses.⁸³ Zone 1 was for recreational water use, implying a direct contact with the water; Zone 2 was for commercial fishing; Zone 3 for aesthetics enjoyment; and Zone 4 for commercial navigation. Biochemical indicators of pollution were assigned different thresholds of tolerance relative to water use Standards were more stringent for Zone 1 than for Zone 4, for example, in order to optimize pollution control efforts. Some contaminants, such as floating solids, greases, and oil, were classified as intolerable, regardless of zone, and should be removed.

⁸² Secades, "Relatório do Grupo de Trabalho," 28.

⁸³ Victor M. B. Coelho and Ricardo Lisboa Cunha, "Accident to the Tarik Ibn Ziyad in Guanabara Bay - Preliminary Report," (Rio de Janeiro: FEEMA, 1975), 160.



Fig. 18 - Water use zoning in Guanabara Bay. Illustration in Coelho and Cunha 1975, 160.

Zoning of the Guanabara Bay according to the uses was a constant in all IES reports. Fig. 19 shows the more detailed grid used in mathematical models.⁸⁴ The technical staff plotted these models, calculating the tolerable level of fecal coliform for each area. They considered the water circulation patterns, to pinpoint discharge sources that could threaten the most sensitive areas, and then prioritize intervention. In their words, "mathematical models related waste inputs to water quality in the receiving water

⁸⁴ Victor M. B. Coelho and Maria Regina M. B. Fonseca, "Utilização dos Modelos Matemáticos da Baía de Guanabara no Controle de Poluição de suas Águas," (Rio de Janeiro: FEEMA, [1977]), 258.

body; they were used to evaluate alternative engineering plans for control and management of water quality.”⁸⁵

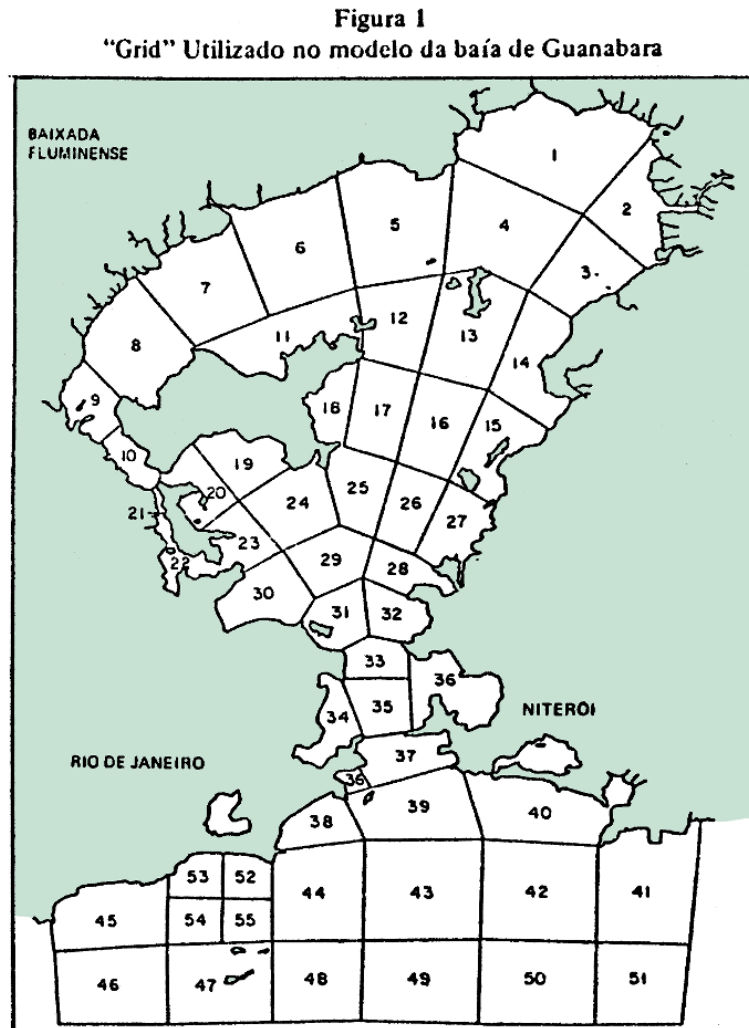


Fig. 19 - Grid used for mathematical models. Illustration in Coelho and Fonseca 1977, 258.

By associating mathematical models of water quality to intended uses, it was possible to develop cost-benefit analyses and to differentiate pollution control approaches.⁸⁶ Industrial discharge in the Penha region that brought pollution to an area mostly used for navigation was thus not a priority, regardless of its toxicity. Domestic

⁸⁵ Hydrosience Inc., "Water Quality Model," 30.

⁸⁶ Coelho, "Aplicação de Modelos", 4.

sewage that could threaten the use of the residential beaches of Flamengo or Botafogo was however a more urgent matter. Fig. 20 exemplifies this strategy.⁸⁷ The map on the left displays acceptable levels of fecal coliform for Guanabara Bay, while the map on the right are levels of dissolved oxygen. By comparing Fig. 18 to Fig. 20, it is possible to notice that areas with lower projected goals for fecal coliform overlapped with areas designated for recreational use.

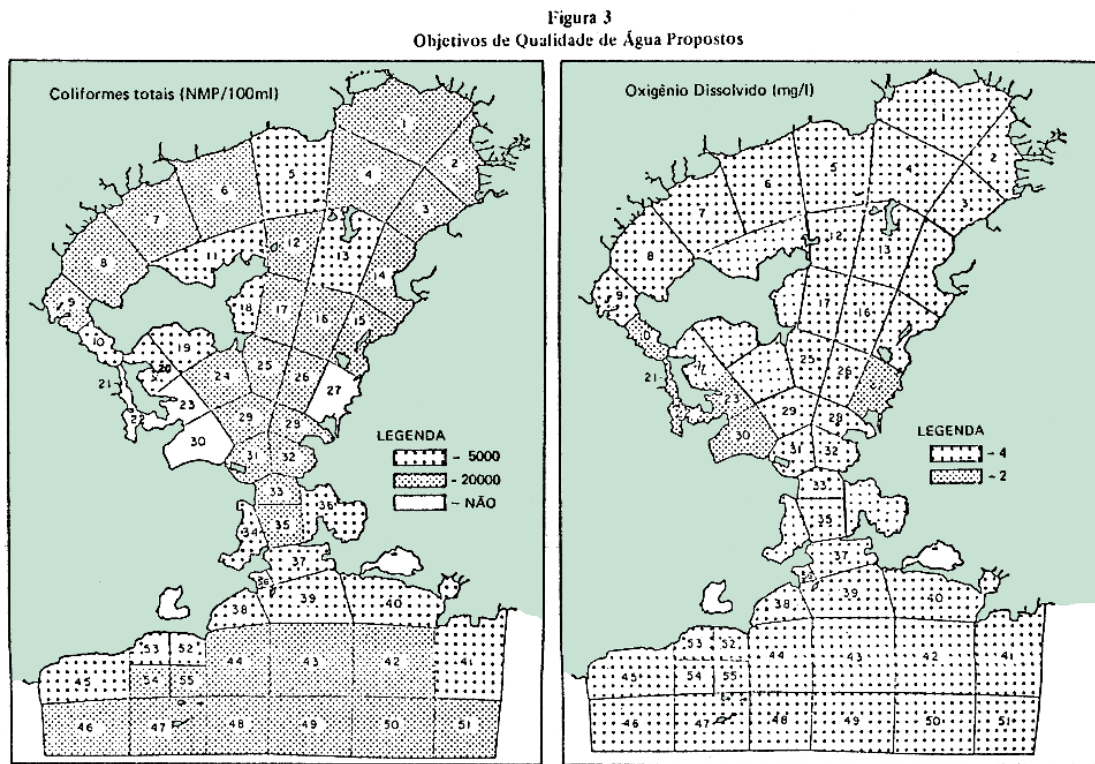


Fig. 20 - Proposed goals for water quality. Illustration in Coelho and Fonseca 1977, 259.

Although it made sense to set priorities, some problems resulted from the adoption of these models. For example, the models emphasized biochemical indicators over a biological or ecological understanding of the bay. Ecosystems are rarely contained within an orderly-defined plot. Fish swim across grids, and the same water circulation

⁸⁷ Coelho and Fonseca, "Utilização dos Modelos Matemáticos," 260. See Glossary for definitions on fecal coliform and Dissolved Oxygen.

that bring seeds and bio-organisms from one mangrove forest to another circulated around zones defined by the IES. To survive in the more protected areas, organisms also had to tolerate the high pollution levels of Zones 3 or 4. Therefore, damage to an ecosystem might go unnoticed for a long time before the biochemical indicators detected it. Besides, tolerable standards for beneficial human use such as navigation might have not been tolerable for dolphins, mullets, or plankton sharing the same space.

The attachment to mathematical models as the only way to frame pollution was enrooted in the institutional mentality of the IES. In practice, the methodology measured pollution as a biochemical event, and this often underestimated physical elements related to habitat deterioration, such as erosion and siltation, or the links between pollution and social, health, economic and ecological spheres. Moreover, mapping uses of the bay through mathematical models tended to crystallize them. By allowing higher pollution standards in areas close to industry, the models ensured the area would most likely never recover enough for fisheries. More alarming, the models reinforced patterns of inequality in the city. Middle and upper class residents usually lived in areas where water use was defined as primarily recreational. The poor population on the other hand often lived in mixed areas, and favelas in the 1960s and 1970s grew in the new landfilled areas of Avenida Brazil, side by side with the worst polluting industries in the region. The models were not efficient in dealing with such mixed uses of water, and this meant that poor populations would have to live with water quality standards defined for industry.⁸⁸

⁸⁸ Since the 1970s, fashion and pollution stimulated the “beach-commuting”, i.e., every weekend, population located close to interior beaches of Guanabara Bay flooded the public transportation system to go to the more fashionable and cleaner Oceanic beaches of Copacabana, Ipanema and, more recently, Barra da Tijuca.

Once Guanabara Bay was zoned, and acceptable levels of pollution for each zone defined, the next step was to address pollution sources. Improving the sewage system was thus a critical stage. In Guanabara state, the submarine outfall for Guanabara state was supposed to solve domestic sewage concerns, and the state had laws against industrial pollution since 1954, though inconsistently enforcement. In Rio de Janeiro state, the Waters and Sanitary Sewage Commission since 1962 studied plans for installing a submarine outfall for São Gonçalo e Niterói, channeling sewage from these municipalities to the Ocean beaches. There were no plans to control industrial waste. Other suggestions by the 1962 Working Group to eliminate pollution sources were self-evident, but quite beyond simple pollution control or remediation.⁸⁹ The group's recommendations to urbanize and sanitize the favelas, or to relocate the sanitary landfills from near the bay, would have required complicated political negotiations, extensive funds, and long-term planning.⁹⁰

The 1962 Working group was particularly fortunate with two of its proposals, but that would have to wait more than a decade for implementation: more active incorporation of the population in the management of Guanabara Bay, and the creation of

⁸⁹ The Working Group report constitutes an amazing document not only for its influence on the proposals that did survive within the IES, but for its overall recommendations, including those never adopted. These recommendations included the unification of the water pollution legislation at national level, modernization and training of the port captaincy to deal with pollution, long-term plans for soil protection in urban and rural areas in order to avoid erosion and siltation, reforestation, monitoring of the transport of sediments from the tributary rivers, protection for all bay's shoreline and the creation of a National Fund for Pollution Control, for emergencies and studies. Forty years later, some of these proposals are still popular among environmental agencies. Secades, "Relatório do Grupo de Trabalho," 42.

⁹⁰ To this day Guanabara Bay struggles with the pollution from the favelas. Proposals for their urbanization were not new in 1962, but they competed with another very popular idea at the time, of the forcible removal of the favelas. It was the idea favored by the Governor Lacerda from Guanabara. The removal of the sanitary landfills from the Islands of Sapucaia and Bom Retiro, to the dubiously more appropriate site of Jardim Gramacho, took place only in 1976, although almost every administration since 1960 sponsored studies for the removal. The new sanitary landfill was created, as its predecessors, on the top of a large flooded mangrove forest on the shores of the Sarapuí river, a tributary to the Guanabara Bay.

an agency for pollution control that had jurisdiction over all of Guanabara Bay.⁹¹ “Since there is federal and state jurisdiction [the bay and its basin],” claimed the report, “the best method to control pollution is through an organization that includes the federal government, the two States and the representatives of the final users.”⁹² The inclusion of final users in policy-making circle, or the monitoring of Guanabara Bay, was quite unusual for the 1960s, but became commonplace twenty years later.

Debating is usually easier than actually enforcing policies. The IES embraced many of the recommendations of the 1962 Working Group, although not as fast as the group may have wanted. Only in 1969 did Guanabara state approve a law against pollution by industrial waste that actually had teeth. IES used the law against all industries discharging effluents in the bay or tributary rivers, regardless of toxicity. The new law had three important characteristics. First, it was inclusive and clearly framed, in contrast to the generic previous legislation of 1954.⁹³ Second, the law assigned sanctions to the industries that failed to comply. And third, by its combinations of fees and

⁹¹ The report stated, for instance, for the “rural population, it should be carried on an active campaign for sanitary education,” with special focus on the tributary rivers—and this is one of the only occasion that education was connected to pollution control policies in all the technical and political reports. It proposed also the creation of a Sociedade dos Amigos da Baía da Guanabara – Friends of Guanabara Bay Society, congregating “governmental and non-governmental entities.” Secades, “Relatório do Grupo de Trabalho,” 50.

⁹² It was not clear, however, how this representation was to be organized. To avoid the suggestion of complete anachronism, a more detailed reading of the intended participants for such agency included the Navy, the National Confederation of the Industry, National Council of Sports, the Federal Patrimony Service, the Brazilian Commission for Tourism, and the National Council for Development of the Fisheries. It did not mentioned neighborhood associations or fishing colonies, or other direct end-users, who would take a more active role in the environmental management of Guanabara Bay in the 1980s. Secades, “Relatório do Grupo de Trabalho,” 50.

⁹³ The decree defined water pollution as any “alteration of physical, chemical and biological properties of the waters (...) caused by substance” that: a) had the potential to harm public health, safety or well-being; b) damage fauna; c) contained oils, fats, grease, refuse or debris; d) and damage the water use for domestic, industrial or recreational purposes, for navigation or pisciculture, and for any other “justifiable or useful purposes or that affect the aesthetical aspect of the waters”; and finally, e) that had the potential to affect unfavorably underground water. *Regulamento do Despejo Industrial no Estado da Guanabara*, Decreto N° 2.721.

pollution standards, it in fact admitted that some pollution had to be tolerated, but not necessarily for free. The law provided the IES with negotiation tools to force industries to adopt pollution control policies and make enforcement more realistic and profitable.⁹⁴

There was nothing comparable in Rio de Janeiro state, or in most of Brazil.

For domestic sewage, both Niterói and Rio de Janeiro city had different options. Sewage could be released into the ocean with little treatment through an expensive and time consuming submarine outfall.⁹⁵ Or the city could invest in more aggressive water treatment, keeping the bay as the final destination of sewage. Choosing either option had political and technical challenges. The outfall option assumed organic pollution as end-of-pipe problem that would be addressed by way of powerful dilution in the ocean. Water treatment represented another view of pollution as an integral part of a large city, requiring transformations in the shantytowns and the processes related to waste production.⁹⁶ Choosing one or the other was just the first problem; the second was to deal with the imperfect implementation of that choice. What if Niterói decided to invest in water treatment, but it could not treat the sewage of the growing shanty towns? Or what if

⁹⁴ As outside observers commented in 1977, "control efforts for the industrial waters in Guanabara Bay basin have been in effect since 1969. At present 34 industries have introduced treatment systems for their effluents, and about 31 of them already have projects." Hydrosience Inc., "Water Quality Model," 101.

⁹⁵ Cost and benefit analyses of the submarine outfall in Ipanema have emerged in the recent years for new debate, as a submarine outfall is planned for Barra, an Ocean Beach on the west coast of Rio de Janeiro city. The submarine outfall was a child of Evaldo Cravo Peixoto, as much as the IES itself. Peixoto, while director of the Superintendence of Sanitation, invited to Rio de Janeiro Dr. R. Pearson, from the company Engineering Science, based in Los Angeles, California. Pearson had built many submarine outfalls in California, and found that Brazil was very enthusiastic about the technology. His company eventually moved to Brazil, with the name of Engenharia Ciência do Brasil (ENCIBRA), a consulting company for many large sanitation problems in Brazil, including the "submarine outfalls of Ipanema, Ipanema (RJ), Salvador (BA), Fortaleza (CE), Manaus (AM), Santos (SP) and Porto Alegre (RS). As in the past, the revolving door between industry and government was in full steam: when he left the public administration for private practice, Cravo Peixoto went to work as consultant and public relations officer for ENCIBRA, the company he helped to bring to Brazil. See Evangelista, "Uma Abordagem Geográfica", 8.

⁹⁶ Once waste treatment was provided, the bay could be the final receptor for the all sewage produced by the city for more 35 years, according to a 1975 estimates. The estimate required, of course, "controlled" discharges, i.e., not discharge from favelas or uncontrolled urban runoff. Hydrosience Inc., "Water Quality Model," 8.

(as it ended up doing) the city opted for the submarine outfall, but couldn't afford it for the next twenty years?

During the 1960s, the Institute of Sanitary Engineering was considered well prepared to embrace pollution control in Guanabara Bay. It had a strong and competent staff, a well equipped laboratory, and access to worldwide research on pollution control. But the agency constantly struggled with weak enforcement capabilities. IES also had access to a limited but creative source of literature on pollution control: the studies produced by Petrobrás, and the Ministry of Transportation and Public Works' 1962 Working Group. Some of the solutions in this literature were beyond IES's political power or financial resources. But among the choices within its discretion to adopt, IES opted for those more familiar to its personnel in sanitary engineering. This disciplinary choice affected not only the understanding of the impact of pollution control on the bay and its human population, but also the understanding of the bay in its complexity.

From Sanitary Engineering to Environmental Engineering

Fifteen years after representatives of Rio de Janeiro and Guanabara states met in Brasília to assess pollution in the Guanabara state, the gap between the two states was still huge. Some advances occurred in Rio de Janeiro state towards the identification of pollution sources, but little of this translated into actual pollution control. SANERJ, the Sanitary Company of State of Rio de Janeiro, mirrored some of IES's earlier initiatives, but until 1972, they developed very few projects together.

According to these new records, pollution sources in Rio de Janeiro state had become overwhelming. Over ten canning facilities released their untreated organic

material on the shores of the bay. Textile industries produced especially heavy organic discharge, followed by the food industry, while biochemical and leather treatments adding heavy metals. Shipyards (there were over twenty-eight in the bay) added oil to the mix, and so did the hundred maritime gas stations leaked oil into the bay without a second thought. Estimates for the daily discharge of organic waste from the state to the bay were 156,020 Kg BOD/day. Over half of it (56%) came from domestic sewage.⁹⁷ Niterói was still the only municipality with a sewage network serving a significant portion of the urban population. But the population of São Gonçalo and Niterói has surpassed 700,000 people, according to the 1970 census. Also in the state of Rio de Janeiro, the rural Baixada Fluminense (Fluminense lowlands) contributed an additional population of 1.6 million people, all with no sewage system whatsoever.

The sewage situation in Rio de Janeiro city (including the city of Rio de Janeiro) had remained stable since 1960, in which the same percentage of population (60%) had access to sewage system. But the population had increased to 4.3 million inhabitants according to the 1970 census. The sewage of 2.8 million people still discharged into the bay, with only partial treatment. Circa 193,980 kg BOD/day of organic waste from Guanabara state reached the bay—24% more than Rio de Janeiro state. Thus by 1975, after fifteen years of pollution control policies, about 10 m³/s of sewage discharged into

⁹⁷ The estimates for industrial sewage were mostly based on the literature from developing countries, and sometimes from actual field analysis. The authors believed that literature-based values underestimated the real discharge. For instance, scientific literature estimated that a pulp and paper factory with 160 employees and an average daily production of 18 tons of mechanic paste would discharge 203 kg BOD/day; field analyses showed that one such a factory in Guanabara Bay discharged fifteen times this amount. Vannier, Silveira, and Faquer, "Avaliação da Carga Poluidora", 438. For the sake of comparison, a person in Rio de Janeiro Metropolitan Area in 1990 contributed with circa 54 g of BOD per day. Organic waste of that magnitude was equivalent to 769 factories as described above, releasing their untreated effluents at the bay per day, or the raw sewage of a city with 3 million people. Ciléa Souza Silva, José Carlos Valim Rodrigues, and Nelly Lamarão Câmara, "Saneamento Básico e Problemas Ambientais na Região Metropolitana do Rio de Janeiro," *Revista Brasileira de Geografia* 52, no. 1 (1990): 63-71.

Guanabara Bay, of which only 10% received secondary treatment. The estimated organic load that reached Guanabara Bay, coming from different sources of pollution, was on the order of 350,000 kg BOD/day. This estimate did not include other pollutants such as oil, heavy metals and toxic substances. It is comparable to discharging raw sewage produced by 6.5 million people in Guanabara Bay, which is ten times smaller than San Francisco Bay, every day. Beyond direct water pollution, urban and industrial development on the Bay shores and in river valleys produced radical changes in soil surface characteristics, altering the rain accumulation/drainage relationship, and increasingly causing floods in areas close to these rivers.⁹⁸

In short, although Guanabara state had invested much more in pollution control than Rio de Janeiro state, both states were still heavily discharging pollutants in the Bay, at similar orders of magnitude. Although in relative terms Guanabara state treated more wastewater than its neighbor, its larger population and industrial density more than compensated for the difference. Pollution was anything but controlled—on both shores.

Context for change

On the international scene, debates on pollution, particularly air pollution, increased loudly during the 1960s—not only in diplomatic circles, but also on the streets of the western world. Responding to this debate, the United Nations called for an international conference on the human environment. The conference took place in 1972 in Stockholm with a focus on acid rain and other global environmental problems. In Brazil, what environmental movement that existed was very timid. The political climate

⁹⁸ The final disposal for sewage from the wealthier south zone was through the finally concluded submarine outfall located 4.5 km from Ipanema beach, discharging raw sewage on the ocean. The north system received waste from 2.8 million people and by 1977 still did not have a final disposal defined, other than two small sewage treatment plants. Hydrosience Inc., "Water Quality Model," 11-19.

discouraged popular organizations, and under a violent dictatorship in a country with widespread poverty, many left-wing groups dismissed environmental concerns as bourgeois.⁹⁹ If there was one concern that left and right groups shared in a deeply divided Brazil, it was a mistrust of the motives of industrialized countries that called the UN conference, and a fear that international agreements would hinder Brazilian development.

The Brazilian delegation sent to Stockholm therefore had a dual mission. The delegation first had to display a level of expertise and success in pollution control to preempt suggestions for international regulation. Brazilian delegates also sought to relieve international pressure for stringent and expensive pollution control that could interfere with the fast pace of development that Brazil was experiencing in the early 1970s. To accomplish this goal, the federal government sought out this expertise in Rio de Janeiro in the person of Fausto Guimarães, one of the founders of IES, to act as a technical advisor to the Brazilian delegation.¹⁰⁰

Domestically, the Navy shared the government's dislike for international pressure, and sought to advance its own pollution control project. The Navy encouraged pollution control initiatives in several states of the Union, starting with Guanabara Bay. With the Navy acting as mediator, the states of Guanabara and Rio de Janeiro in 1971 signed an agreement to collaborate on pollution control for Guanabara Bay's Waters. "It was beautiful," recalled Coelho, "the two Governors shaking hands onboard a Navy ship, in the middle of the Guanabara Bay." The Navy, which was also the only agency that

⁹⁹ For a discussion on the birth of the environmental movement in Brasil, see José Augusto Pádua, "Natureza e Projeto Nacional: Nascimento do Ambientalismo Brasileiro," in *O Ambientalismo no Brasil: Passado, Presente e Futuro*, ed. Enrique Svirsky and João Paulo R. Capobianco (São Paulo, Brazil: Instituto Socioambiente/Secretaria do Meio Ambiente do Estado de São Paulo, 1997).

¹⁰⁰ Guimarães had been temporary "exiled" to a marginal position in the Department of Waters, due to internal IES politics. Guimarães, Interview, tape 5, side A.

could board ships spilling oil in the Bay, contributed its fast boats from the Port Captainship; IES had a helicopter, while its counterpart SANERJ contributed mostly with Fluminense jurisdiction and personnel. While the agreement lasted, enforcement was finally possible.¹⁰¹ Oil pollution in the Bay decreased by 40%, and although there were no records available of a decrease in industrial pollution, sanctions against polluting facilities were highly publicized.¹⁰²

Environmental discourse was trickling down to the public administration, though the process was slow. As a result of its commitments made during the UN Conference, Brazil created the Extraordinary Secretary for the Environment (Secretaria Especial do Meio Ambiente – SEMA). IES added environmental topics to its reports more often, although their methodologies remained basically the same.¹⁰³ The renewal of the agreement between IES and the United Nations Development Program in 1974 had an even greater impact. After the 1972 UN conference, IES put even more emphasis on environmental aspects of pollution control, for instance, by initiating a program to measure the impact of pollution on mangroves.¹⁰⁴ From 1974 to 1977, the agreement funded the visit of several international consultants.¹⁰⁵ Reports from these consultants offered an interesting view not only of the state of pollution of the Bay, but also of the shifting understanding of what pollution control implied.

¹⁰¹ Coelho, Interview.

¹⁰² For more information on the Agreement, see Chapter 3.

¹⁰³ Little else changed at administrative level, except that the Superintendence of Sanitation ended and the IES moved to the Department of Science and Technology.

¹⁰⁴ The program was quite timid and did not really take off until 1980s. See Paulo Pinho Filho, Cláudia Ferreira, and Sônia Maria Tavares, "Projeto de Recuperação Gradual do Ecossistema da Baía da Guanabara - Indicadores Ambientais de Degradação/Obras e Projetos de Recuperação," (Rio de Janeiro: FEEMA/Departamento de Planejamento Ambiental, 1989), 13. Lip-service or not, the program did mark a depart from the previous policies.

¹⁰⁵ Consultants were mostly American scientists, from the newly-created US Environmental Protection Agency, University of Texas, Loyola University of Los Angeles and University of California at Berkeley.

While consultants praised the competence, training and dedication of the Institute's staff, they were concerned by the Institute's narrow understanding of the pollution crisis, and its overemphasis on technical solutions.¹⁰⁶ Robert Selleck from the University of Berkeley warned that the institute was not able to translate quality of water information to the average citizen in any meaningful way.¹⁰⁷ Biologist Gerald Walsh from the US Environmental Protection Agency was more critical of the institute. He lamented that

the importance of biological studies was still not recognized, and that water quality was considered only in physical and chemical terms. This approach, which is incomplete and nearly obsolete in countries with greater experience, is due to an administrative structure that does not include biologists in the decision-making process. ...The Engineers in charge now do not seem to understand the complete problem of pollution. They do not realize that the engineering approach is only a partial approach. ... [The importance of biological indicators] studies on biological characteristics of the bay are needed because water quality in any body of water is related to the organisms within it.¹⁰⁸

¹⁰⁶ "Mathematical models," wrote consultant James Foxworthy, himself a sanitary engineer from University of Texas, Austin, "while vital in developing suitable water quality management schemes, are not an end in themselves. They serve only as tools to help define solutions to problems. Human beings must evaluate these solutions and select those which provide the greatest benefits for the economic resources available." James E. Foxworthy, "Final Report," (Rio de Janeiro: Pna American Health Organization/ World Health Organization, 1977), 4.

¹⁰⁷ Robert E. Selleck, "Relatório Sobre Problemas de Poluição de Água Associados Com a Lagoa Rodrigo de Freitas, Baía de Guanabara e Outras Águas Receptoras," (Rio de Janeiro, Brazil: Pan American Health Organization/ World Health Organization, 1969), 12. Russell Ludwig, while praised the IES's "basic organization to conduct field and laboratory studies and analyses," criticized its fragmentation. The Division of Pollution Control, particularly the Section on Water Pollution, was badly equipped and too loosely connected to the rest of the institute to fulfill its objectives. For Ludwig, the institute still depended on the UNPD for equipment, training and coordination in a multi-state program. Russell G. Ludwig, "Problems of Water Pollution in Guanabara State," in *Project 71/WS/BRZ/6400*, ed. Regional Office of the World Health Organization Pan American Sanitary Bureau (Guanabara, Brazil: Instituto de Engenharia Sanitária-IES, 1971), 3.

¹⁰⁸ Walsh visited Guanabara Bay twice, once in 1974, when the IES was still the pollution control agency and another in 1977, working with FEEMA. Most of his comments were directed at FEEMA, but they focused exactly on those aspects that FEEMA received from IES. Comparing to his first visit in April, Walsh said in 1977: "A very important aspect of my first report concerned the administrative structure under which biological work is conducted at FEEMA. I have seen no progress with regard to administration of biological, studies, which are still under the direct administration of an engineer. ... If FEEMA is to carry out meaningful studies on pollution of Brazilian waters, it must understand the importance of field

Particularly damaging in Walsh's criticism was the fact that the IES actually did have access to biological indicators studies. Supported by Fausto Guimarães, Lejeune de Oliveira had developed biological indicators for Guanabara Bay for almost 40 years, and taught most of the technical staff of the Institute from 1962 to 1971 at the Hydrobiology Laboratory on Pinheiro Island.¹⁰⁹ Those classes apparently did not translate into pollution control policies.

Despite these criticisms, IES did have some very interesting successes. IES technicians pioneered studies and techniques in water pollution control that were adopted by other states. They developed legislation to regulate industrial discharges which anticipated the "polluter pays principle," a concept that would become consecrated internationally in the United Nations Conference on Environment and Development in 1992. They created mathematical models of Guanabara Bay to map pollution and pollution sources, and argued that pollution standards had to be adapted to the physical, economic and social characteristics of Brazil. Unfortunately, they also stuck to a narrow definition of pollution derived from their experience in sanitary engineering, which ultimately stopped short of an integrated environmental perspective. Above all, their projects for Guanabara Bay ignored those who were supposed to be the beneficiaries of their sanitary efforts: the population that kept crowding the shores, mangroves, and the beaches of Guanabara Bay.

and laboratory studies that define responses of living systems to pollutants. ... Gerald E Walsh, "Biological Methods in Pollution Studies," in *Environmental Control Program in the State of Rio de Janeiro*, ed. Pan American Health Organization (PAHO/WHO ZONE VI) (Rio de Janeiro: United Nations Development Program/ World Health Organization, 1977), 6-8.

¹⁰⁹ Krau, interview.

Merging the states, the bay and the institutions

In 1975, with the merging of the states of Rio de Janeiro and Guanabara, their administrative structures joined as well, and a new administrative reform ensued.¹¹⁰ For the first time, a single state had jurisdiction over all of Guanabara Bay. There was hope that more coordinated policies would bring more development for the region, and a less uneven, more integrated map of Guanabara Bay would follow.

Sadly, this was too much to hope for. Although the SANERJ staff collaborated in some projects with the IES staff, putting the two teams together proved to be a long and difficult process. Their contracts were regulated by two different labor systems, and their coexistence under a single agency exacerbated the differences. Engineers from the former Guanabara state complained about a huge technical gap between them and their less sophisticated colleagues from the other side of the bay—who, to add insult to injury, had higher salaries. In turn, the new co-workers resented the high-handed, condescending manner in which they were assimilated into the former administrative structure of Guanabara state. Assimilation did take time, and the split was still visible in publications almost a decade after the merger.

The merger of the two states also meant human and financial resources of the Institute of Sanitary Engineering, until then concentrated on the west shore of Guanabara, now had to be spread out across the entire 43,900 km² of the new state. Basic work towards identifying polluting facilities had advanced in the city of Rio de Janeiro, but for

¹¹⁰ For more on the merging of the states, see Chapter 1.

the whole state, it had to start almost from scratch.¹¹¹ Pollution in Guanabara Bay now had to compete for resources with deforestation in the south, pollution in water supplies in the north, and with an almost nonexistent sewage system (much less sewage treatment) outside of Rio de Janeiro city and Niterói.

The State Foundation of Environmental Engineering (FEEMA) emerged from this context. FEEMA resulted from the combination of four different departments: the Institute of Sanitary Engineering, from Guanabara state, a well equipped agency focused on pollution control; the IES's smaller Fluminense equivalent, the Pollution Control Department at SANERJ; a Department for Vectors Control, from the Guanabara state side, which was in charge of controlling the population of rats, mosquitoes, and other disease vectors; and the Institute for Conservation of Nature, a small agency from Guanabara state, until then totally unrelated to pollution control. None could be more surprised by the inclusion of this last institute than the IES technicians. "We did not know what to do with those guys," said Victor Coelho, then the director of pollution control of the former IES. "We wanted to control pollution, erosion; we wanted to do important stuff. We saw them as romantics, bird-lovers, and marginal to our main effort ... We wanted to create mathematical models to understand and control pollution, this was important. Biology was too slow. Conservation of nature was to be an obvious consequence of pollution control."¹¹²

Coelho's uneasiness was not unique. Internal conflicts aside, FEEMA developed in Brazil a new concept of environmental protection that linked pollution, nature

¹¹¹ Although services replaced industry as the motor of Rio de Janeiro's economy, there were at least 10,000 industries in the State in 1983. FEEMA considered that at least 5,000 were "significant polluters." Coelho, "Baía da Guanabara," 3.

¹¹² Coelho, interview.

conservation, and public health, a conception that been developing abroad for at least forty years.¹¹³ On the ground, FEEMA responded to calls of an incipient but vocal environmental movement in Rio de Janeiro. Conceptually, the agency was strongly influenced by the 1972 UN conference in Stockholm.¹¹⁴ Many FEEMA policies were also inspired by the three-year-old Environmental Protection Agency (EPA) in the United States.¹¹⁵ However, an understanding of the environment, or even of environmental engineering, had yet to reach the technical staff, and they still did not understand how environmental engineering would differ from sanitary engineering. And as Gerald Walsh complained in 1977, although the name might have changed, the power structure of the IES lived on in the new agency. In fact for quite some time, mathematical models of pollution, which privileged biochemical indicators, still retained precedence over ecological studies that focused on biological indicators in relation to the ecosystems.

* * * * *

Interviews with former officials of the pollution control institutions, yield a general feeling of disappointment towards what could have been accomplished in Guanabara Bay but failed. In Guimarães, disappointment comes from the expectations his generation had in the first half of the twentieth century. Rio had such a head start in terms

¹¹³ See Hays and Hays, *Beauty, Health, and Permanence*.

¹¹⁴ Haroldo de Mattos, one of the Brazilian representatives at the conference, was the first director of the new agency, and he quickly requested his mentor, Fausto Guimarães to join the team.

¹¹⁵ One of FEEMA's first initiatives was a system of pollution permits (SLAP–*Sistema de Licenciamento de Atividades Poluidoras*) adapted from the EPA's own project.

of sanitation compared to any city in South America.¹¹⁶ For Victor Coelho, it was almost a personal failure. “Today I am frustrated,” he affirmed. “What did I accomplish? Nothing. Thirty years working on pollution control and I got nothing. We said, ‘Sepetiba Bay will be different.’ It wasn’t. Economic development carried along everything in a wave.”¹¹⁷

It was an understandable reaction. For those looking at Guanabara Bay in the twentieth-first century, any report of pollution in Guanabara Bay in 1960 pales in comparison to the current state of the Bay. But such comparisons mislead the observers to believe the task was easier then. To contemporary sanitary engineers, the Institute of Sanitary Engineering symbolized the triumph of a new discipline, and opened a world of possibilities to address a sanitary situation. Entrusted with the task of pollution control in Guanabara Bay, the Institute sought to develop new tools and legislation framed within the parameters of sanitary engineering. Ultimately, it would have to overcome the limits of that discipline because everything around it shifted continuously: the waters, the pollution, the fisheries and mangroves, the population and the industries, the science and the technology, international and domestic partners, and just as important, the political framework in which it worked.

Engineers in Rio de Janeiro thought their role was to bring order to human activities in the bay. Controlling the results of such activities through pollution control was a necessary step for the development of society. But they were outpaced at every step by this same urban development that was contrary to their hopes, unordered and

¹¹⁶ Guimarães, interview, tape 10, side B.

¹¹⁷ Coelho, interview.

uncontrolled. New populations were attracted by another sign of development: industrial growth. Although the agencies had more tools to address industrial pollution, they lacked enforcement capability to make these tools meaningful.¹¹⁸ Moreover, legislation and enforcement varied tremendously in different areas of the bay, making integrated work very difficult.

The sheer pressure from population growth was overwhelming. While institutions tried to address the pollution issues that resulted from the 4.8 million people living around the bay—a very challenging task by itself—, but only ten years later, this population increased to 6.9 million. This was an increase of 42% in one decade, a growing population that built their shacks on stacks in the waters, on the top of hills, near sanitary landfills, on new landfills areas planned for industry or transportation; anywhere they could. Expensive engineering projects, like the submarine outfall of Ipanema, coexisted with recently-opened ditches carrying debris, sediment and raw sewage to the bay, a de facto sewage system that was parallel to the ordered world of treatment stations and runoff galleries.

The population's presence in the physical Guanabara Bay could not go unnoticed, but it was remarkably absent in the bay that existed in the world of institutions and technicians. Yet, this population had the most to gain or to lose from the pollution in Guanabara Bay; that is, they were the “stakeholders” in Guanabara Bay. Sometimes these new populations appeared in technical reports as “users”, “beach-goers,” or “fishermen.” More often they were referred to generically as “the population,” and tacitly understood

¹¹⁸ For instance, agencies could require refineries to built oil collector systems to prevent oil residues to spill in the bay, but they could not monitor the refineries so often as to make sure such collector system were used, or that oil from washing decks did not join runoff water.

as “the polluters,” or those who continuously produced waste material faster than the administration could build sewage systems. They were almost never considered as possible partners.

This silence toward Guanabara Bay’s population was due in part to the late birth of the environmental movement in Brazil. Before the 1970s, there were few partners for environmental conservation, few non-governmental organizations, and none actually able to mobilize the population. The military regime actively discouraged popular movements. The first organized popular campaign for environmental matters in Guanabara Bay did not occur until 1977.¹¹⁹ This delay in the movement’s presence was also the result of a technocratic administrative structure that could not conceive common people had anything to contribute to the debate. Pollution and nature conservation were understood as technical, not political, issues. Within the federal or state administration, there was no forum to incorporate public participation. “There was no Environmental Council or Public Ministry,” said Coelho, referring to institutions created within the public administration later in the century, that would actively incorporate environmental causes. “We stood alone against everybody else who said they favored development.”¹²⁰

Another remarkable absence from the technical reports until 1975 was the environment of the Bay itself. Certainly, the reports included words like “fauna”, “flora,” and “ecology.” But they failed to connect the parts into a comprehensive whole. If the political Guanabara Bay was split in two states, its environment was split into many more pieces. Siltation, fish, shellfish, and mangroves: it was not that the technical staff ignored

¹¹⁹ Even then, the campaign against the Inhaúma landfilling was rather a reaction against the removal of a slum and landfilling of the area than a clear struggle against pollution.

¹²⁰ Coelho, Interview.

the state of each of these elements. Siltation in Guanabara Bay was alarming enough; the economic impact on fisheries was frequently quoted, as well as the littering of mangroves.¹²¹ The reports just neglected to relate all these into an integrated conceptualization of pollution.¹²²

Pollution control legislation and studies did not stop with the foundation of FEEMA. Just the opposite. With all its shortcomings, crises, and difficulties, the creation of FEEMA marked the institutionalization of environmental management that would include but not be limited to pollution control. FEEMA did not sprout from nothing, but was the result of the complicated evolution of institutions, knowledge and political influences. It is important to identify not only what its precursors such as the Institute of Sanitary Engineering failed to do, but also what it accomplished. IES was able for instance to develop the seeds of some concepts that today constitute sound environmental management, such as the “polluter pays principle,” or the concept of “carrying capacity.”

It is interesting to note that FEEMA entered the life of the Rio de Janeiro population much faster than IES ever could or wanted. Times were changing. Environmental movements grew, and the military dictatorship relaxed its grip slightly in the 1970s. Lack of enforcement and inordinate urban growth were challenges for FEEMA as they were for IES, but pollution increased to a point that nobody could actually ignore it, whether in the slums or the Governor’s office. Moreover, there was an

¹²¹ Siltation in Guanabara was 83 cm/century for the period 1935-1962, compared to 18 cm/century according to the estimates of the nineteenth century. Amador, *Baía de Guanabara e Ecossistemas Periféricos*, 87.

¹²² This was one of the strongest criticisms by Gerald Walsh regarding the pollution control activities in Rio de Janeiro. “If FEEMA is to carry out meaningful studies on pollution of Brazilian waters, it must understand the importance of field and laboratory studies that define responses of living systems to pollutants.” Walsh, “Biological Methods,” 6-8.

understanding that pollution was supposed to be controlled and monitored, not only tolerated as a by-product of modern life. “Call FEEMA” in the 1980s was more or less like calling the environmental police—FEEMA could fail to show up or resolve the problem, but then so could ordinary police. Coliform, the bacilli used to measure the pollution on the beaches, also became a household name. Middle-class families routinely checked the newspapers for FEEMA’s classification before going to the beaches.

Ironically, FEEMA’s popularity was also bolstered by the largest oil spill that ever happened in Guanabara Bay. In March 1975, just three months after the agency was created, the tanker Tarik Ibn Ziyad ran aground during low tide inside Guanabara Bay. The tanker carried approximately 104,000 tons of petroleum (31,408 gallons), and about 6,000 tons of oil (1,802 gallons) leaked into Guanabara Bay. Fires broke out the next few days, and mangroves and beaches on the west shore of Guanabara Bay were covered by oil. The amount of spilled oil alarmed the population and FEEMA put all its effort into developing solutions and creating procedures for this and other possible future oil spills.¹²³ The press followed the cleanup carefully, and pollution in Guanabara Bay was discussed in every bar and circle. Oddly enough, there was some disguised pride in the city: after the Torrey Canyon wreck in 1967 in Europe, and the oil spill in Santa Barbara, USA in 1969, Guanabara Bay had entered the sophisticated map of oil spills.

¹²³ Coelho and Cunha, "Accident to the Tarik," 2.

Conclusion

Searching for recurrent features of the relationship between state and nature in Guanabara Bay, what jumps to view is the presence of so many “unfinished bridges,” projects as real and forlorn as the one ironized by Machado de Assis in 1894. These “bridges” are testimony to all the Guanabara Bays that never came into being. They mark the distance between the Bay that was planned within the State bureaucracy, and the multiple layers of the real Bay—with its poor and growing population, oil, altering ecosystems, political divisions, and competing institutions. These “bridges” can be seen in the failed sanitation plans, the never-consolidated projects, the aborted or short-lived institutions, the unenforceable laws.

Of course, the failure of states to shape nature as they wish it is not exclusive of the Brazilian case.¹ But the constant incapacity of the Brazilian state to close the gap between the planned bay and the real bay—in its most celebrated postcard, where national pride was at stake—points to a persistent frailty of the Brazilian state. Or does it? The words of Victor Coelho, recalling the IEF continuous struggle for implementing its policies, haunts us: “We stood alone against everybody else who said they favored development.”² How much of this state’s frailty arose from the low priority assigned to environmental management? While it is true that enforcement failures have always plagued the Brazilian state, it is also true that some laws matter more than others. Enforcement agencies were sensitive to the unwritten messages from the political

¹ An excellent study of the outcomes of state macromanagement and hypermodernism is James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, ed. James C. Scott, Yale Agrarian Studies Series (New Haven and London: Yale University Press, 1998).

² Coelho, interview.

hierarchy. If environmental concerns were not able to muster enough political pressure within the bureaucracy to compete with more traditional administrative priorities (such as development), they would remain trapped on paper, regardless of how many plans and meetings and policies generated.

I have also argued that some of the factors directly affecting on Guanabara Bay, such as the rampant urbanization and industrialization of the mid-twentieth century, were not local features, but followed national and international trends. This begs the question of whether more integrated state agencies, or a more active civil society on environmental matters would have left Guanabara Bay in better shape. Although possible, this outcome was unlikely. They were not, and the bay did not. A paradox results: on the one hand, there is a success story of different institutions helping to build a new concept of environmental management that emerged from the expansion and intersection of their own institutional roles; and on the other hand, there is a declensionist narrative for the environment of Guanabara Bay, which degraded at a fast pace, precisely when more institutions were mobilizing to protect this environment.

More specifically, what the dissertation shows is that the interface between state and environment was multifaceted and often contradictory; that individuals matter in environmental management; and that the transformation of the state in Brazil during this period had noticeable impacts on the Guanabara Bay's ecosystem. It is possible to pinpoint specific transformative events in the state that yielded larger impact on the bay's management, such as the Pereira Passos Reform, the reform of the public administration under Getulio Vargas, the creation of Petrobrás, Brazil's state oil company, or the merger of Rio de Janeiro and Guanabara States. By the same token, we can also identify

individuals in the history of Guanabara, such as Paulo de Frontin, Paulo Moreira da Silva, Lejeune de Oliveira or Fausto Guimarães, that left their mark in the construction of environmental agencies. By telling the environmental history of Guanabara Bay through these historical landmarks and individuals, we also tell the history of the Brazilian state, and its evolution over cycles authoritarianism and democracy.

Yet, much of the history of Guanabara is written beyond the lives of individuals or the echo of events. The changes in the bay observed by the scientists Lejeune de Oliveira and Luiza Krau at Pinheiro Island were often independent from national landmarks—the ones mentioned here as well as those proposed by more traditional chronologies. Major projects of land reclamation, for instance, were a common practice before, during and after the Vargas Era (1930-1945), as they would be before, during and after the military dictatorship (1964-1985).³ As mentioned before, the industrialization and population growth that followed the post-war period were a global trend. Lack of adequate legislation (including housing policies) and the non-enforcement of the existing pollution codes favored industrial and organic pollution more than any regime change.

The foundation of FEEMA represents a benchmark in the continuum of environmental management in Brazil, the long development from loose, disconnected practices of environmental management to an articulated awareness of environmental management per se. It did not represent the final feature—if there is such a thing—of such a continuum. In August 2001, as part of its efforts to remediate a catastrophic oil

³ It can be argued, however, that the military dictatorship delayed the establishment of grassroots movements in Guanabara Bay, as they appeared in other countries. For a discussion on the development of the environmental movement in Brazil, see José Augusto Pádua, "O Nascimento da Política Verde no Brasil: Fatores Exógenos e Endógenos," in *Ecologia e Política Mundial*, ed. Hector R. Leis (Rio de Janeiro: FASE/Vozes/AIRI/PUC-Rio, 1991).

spill in Guanabara waters, the state-owned oil company Petrobrás held a seminar on the environmental management of Guanabara Bay. One of the preparatory documents for the conference was a small guide for the governmental and non-governmental organizations active in Guanabara Bay. Out of the total of 75 listed institutions, 32 were governmental.⁴ Twenty-five years after the creation of FEEMA, there were even more governmental organizations participating in the environmental management of Guanabara Bay. Thus, the creation of FEEMA did not mark the monopoly of environmental agency by one institution. Engineers, scientists, bureaucrats, military did not surrender their prerogatives of acting, studying, monitoring or transforming Guanabara Bay in 1975. The Navy, through the port captaincy, still holds most of the functions discussed in Chapter 3, such as the maritime justice and power of decision in labor conflicts with sailors and fishermen. It is still the only institution legally allowed to board foreign ships, although it is in some cases replaced by the Federal Police. A number of universities and research centers carry on research on biological indicators in Guanabara Bay, following Lejeune and Luiza's steps. Embankments and landfilling are still popular among public administration, at the state and municipal level. Rather, more Guanabara Bay stakeholders joined the institutions studied in this dissertation, as the country's civil society grew under an increasingly democratic regime, and environmental and popular movements became more active. A large number of non-profit organizations signed agreements with the government to create programs of intervention in the bay. What

⁴ The number is even larger as several autonomous divisions were listed only under their mother institutions. For instance, eight state foundations, including FEEMA and, SERLA (Foundation State Superintendency of Rivers and Lagoons) were considered subdivisions of the State Secretary of Environment and Sustainable Development and counted only once. Márcio Barroso (ed.) Santa Rosa, "Guia de Instituições Atuentes na Baía de Guanabara," (Rio de Janeiro, RJ: Centro Internacional de Desenvolvimento Sustentável, 2001).

FEEMA did offer was a focal point for coordination (sometimes conflict) among the several institutions with claims over Guanabara Bay and a public admission by the state that environmental management was integral part of its obligations toward society.

Even as I argue that the development of an environmental management concept demanded more integration among institutions, it is important to stress that integration does not mean simplification. FEEMA's purpose was not to replace the municipalities, the Navy or research institutions in their interface with Guanabara Bay. Instead, it added complexity to the mix, by unveiling the political space in which all these agencies had to operate in order to carry on their institutional practices. In the interpretation offered here, FEEMA is not a *deus ex machina* institution, through which all the previous dilemmas of incorporating the environmental in public policy were solved. In fact, the effectiveness of the new institution in coping with such dilemmas in the following decades is yet to be studied.

By studying the process that led to the creation to the FEEMA as a focal arena for environmental management, I identified three factors in the evolution of the relation between State and environment in Brazil. First, I argue that, over the century, the state managed the environment in Guanabara Bay both directly, through several of its institutions that had a clear stake on the bay, and indirectly, by promoting or discouraging activities that would have an effect on the bay, such as facilitating the creation of industries in the bay's shores. Second, integration among these state agencies was usually limited. Different institutions pursued diverse projects and privileged different uses of Guanabara Bay, and these projects and uses were at times at odds. Whenever integration between agencies was missing, attempts to regulate or control human impacts on

Guanabara Bay were likely to fail. Finally, the agents involved in these environmental management practices usually demanded and sought more integration, often despite the lack of commitment of their own institutions toward this goal.

I argue through this dissertation that environmental management, understood in a broad sense of the series of practices through which states transform their environment by managing their natural resources, is a fundamental characteristic of states, regardless of the existence of an explicit awareness or concern of how these practices affect the environment. In other words, states manage their environments even when they do not know it. But as the concept of environmental management evolves, incorporating new concepts and goals such as sustainable development, conservation, and environmental justice, it demands more integration of the state agencies charged with implementing these practices. Because environmental management (in a broad sense) engages so many branches of the state, environmental management (in the modern sense) will not be effective without a commitment on the part of the state to bring all these branches around a common environmental agenda.

The history of Guanabara Bay illustrates an institutional problematic: on the one hand, environmental management (in the broad sense) implies a multiplicity of actors; on the other hand, environmental policies—if they are to be efficient—demand a coordinated approach, in which all these actors are involved. As much as we claim that individuals and institutions do matter, their range of action is severely limited when such coordination is missing. This was the lesson learned by Fausto Guimarães, Lejeune de Oliveira, Paulo Moreira da Silva and Vitor Coelho, at the expense of both Guanabara Bay and themselves. Moreover, these myriad actors and agencies bring to the table not only

their own agendas and priorities, but also their disciplinary discourses and representations that resist translations across institutions. The challenge modern states face is how create meaningful policies that incorporate this diversity. That was the challenge that faced by FEEMA in Guanabara Bay at the end of our story.

* * * * *

During my field research year, for two months I went every day to the Navy archives in the Island of the Snakes (Ilha das Cobras). The former island was now connected to the continent by a bridge crossing a narrow channel, very close to the old arsenal. I could see a very thin layer of oil over the water, and a couple of very resistant mangrove trees still showed the oil marks of the high tide. And yet, fish jumped in those waters, as if it was the cleanest of the waters. Mulletts, many of them, swam fiercely against the current originated by a sewage pipe coming out of the seawall. I asked a sailor who was passing by why no one fished there. He laughed to my naïve face and said that the mullets there tasted like gas.

One-foot-long silvery mullets kept swimming against that nutrient-rich current that reeked of sewage. I laughed back to the sailor. I knew that in that eyeful I had my whole dissertation. Here there was the seawall modifying the bay shoreline, erected in one of the many public works in the early twentieth century. Over there I could see the Navy buildings, standing right before me, stubbornly compressed by the growing civil city. The biological indicators suggested by Lejeune were present in the mullets and the sailor's taste. And here I could also see the sewage pipe, showing the attempts of the

administration to regulate the interaction of the population with Guanabara Bay. Through these visible, ordinary sights, nature and state were forever intertwined in the landscape of Guanabara Bay.

Appendix A - Municipalities in Guanabara Bay

Historical Evolution

Rio de Janeiro city	1565 - Cidade de São Sebastião do Rio de Janeiro
Cachoeira de Macacu	1647 - Santa' Anna de Japuíba 1679 - Vila Santo Antônio de Sá. 1868 - Santo Antônio de Sá into Sant' Anna de Macacú, 1898 - Sant' Anna de Macacú into Sant Anna de Japuíba 1938 - Sant' Anna de Japuíba into Cachoeiras 1943 - Cachoeiras into Cachoeiras de Macacú
Duque de Caxias	1931 - Caxias District, belongs to Iguaçu 1943 - Duque de Caxias, severed from Iguaçu, and includes Meriti District. 1947 - Meriti District severed into an independent municipality
Itaboraí	1696 - Freguesia de São João de Itaboraí 1833 - Vila de São João de Itaboraí 1890 - Cidade de São João de Itaboraí 1911 - São João de Itaboraí into Itaboraí 1995 - Tanguá District severed into an independent municipality
Magé	1696 - Freguesia de Magé 1789 - Vila de Magé, with lands from Santana do Macacu and Rio de Janeiro city. 1857 - City of Magé 1990 - Guapimirim District severed into an independent municipality
Nilópolis	1916 - São Matéus District, belongs to Iguaçu 1921 - Nilópolis District, belongs to Iguaçu 1947 - Nilópolis, severed from Iguaçu

Niterói	1568 - Aldeia de São Lourenço, close to São Lourenço hill.
	1866 - Extinguished Aldeia de São Lourenço
	1696 - District of Vila Real da Praia Grande, belongs to Rio de Janeiro city
	1819 - Vila Real da Praia Grande, severed from Rio de Janeiro city
	1835 - Niterói, capital of the Província do Rio de Janeiro
	1890 - Freguesias of São Gonçalo, N. S ^a da Conceição de Cordeiros and São Sebastião de Itaipu, severed from Niterói to form the new municipality of São Gonçalo
	1894 - State capital transferred to Petrópolis
	1902 - State capital returned to Niterói
	1943 - Itaipu District, severed from São Gonçalo, is attached to Niterói.
	1974 - State capital transfered to Rio de Janeiro city, due to the merger of States of Rio de Janeiro and Guanabara
Nova Iguaçu	1833 - Vila de Iguaçu em 1833
	1916 - Nova Iguaçu District is the seat of the municipality.
	1933 - Iguaçu into Nova Iguaçu
	1943 - Caxias and Meriti Districts severed to form the new municipality of Duque de Caxias
	1947 - Nilópolis District severed into independent municipality
	1990 - Belford Roxo and Queimados Districts severed into independent municipality
São Gonçalo	1647 - Freguesia of São Gonçalo, belongs to Niterói
	1890 - Vila de São Gonçalo, severed from Niterói
	1920 - City of São Gonçalo in 1920
	1943 - Itaipú District severed from São Gonçalo and attached to Niterói
São João do Meriti	District of S. João Batista de Meriti or Meriti, belongs to Iguaçu.
	1982 - São João de Meriti District, belongs to Iguaçu
	1937 - Meriti District, belongs to Iguaçu
	1943 - Meriti District, belongs to Duque de Caxias
	1947 - São João do Meriti, severed from Duque de Caxias
Rio Bonito	1848 – Municipality of Nossa Senhora da Conceição de Rio Bonito
	1890 - City of Nossa Senhora da Conceição de Rio Bonito
	1911 - Nossa Senhora da Conceição do Rio Bonito into Rio Bonito.

SOURCE: IBGE, “Municípios do Rio de Janeiro,” (computer files, IBGE, work in progress). Kindly shared with the author.

Appendix B - Mayors of Rio de Janeiro, 1987-1930

Mayor	Training	Administration		Years
Barata Ribeiro	Physician	1892	1893	0.5
Henrique Valadares	Engineer (military)	1893	1894	2
Francisco Furquim	Physician	1895	1897	3
Ubaldo do Amaral	Lawyer	1897	1898	1
Luiz Van Erven	Engineer	1898	1898	0.2
Cesário Alvim	Lawyer	1898	1900	1
Felipe Pereira	Engineer (civil)	1900	1901	1
Coelho Rodrigues	Lawyer	1900	1900	0.5
João Felipe Pereira	Engineer	1900	1901	0.8
Xavier da Silveira	Lawyer	1901	1902	1
Leite Ribeiro	Lawyer	1902	1902	0.4
Pereira Passos	Engineer (mathematician)	1902	1906	4
Sousa Aguiar	Engineer (military)	1906	1909	3
Serzedelo Correia	Engineer (military)	1909	1910	1
Bento Ribeiro	Engineer (military)	1910	1914	4
Rivadavia Corrêa	Lawyer	1914	1916	2
Azevedo Sodré	Physician	1916	1917	0.6
Amaro Cavalcanti	Lawyer	1917	1918	2
Paulo de Frontin	Engineer	1919	1919	0.5
Sá Freire	Lawyer	1919	1920	1
Carlos Sampaio	Engineer	1920	1922	2
Alaor Prata	Engineer	1922	1926	4
Prado Junior	(Non declared)	1926	1930	4

SOURCE: Reis, José Oliveira, "As Administrações Municipais e o Desenvolvimento Urbano." In *Rio de Janeiro em seus Quatrocentos Anos: Formação e Desenvolvimento da Cidade*, edited by Fernando Nascimento Silva and Aécio Bossuet Bagueira Sampaio. (Rio de Janeiro: Distribuidora Record, 1965): 125-61.

First Republic: 11 engineers out of 23 Mayors, or 23 years out of 38 years of administration; I suppressed mayors who stayed in office for less than three months from the list.

Appendix C - Officers of the Port Captaincy of Rio de Janeiro

	Name	From	To
CMG	Antonio Pedro de Carvalho	1846	1850
CMG	Pedro Ferreira de Oliveira	1851	1852
CMG	Joaquim Marques Lisboa	1852	1854
CMG	Joaquim José Ignacio	1855	1855
CMG	Antonio Felix Corrêa de Melo	1855	1874
CMG	Rodrigo Antonio Delamare	1875	1876
CMG	Elisario José Barbosa	1877	1878
CMG	Rodrigo Antonio Delamare	1879	1881
CMG	Olegario Pereira Freire	1882	1884
CMG	Antonio Manoel Fernandes	1885	1887
CMG	Julio Cesar de Noronha	1888	1889
CMG	Manoel Marques Mancebo	1890	1892
CMG	José Pinto da Luz	1893	1894
CMG	Rodrigo José da Rocha	1895	1896
CMG	Joaquim Cardoso Pereira de Mello	1896	1897
CMG	Joaquim Gonçalves Duarte	1897	1898
CMG	Joaquim Thomaz da Silva Coelho	1899	1900
CMG	Joaquim Cardoso Pereira de Mello	1900	1901
CMG	José Antonio de Oliveria Freitas	1904	1904
CMG	José Ramos da Fonseca	1904	1911
CMG	Pedro Velloso Rabelo	1912	1913
CMG	Theodorico Machado Dutra	1914	1917
CMG	Heleno Pereira	1918	1919
CMG	Alfredo Godoval Petit	1919	1920
CMG	Ernesto Mafaldo Oliveira	1920	1922
CMG	Octavio Luiz Teixeira	1922	1923
CMG	Bento Machado da Silva	1923	1924
CMG	Damião Pinto da Slva	1924	1925
CMG	Oscar Gitahy de Alencastro	1925	1926
CMG	João Antonio Ribeiro da Silva Junior	1926	1927
CMG	Arthur da Costa Pinto	1927	1930
CMG	Adalberto Nunes	1931	1932
CMG	Amphiloquio Reis	1932	1932
CMG	Raimundo M. R. de Mendonça	1932	1934
CMG	Durval de Oliveira Teixeira	1934	1935
CMG	Virgilio Mesquita Barros	1935	1935
CMG	Luiz de Barros Falcão	1935	1946
CMG	Humberto de Aréa Leão	1946	1946
CMG	Jorge Paes Leme	1946	1946
CMG	Waldemar de Araujo Motta	1946	1950
CMG	Bertino Dutra da Silva	1950	1951
CMG	João Baptista Guimarães Roxo	1951	1952

CMG	Luiz Teixeira Martini	1952	1954
CMG	Mario Affonso Monteiro	1954	1956
CMG	Gentil Homem de Menezes	1956	1958
CMG	Haroldo Mathias Costa	1959	1961
CMG	Manoel João de Araujo Neto	1961	1961
CMG	Raymundo Edmilson Gomes Fontenelle (INT)	1961	1962
CMG	José Luiz de Araujo Goyano	1962	1962
CMG	Geraldo Monteiro de Barros Bittencourt	1962	1964
CMG	Geraldo Avila Malafaia	1964	1966
CF	Carlos Eduardo Jordão Montenegro (Int)	1966	1966
CMG	Eugenio Marques Rodrigues Frazão	1966	1968
CMG	Affonso José Pereira	1968	1970
CMG	Helio Costa Bastos	1970	1971
CMG	Henrique Saboia	1971	1973
CF	Antonio Carlos Gouvêa da Costa (Int)	1973	1973
CMG	Bernard David Blower	1973	1974
CMG	Raphael de Almeida Cunha Medeiros	1974	1976
CMG	Luiz Carlos Veiga do Amaral	1976	1978
CMG	Jefferson Placido Silveira	1978	1980
CMG	Milton Ferreira Tito	1980	1982
CMG	Ricardo Ramos Barbosa de Amorim	1982	1985
CMG	José Homero Xavier Sampaio	1985	1987
CMG	Aloisio Romano Moreira	1987	1989
CMG	Sérgio Nunes de Azevedo	1989	1991
CMG	Cesar Augusto Santos Azevedo	1991	1993
CMG	Henrique Araujo de Souza	1993	1995
CMG	Napoleão Bonaparte Gomes	1995	1997
CMG	Celso Guimarães Lapa	1997	1999
CMG	Henrique Almeida de Mendonça Küssel	1999	2001
CMG	Francisco Antonio de Magalhães Laranjeira	2001	2002

SOURCE: Data from framed table at the headquarters of the Port Captaincy of Rio de Janeiro, Division of Ports and Coasts, Navy Ministry

Appendix D - Six Degrees of Pollution

FIRST DEGREE	The most sensitive organisms disappear, such as several echinoderms, starfishes such as <i>Echinaster</i> and <i>Astropectem</i> and sea urchins. The beautiful <i>Astropectem</i> starfish vanishes, while the <i>Enoplopatiria emarginata</i> starfish remains. Red and russet algae, very sensitive to pollution, are also among the first to disappear.
SECOND DEGREE	The shrimp <i>Alpheus heterochelos</i> with its peculiar musical “clicks” disappear. There are fewer birds, and more than an occasional vulture. The red algae <i>Bostrychia Scorpioide</i> still thrives, as well as most of flora above the water line. But no more Ascidians, so useful for the endocrinology department at the Oswaldo Cruz Institute, can be found.
THIRD DEGREE	Only certain resistant species of crab are observed. Siri-puã and Siri-açu show a high tolerance to a huge gradient of salinity, which enables them to live in polluted areas—which, by 1953, would be the east beach in Pinheiro Island, right in front of the garbage dump of the Caju promontory. Even the <i>Enoplopatiria</i> starfish disappears, as well as the <i>Bostrychia</i> algae and the <i>Balanus</i> barnacles and the seahorses. Agonizing blue crabs (more sensitive to pollution, such as the <i>Exasperatus</i> , the <i>C. Acutidens</i> , and <i>C. Danae</i>) are often found agonizing on the waterline. Some mollusks can survive if they are able to close their valves when the water is especially bad, and open them again when the high tide brings more clean water from the ocean.
FOURTH DEGREE	No mussel survives. Most crabs also disappear, surviving only the highly resistant but commercially worthless catanhense crab [<i>Chasmagnatus granulatus</i>], or the big guaiamús, which make their nests high in the mangrove trees, above the water level and therefore safe from oil and other pollution. Not so safe, however, that a number of anomalies in shape and color cannot be observed in the species. The guaiamú larvae, likewise, die still in the first stage, hours after leaving the eggs. Bagres and pufferfishes did not get close to these polluted waters. Beach flea (<i>Orchestia platensis</i>), a small crustacean highly resistant to oil that lives in sewage and garbage, multiplies
FIFTH DEGREE	There were no longer fisheries, cypridium (barnacles) or Xanthidae (the guaiás crabs) and algae Oscillatoriaceae—another opportunistic species—invade completely the beaches. The waters are opaque, sometimes black and the bottom was a-biotic macroscopically. This means that the bottom has little or no dissolved oxygen, no animals, and a huge number of bacteria and protozoa, indicators of a polisaprobic regime—or almost absolute pollution. The Rhizophoracea was almost completely destroyed, and no specimen of marine invertebrate can be found on the benthos.
SIXTH DEGREE	The beaches are black and deserted of life. The Rhizophoretum is destroyed; the trees can no longer survive, remaining only their dead, dry trunks. Even the outer layers of the mangroves, the Laguncularietum and the Avicennietum, are partially damaged.

SOURCE: Oliveira 1958; Oliveira 1972; and Oliveira 1973.

Glossary/Abbreviations

BOD -Biochemical Oxygen Demand /day is a measure of how much dissolved oxygen is being consumed as microbes break down organic matter. A high demand, therefore, can indicate that levels of dissolved oxygen are falling, with potentially dangerous implications for the river's biodiversity. It is one of the most common biochemical measurements of pollution.

Carioca - from the Tupi name for a creek near the city, native or resident of Rio de Janeiro city.

COPES - Commission of Planning of Sanitary Sewage (Comissão de Planejamento de Esgotos Sanitários)

cruzeiro - Brazilian currency from 1942 to 1986.

DASP - Administrative Department for Public Service (Departamento Administrativo de Serviço Público),

dissolved oxygen - biochemical indicator, it measures the amount of gaseous oxygen (O₂) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis.

fecal coliforms - group of bacteria that are passed through the fecal excrement of humans, livestock and wildlife, and are used as indicators of sewage contamination of a waterway and the possible presence of other pathogenic organisms.¹

FEEMA - State Foundation for Environmental Engineering (Fundação Estadual de Engenharia do Meio Ambiente)

Fluminense - from the Latin flumen (river), native or resident of Rio de Janeiro state.

GIPME - Global Investigation of Pollution in the Marine Environment

IADB - Inter-American Development Bank

IBGE - Brazilian Institute for Geography and Statistics (Instituto Brasileiro de Geografia e Estatística)

IES - Institute of Sanitary Engineering (Instituto de Engenharia Sanitária)

JICA - Japan International Cooperation Agency

Mil-réis - Brazilian currency from 1833 to 1942. One conto de réis (1:000\$000) was equal to one thousand mil-réis (1\$000)

MVOP - Ministry of Transportation and Public Works (Ministério de Viação e Obras Públicas)

Palafitte - dwelling built on piles over a lake or a body of water.

¹ Environmental Protection Agency - EPA, *5.11 Fecal Bacteria* January 8th 2004 [cited June 10, 2004]); available from <http://www.epa.gov/OWOW/monitoring/volunteer/stream/vms511.html>.

paludes - swamps, mangrove forests, wetlands

paludism - (also impaludist) generic name for diseases associated with swamps, paludes; generally it refers to malaria and yellow fever.

PDBG - Programa de Despoluição da Baía de Guanabara

quilombola or calhambola - quilombo's residents

quilombos - communities of runaway slaves

SANERJ -Sanitary Company of the Rio de Janeiro state (Companhia de Saneamento do Estado do Rio de Janeiro)

SEMA - Extraordinary Secretary for the Environment

SESP - Foundation Extraordinary Secretary for Public Health (Fundação Secretaria Especial de Saúde Pública)

SURSAN - Sanitary Superintendence (Superintendência Sanitária)

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