Renelson Ribeiro Sampaio

Accumulation & Innovation

Historical Trends in a Newly Industrialized Capitalist Economy

(1850 · 1960)

pimenta cultural

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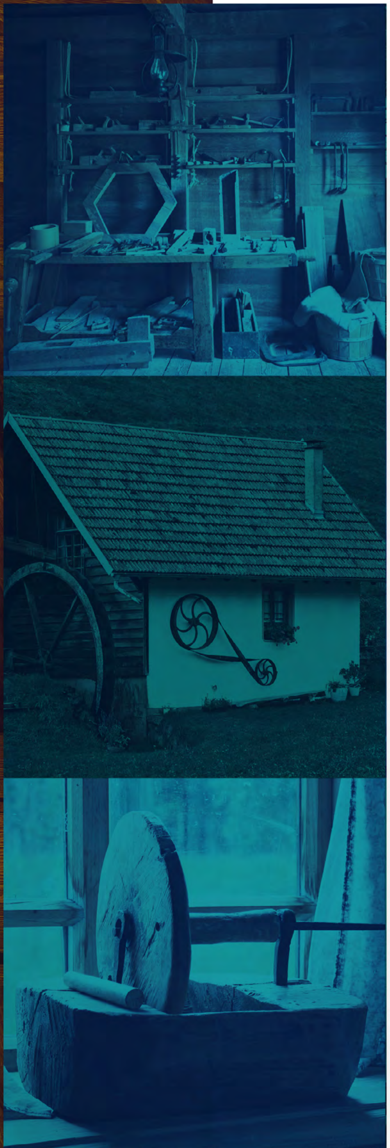

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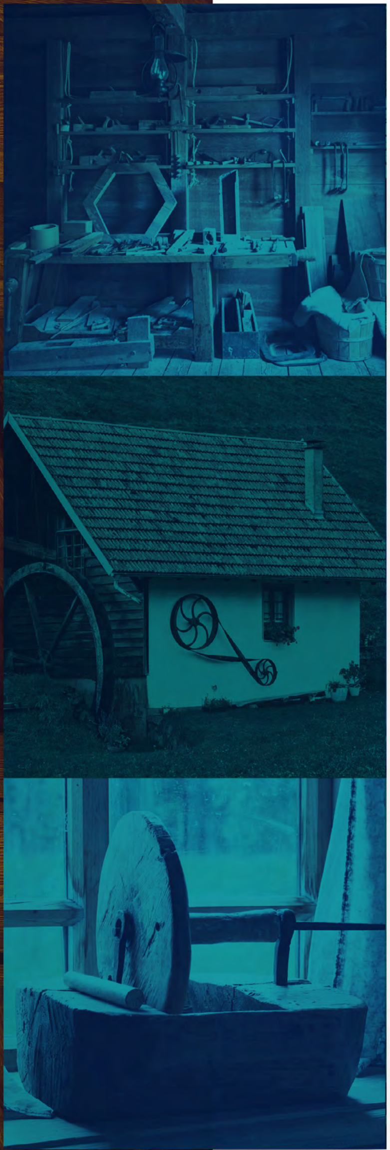

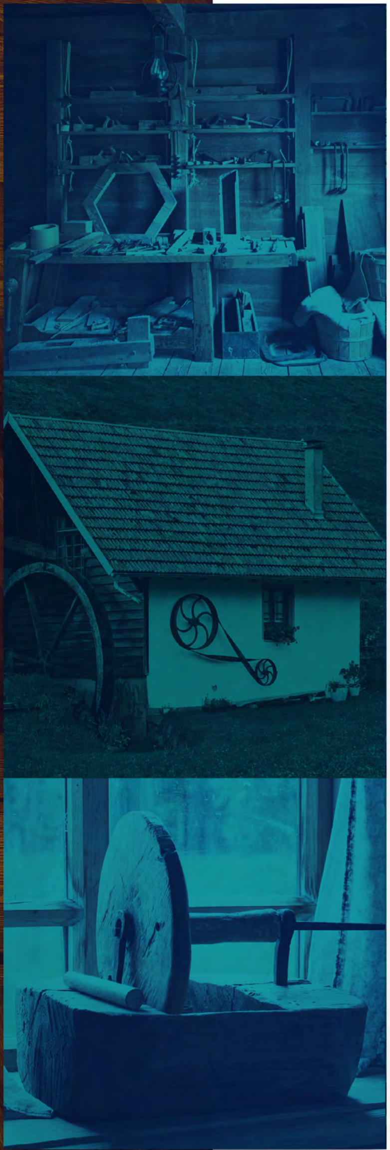

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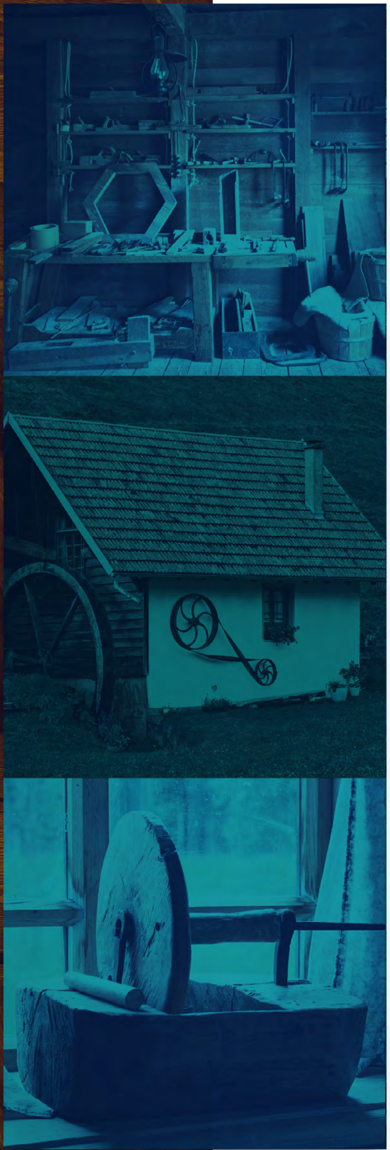

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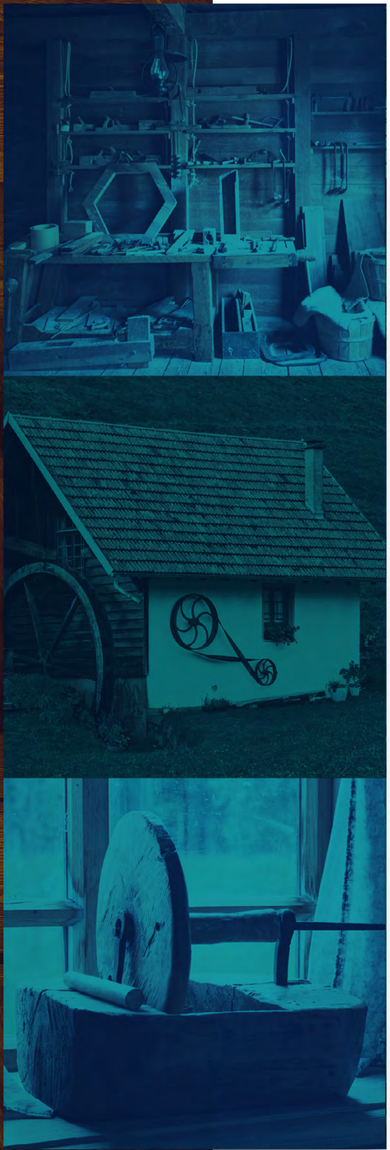

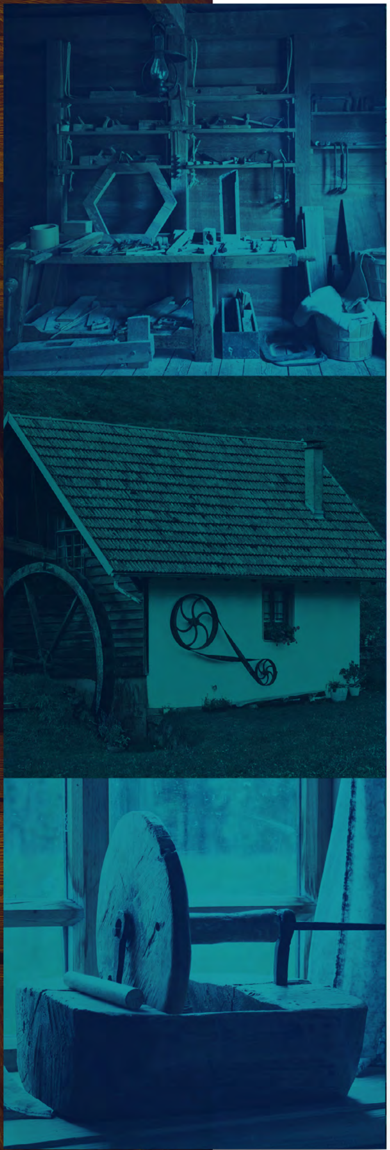

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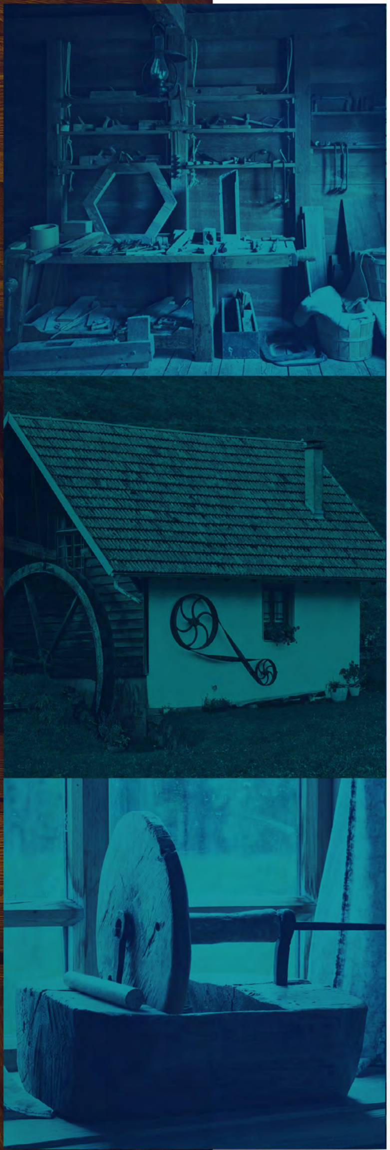

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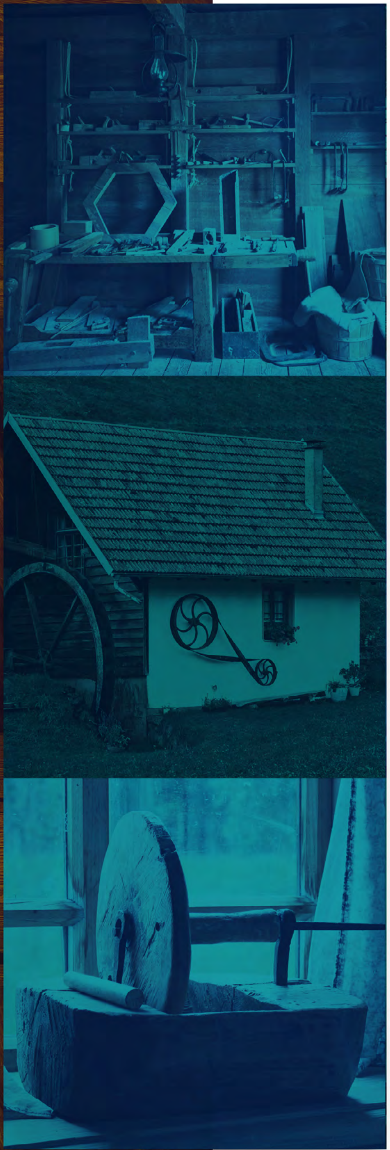

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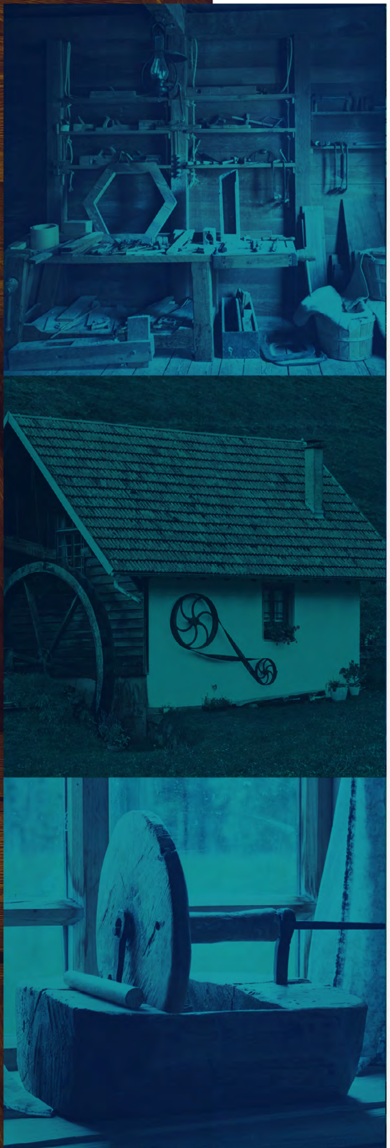
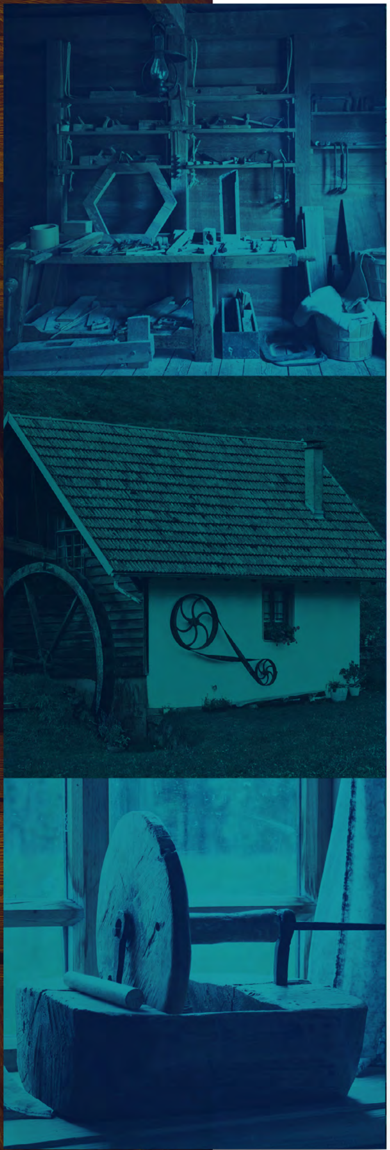


FOREWORD

The challenges of technical and technological progress in developing countries have been object of studies by several scholars in the last decades. The technological backwardness of these countries is a result of several characteristics of a historical development process in which the incorporation of new technologies and new knowledge has always been received low priority. The speeding up of the development in the second half of the 20th century, through the internalization of productive and manufacturing capacities, at the expense of technological capabilities, has been shown over the decades as a rather mistaken strategy. The result was the expansion of manufacturing capacity, without mastering process and, above all, product technology, which would enable technological catch-up. In this way, to overcome underdevelopment, and its traps, countries should master the basic technical and technological capabilities, which must be internalized into endogenous skills. Countries that were able to carry out the technological catch-up, especially the Asian experience, clearly show the importance of the internalization of technological and scientific capabilities.

It is necessary to consider that economic development in countries that are behind the technological frontier requires the implementation of innovative efforts by all agents that make up the national innovation system. This involves firms, agricultural producers, hospitals, and all organizations responsible for the provision of goods and services. Innovation in peripheral regions is not about introducing something new to the world economy, but about introducing something new in the local context, to make it possible to increase the dynamic efficiency of the economy and the well-being of its population. This means that, in general, in countries behind the technological frontier, and that seek to

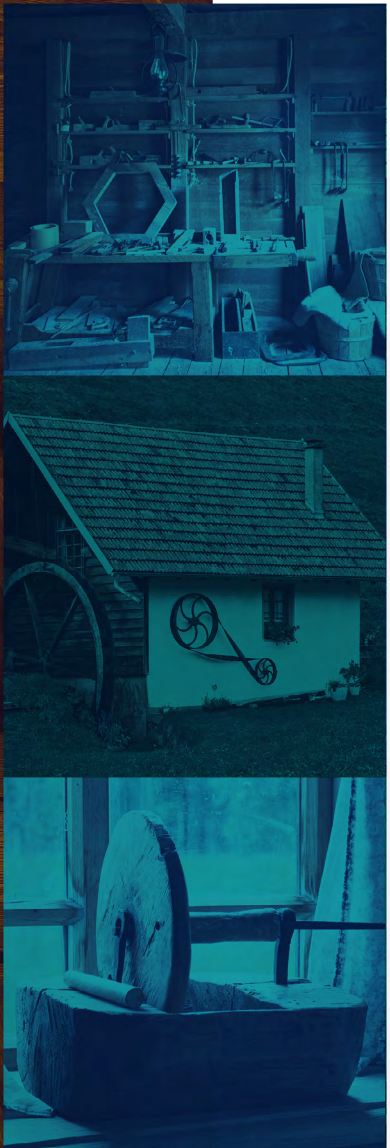


catch-up this backwardness, the new practices put in place by firms tend to be developed on practices that have been employed for some time by firms at the frontier.

In this context, the thesis of Renelson Sampaio, which is now published as a book, clearly shows this phenomenon. The main concern that is present throughout the book is how technical progress, especially the processes of generation and diffusion of new technologies, can account for the dynamics of technological change embedded in the context of developing countries. Strategies of domestic firms and policies undertaken by the State to foster of technological creation and diffusion play a crucial role. To do that, analysis in the book focus on the macro determinants of the technological development process, to advance in the comprehension of the conditions that influence the capacity of a country, and its main actors, to increase its ability to generate and disseminate new scientific and technological knowledge.

To analyze this phenomenon, the book presents an interpretive model for understanding the mains issues related to the incorporation of technical progress in peripheral regions. Analysis is strongly inspired by the concept of technological paradigms, and the model is applied to the analysis of the historical process of industrialization in the State of Santa Catarina, in Brazilian Southern region. Specifically, the analysis focuses on a particular industry, the cassava agro-processing industry, and investigates the ways of incorporation technical progress in this industry, considering the specificities of the capital accumulation in the region. The analysis carried out makes it possible to clearly identify the main challenges and opportunities that are faced by local producers to incorporate new knowledge into local production processes.

In this way, the analysis applies the concept of technological paradigm to the context of a developing country, in which various restrictions can be observed on the process of generating and diffusing technical progress. There is a concern to identify the differences



between developing countries and countries that are close to the technological frontier. In this sense, there are two central issues that this book contributes to the debate. What are the main conditions for applying the concept of technological paradigms to peripheral regions? How can the incorporation of technical progress in these countries overcome the intrinsic restrictions of the local knowledge structures? In addition to analyzing these key issues, the book also brings policy considerations and implications for developing countries.

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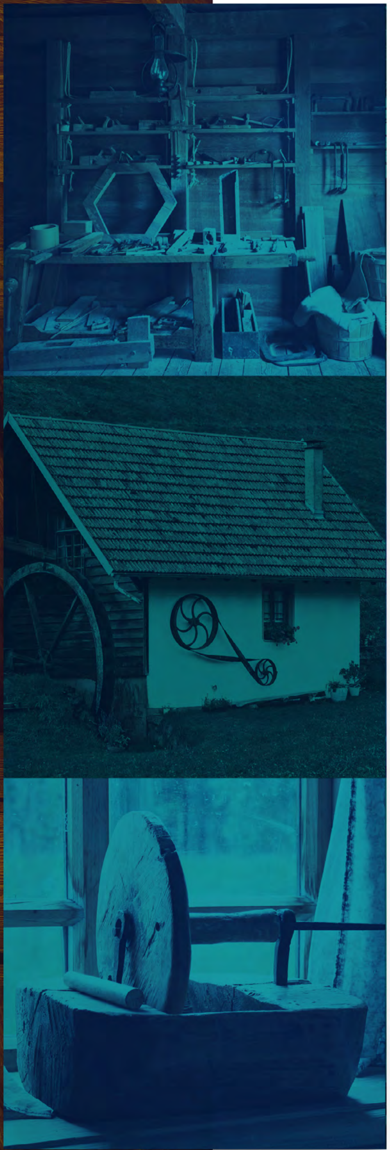
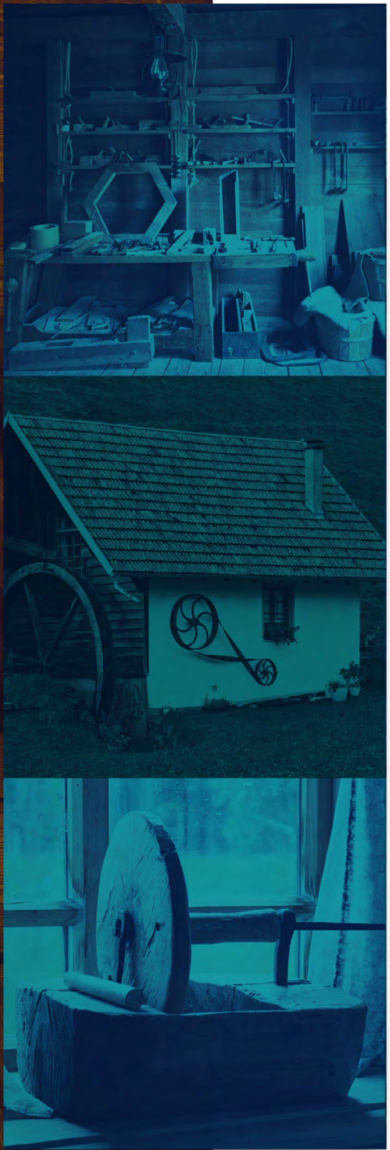


PREFACE TO THE BOOK EDITION (2021)

After thirty-five years, since the defense of the Doctoral Thesis (PhD) in 1986, at the University of Sussex (UK), the resumption of this work for the dissemination of the results of the Thesis research in book form could seem meaningless. After all, three and a half decades have passed since the conclusion of the research in a period marked by profound social, economic, political, and cultural changes at a global level, and, mainly, the scientific and technological changes, which have been induced a radicalization in speed and even greater impacts on changes in society in the period.

Revolutions do not come out of nowhere; they are not disconnected from the past. But it is very difficult to predict outcomes of transformation processes in society, especially when the transformations are radical. Nevertheless, it is possible to understand, partially, what are the possible routes through which the evolution of social and economic processes followed until a given moment, and while it may seem paradoxical, longer time spans can provide a better understanding of the dynamics of the processes involved. However, this understanding is only possible *ex post facts*. Moreover, it is only possible to understand and connect the main points of a given trajectory over time, after it has occurred in the historical perspective of the facts and associated processes.

However, the lack of statistical information and historical data, at the time of the beginning of the thesis research, that would allow a better understanding of the development processes in that region, especially those associated with productive activities, required a deepening of data collection and field work. During the first two



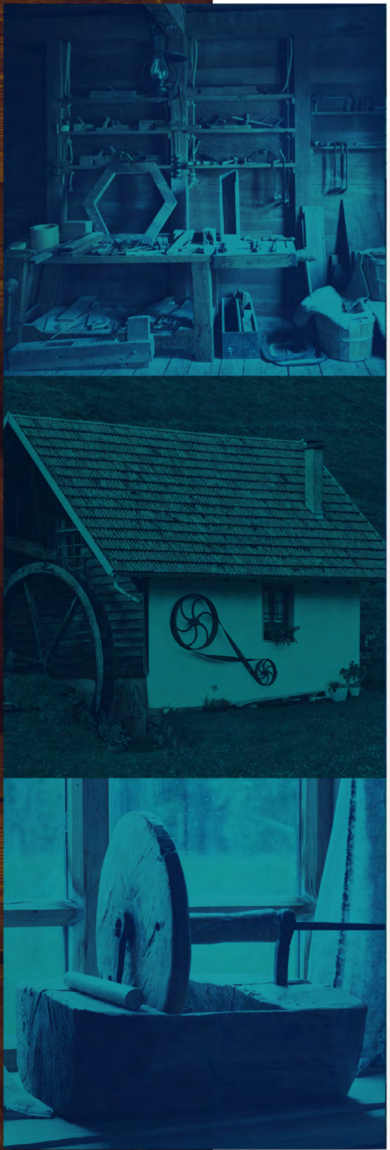
years of the field research, dozens of interviews were carried out with entrepreneurs, many of whom were descendants of the first emigrants. Also, many historical documents, since the foundation of the Blumenau Colony, in 1850, were collected, as well as statistical data available during the period of the research. Much of this material remains unknown to the public.

These observations, added to the fact that since the defense of the thesis in 1986, nothing, absolutely nothing, has been revealed to the public through publications in academic journals or even papers presented at conferences, motivated the preparation of the thesis publication in the format of a book.

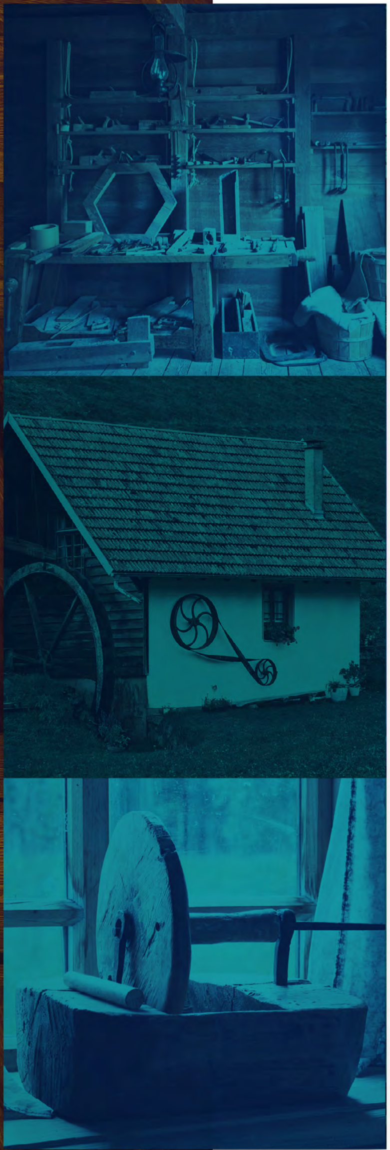
The results found in the research cover a period of one hundred and ten years, from the foundation of the colony of Blumenau in 1850 to 1960. It is interesting to note that since the beginning of the Fifties and until the end of the Sixties, Brazil's Industrial Policy was based mainly on the Industrialization by Import Substitution (ISI), a program that proposed the substitution of imports by domestic production. This policy was based on the premise that a country should try to reduce its external dependence through local production of industrialized products. The issues from technological capabilities were marginally considered.

However, throughout the socio-economic development processes that took place in that period in the Vale do Itajai and Joinville regions, the development of productive activities ranging from the protoindustrialization phase to the industrial consolidation phase. were marked by the improvement of both technological and management knowledge, following the strategies of *learning by doing* to improve competitiveness of the local industries.

Thus, the emergence of an industrial sector with intense determination in the search for technological innovation allied to the



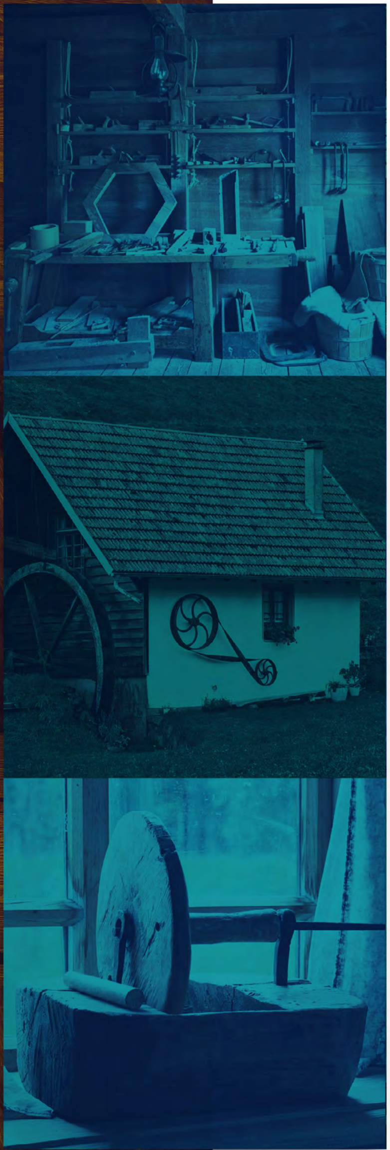
domain of technologies used in production was possible. This culture was gradually developed, establishing links with the very roots of the history of the emergence of colonization in the Vale do Itajai region, continuing to bear fruit with the formation of competitive companies, including at international level, becoming one of the regions with outstanding technological development in Brazil.



PREFACE TO THE THESIS EDITION (1986)

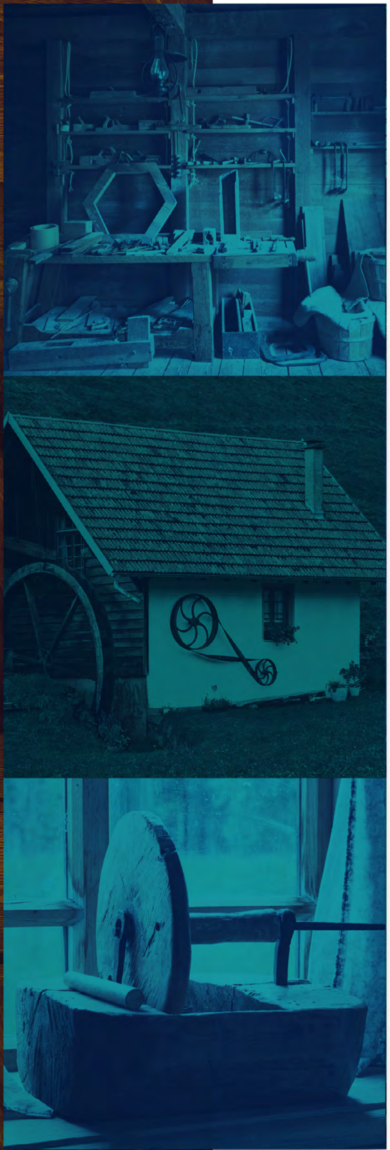
The thesis focuses on the experience of the Brazilian cassava starch agro-industry in developing its technological capabilities since 1917, when it was first established. The cassava starch industry illustrates a broader process of industrialization that has taken place in the Southern Region of Brazil, beginning in the last quarter of nineteenth century. Its main purpose is to explore how the process of technological progress which occurred along with that industrialization, especially regarding the starch industry, has been determined by the following variables: (I) the pattern of capital accumulation, (II) the capability of the related technical base to both the promotion or absorption of technological changes, and (III) firms' strategies towards innovation.

Two areas, Orleans, and Itajai Valley were selected to carry out this research project. Both are in Santa Catarina, a Southern Brazil State and had previously been an immigrant's colonization zone as well as having initially had (1850-75) a similar pattern of development. Only later, after 1895, a differentiation process occurred between them; in Itajai Valley a steady industrialization has taken place since the end of last century, while in Orleans agriculture has become preponderant in its economy. An exploratory framework was designed to carry out the analysis of those case studies, drawn from the relevant literature, upon which a historical approach is applied. Accordingly, the history of that industry is divided in four distinct periods, each corresponding to a given pattern of capital accumulation and to a specific level of technological progress.



The analysis tries then to identify mechanisms through which the pattern of capital accumulation determines both the level and direction of technological progress within the related technical base for each period. On the other hand, by focusing on technological discontinuities brought about by innovations, the pattern of incorporation of such innovations in the productive sector, potentially leading to a new pattern of accumulation, is also analysed. The research is an attempt to assess the conditions of a capitalist development in a Newly Industrialized Country.

The results suggest that the endogenous technical base, which is a necessary pre-condition for a self-sustained process of industrialization, is socially determined. In that sense, to acquire a technological capability means, above all, to be socially capable of generating new scientific and technological knowledge; firms' strategies towards innovation can indeed foster such capability but cannot replace it. Therefore, the technological progress can only be fully understood in the wider context of the social, economic, and political evolution.



ACKNOWLEDGMENTS (1986)

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My stay as a Research Student at the University of Sussex, Science Policy Research Unit (SPRU), from October 1978 to November 1980, was made possible by a grant from the CNPq (National Council for Scientific and Technological Development). During the same period, my studies were partially supported by the Brazilian Ministry of Foreign Affairs.

The financial support received by the STI (Secretariat for Industrial Technology), from March to December 1981, was essential for the field work. Special gratitude goes to Oskar Klingl for his encouragement during this period. It is also important to mention the support given by the *Fundação Nacional Pró-Memória* (Foundation for the National Heritage), which granted both the material and human resources for the analysis of historical documents on the colonization of Orleans. I also would like to express my deepest felt thanks to the late Aloísio Magalhães and Fausto Alvim Júnior, whose provocative ideas were always a valuable source of stimulus.

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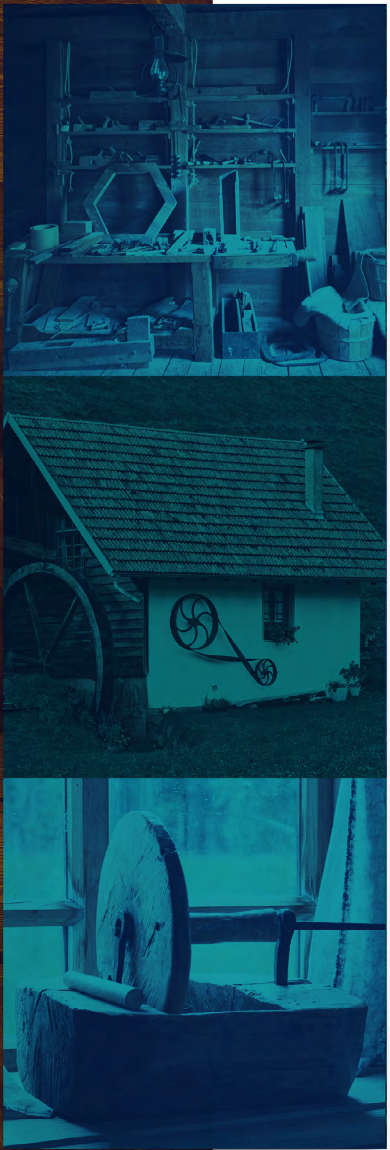

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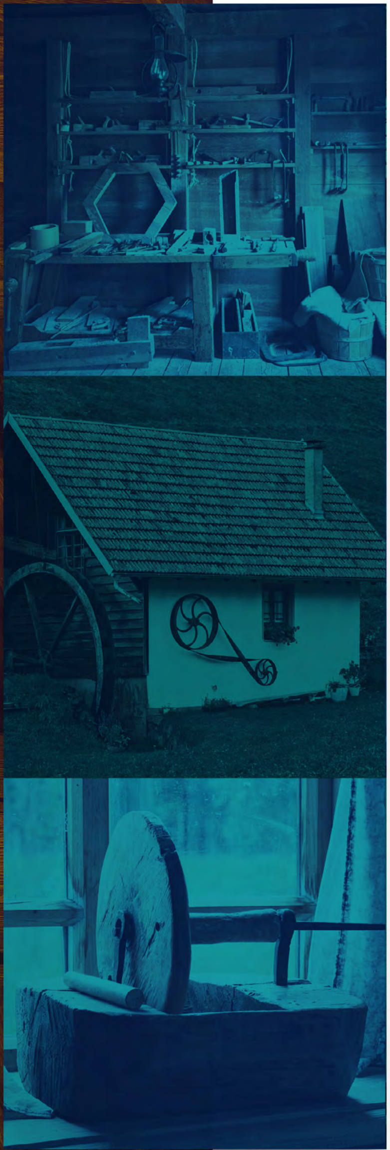
At last, but not least, I would like to mention late Brian Easlea for his friendship to me and my family and for his invitation to come to Sussex University to do my PhD at Science Policy Research Unit (SPRU).

Obviously, the shortcomings of the present work are of my own exclusive responsibility.

The preparation of a thesis usually requires a great strain in one's personal and intellectual experiences before its culmination in written form. During that period, the support given by my family was extremely important and has helped me to overcome all obstacles, especially over tough times. To them I have dedicated this work.



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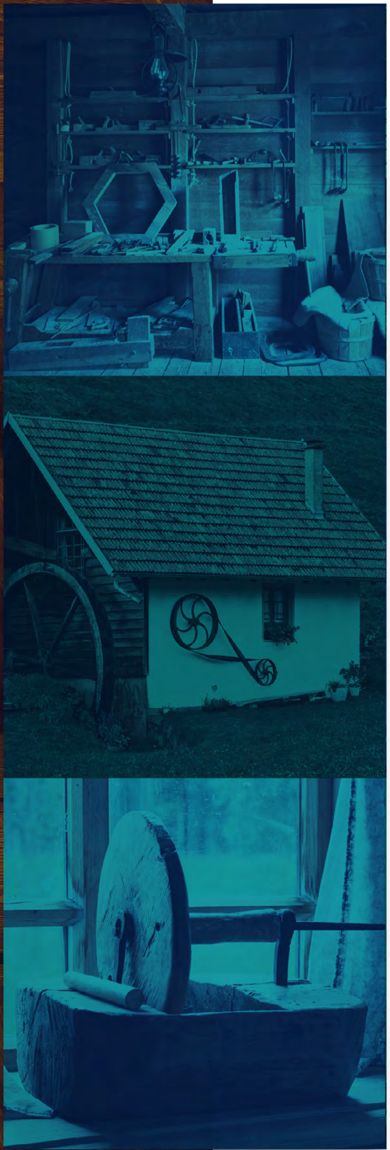
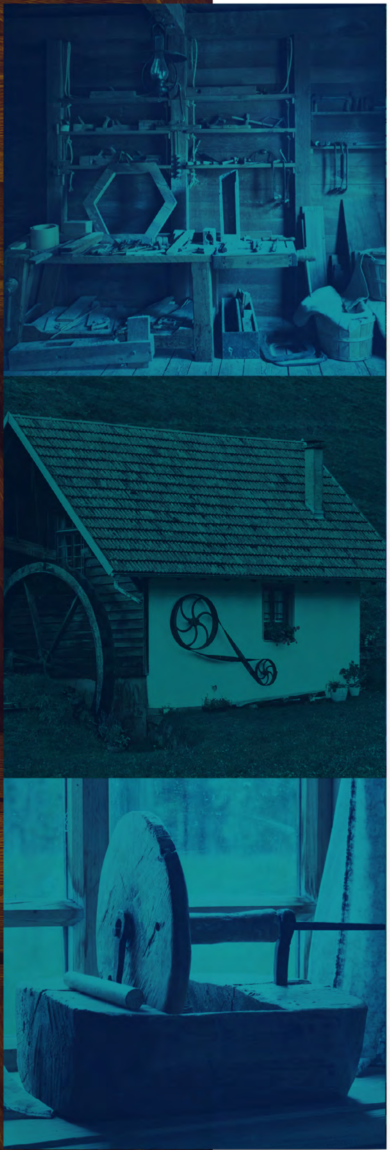
The thesis publication project, in this book-format version, began to take shape in the course of my stay at the University of Wisconsin Madison, during a postdoctoral project carried out at the invitation of Professor Erick Olin Wright, in the Department of Sociology (November 2010 - August 2011). In fact, the connection with the work of Prof. Wright first occurred in 1979, during the period of development of the theoretical framework of my thesis, when I bought, in the Sussex university bookstore, his recently released book, ***Crisis and the State (1978)***, from which I extracted concepts, categories. and structure of the model proposed by Prof. Wright, incorporating them in the Thesis' model.



SUMMARY

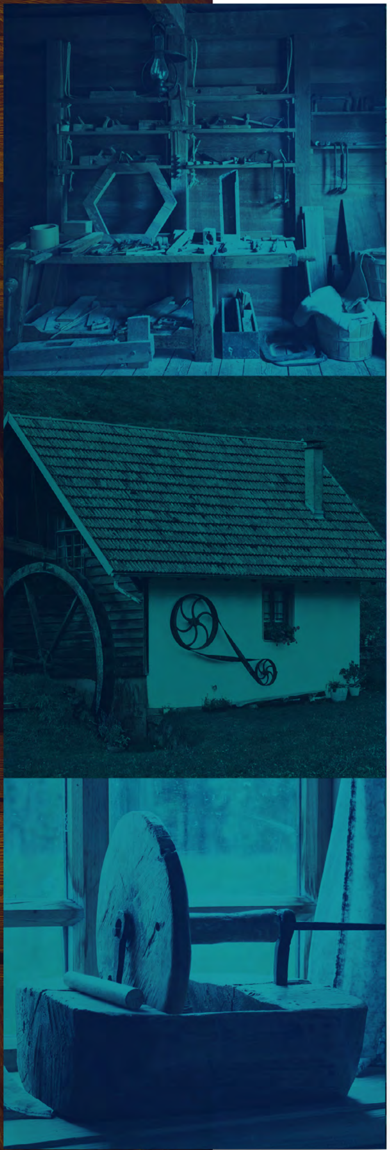


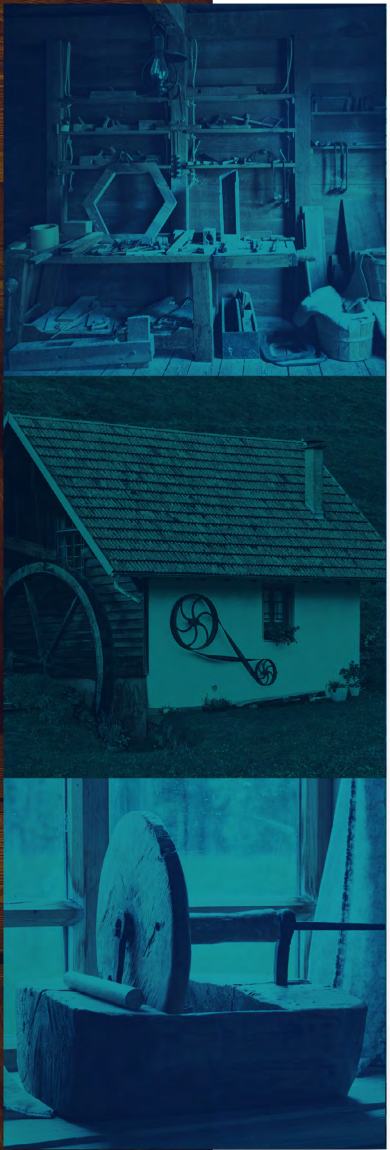
PART TWO

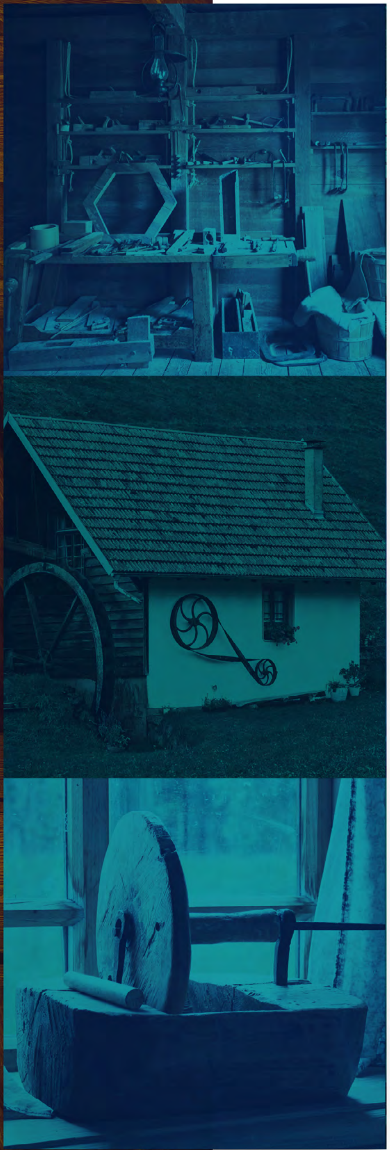
Chapter 3

Chapter 4

Chapter 5

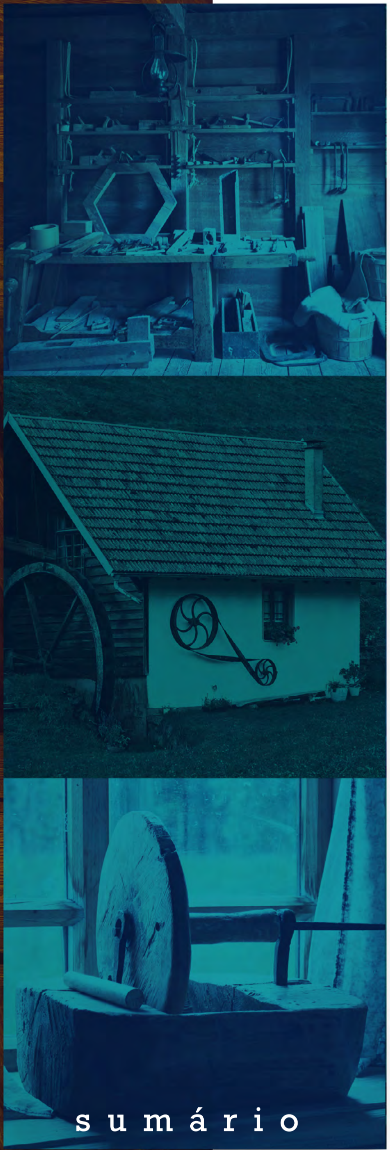






At last, I would like to register here my deeply thanks for all the support and learning received by late[1] Prof. Wright during that period and above all the friendship we have built.

1 He passed away in November 2019.

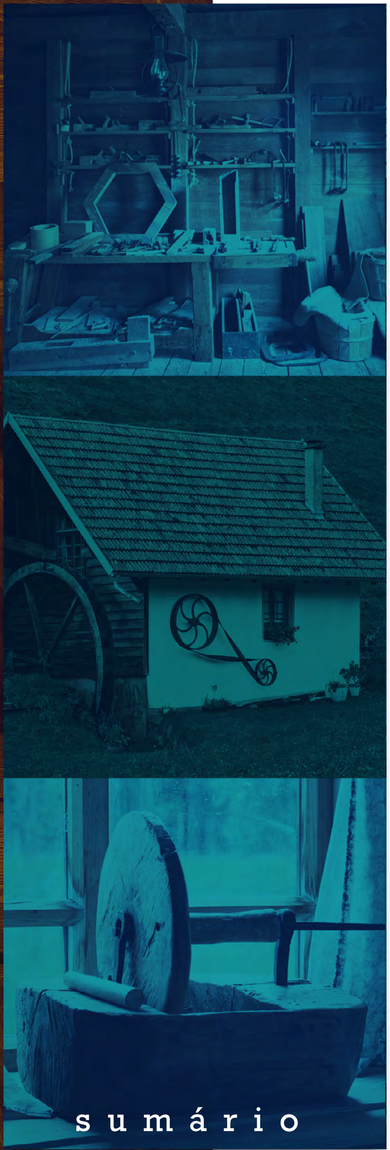


INTRODUCTION

Why has technological progress failed to acquire internal momentum within underdeveloped countries? Why is it that in countries which have experienced a period of rapid growth based on import substitution policies, industrialization is often arrested at some stage?

That both science and technology have been playing increasingly important roles in the general process of development is a widely accepted fact; the crucial and disputed question is how such interplay between science, technology and development can successfully be achieved on a self-sustained basis in the less developed countries - LDCs.

Many interpretations have been advanced to deal with the above questions, within different theoretical frameworks and with distinct ideological flavours as well. Nevertheless, despite such differences, the great majority of the work done on this area can be broadly divided into two fields. One approaches the issue as a macro-economic problem and is mainly concerned with understanding macro conditions for industrialization such as size of the domestic market, pattern of comparative advantages, availability of investment capital, nature of government policies, etc. (BAIROCH, 1976; DAVID, 1974, 1975). The second group, concerned with technology and development, approaches the problem from an empirical perspective that is based largely on micro-level case studies. Its research agenda is mostly concerned with assessing firm strategies towards innovation and technological change. The assumption behind the latter approach, which is not always explicit, is that only the cumulative empirical evidence on technological change will provide an understanding of the processes and mechanisms involved in in-



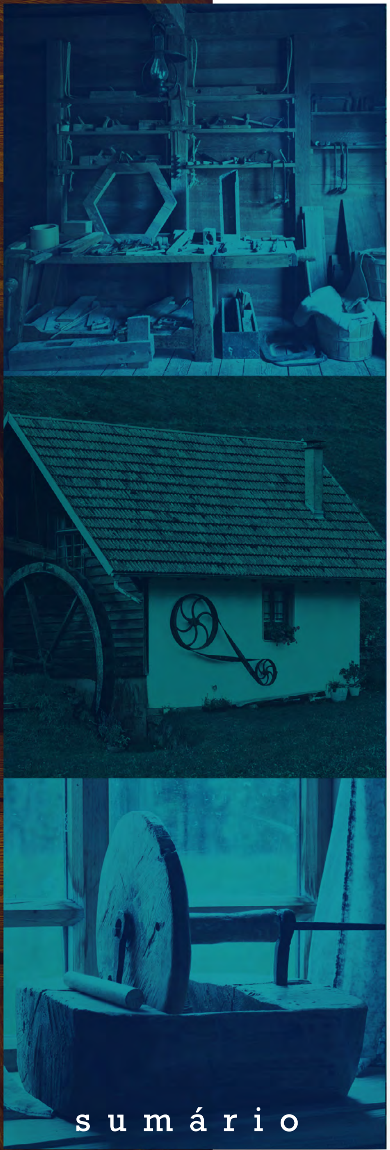
dustrial maturation. From such understanding the development policies could then be designed in a more solid ground.

The different positions covered by the ideological spectrum in this literature are also quite numerous. On the one hand, they derive from the highly neoclassical framework, in which any structural analysis of world capitalism is seen with deep suspicion, especially due to the political implications of such an analysis. The main argument is that the free market forces (sometimes with a little help from the government's invisible hands) will do the job.

On the other extreme of the spectrum, a radical left version claims that an authentic and endogenous technological capability will never be developed in Third World Countries (including the Newly Industrialized Countries - NICs) within the capitalist world-system. No liberated development could ever flourish in the realm of imperialism. Scientific and technological development has been and will always be dependent. Such claim contrasts with the previous view shared by the supporters of the dependency school, who used to say that no significant industrialization would be possible in peripheral economies.

In between such extremes, there is a third group, that could be called 'neo-Schumpeterian', which should be mentioned here not only due to the importance of their contribution to this area of knowledge but also because of the relevance of the empirical findings that they have produced. The main analytical characteristic of this group is the emphasis on the innovation activities, especially the process of 'learning' and the implications that can be drawn from government's policies pertaining to technological development.

Undoubtedly, the lack of a sound theory of technological innovation, which would consider the main factors and mechanisms of the process of technological change within developing countries, makes it difficult to fully grasp that process. In other words, it is not enough to

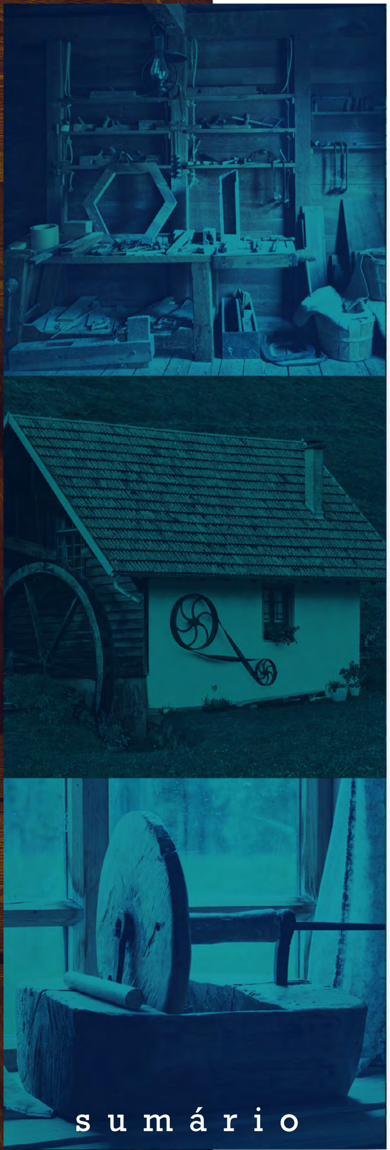


have piles of empirical data on firm strategies regarding technological change and innovation, gathered from different branches, firm sizes, market conditions, etc and try to measure growth rates of productivity or R & D performance. The results from different case studies, produced within distinct and sometimes even inconsistent analytical frameworks, are unlikely to match.

As opposed to the empirical approach described above, the great majority of Marxist economists and sociologists simply dismiss the importance of such empirical evidence; actually, some of them claim that not even the technological issue is relevant for the analysis of the process of development (or rather, underdevelopment) of the Third World Countries. Any empirically testable proposition is, therefore, regarded as purely ideological, meaningless, a mere product of a positivist methodology. There are also other Marxist critics who try to generate empirical studies, particularly on development issues (SUTCLIFFE, 1971; WARREN, 1982). Nevertheless, the technological issues are marginally discussed.

We are faced then with two discrepant views of the process of technological progress in developing countries. In the first, heavily based on neo-classical analytical tools but also influenced by the Schumpeterian paradigm, the predominant pattern of technological change is characterized by a process of piecemeal technical changes, leading to an increase of technical skills and technological knowledge. Their followers claim that the empirical evidence gathered from some industrialising economies (mainly Argentina, Brazil, India, and South Korea) have shown the occurrence of that pattern; moreover, the evidence has demonstrated the existence of a process of accumulation of technological capacity in developing countries.

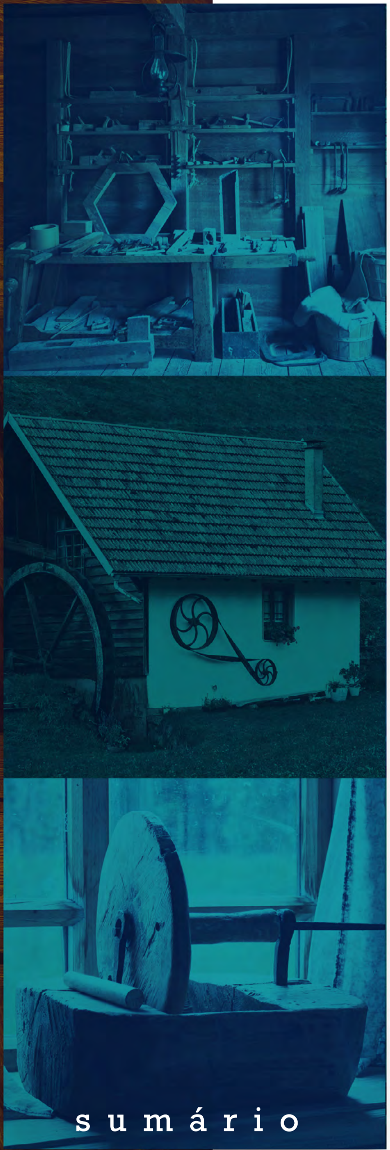
From the second point of view, somewhat based on a Marxist framework, technological progress in developing countries is presented as arriving from without, generated in developed countries, and



brought in either by transnational companies or by local firms through the purchase of technology or other forms of licensing contracts. Therefore, the predominant pattern of technological change in developing countries is characterized by discontinuous technological jumps, either due to the introduction of a new technological paradigm (the concept of technological paradigm is applied here in the same sense of Dosi's analysis on technological development - see DOSI, 1982) or as a result of the adoption of a brand new technology (of process and/or product) within the existing paradigms already being used in the country's economy. No significant process of endogenous technological capability can occur in those countries; their process of economic growth - hence of technological progress - is totally determined by the movements of foreign capital.

This thesis argues that the dilemma just identified is a misleading one and is caused by frequently unclear ideological positions underlying an inadequate and/or incomplete conception of technological progress. In that conception, technological progress is seen as a somewhat independent process which reacts (positively or negatively) to market signals or as a mere appendix to the capital accumulation process. This partly explains the fact that in most work done in technological change and development, technology tends to appear as an independent variable, subject to economic forces, despite the great efforts made to produce empirical analyses on the technicalities of that process (STEWART, 1978). Furthermore, it is also assumed that the relationships between the technological and economic processes are linear and quite often one-dimensional. The use of such conceptions and their associated assumptions becomes still more problematic when applied to development analysis.

The aim of this thesis is to sketch a concept of technological progress that does not suffer from the disadvantages outlined above and which could be applied for explaining the very process of development

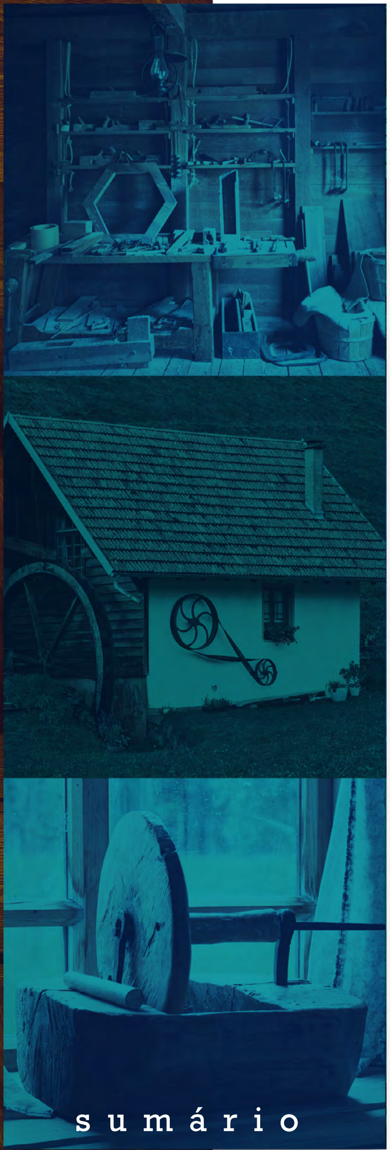


of capitalism in the NIC's. Such a concept, whose theoretical framework is developed in Chapters 1 and 2 below, shall be able to deal with the dynamics of the process of technological change embedded in the process of capitalist development of those countries. In other words, it must turn the focus of the analysis away from both the firms' point of view - aiming to appraise any possible success of their strategies for the acquisition of technical capability - and from governmental policies, mostly concern with the assessment of the feasibility of State's interventions favouring technological development.

It is desirable that an analysis of the process of technological progress, while structurally linked with a kind of macro theory i.e., a theory which tackles the issue from the macro perspective of the social and economic determinants of that process, should consider the specificities of technical change; at least, it should be consistent with them.

Broadly speaking, in any process of technological progress we can distinguish three important aspects: generation, diffusion (in between we could have included the learning phase) and impact (technical, social, economic, cultural, etc.). The analysis of these aspects can be made at different levels, ranging from a plant's technical bottlenecks, going through cross-sector analysis, all the way to the country's industrialization process.

This thesis is mainly concerned with the first two of the aspects mentioned above. Moreover, the analysis is going to be focused on the macro determinants of that process, in other words, the central question here is to understand the range of conditions which make possible for a country, or its main social and economic actors, to increase the country's capabilities to generate and/or acquire technological knowledge, or, in terms of the thesis' analytical model, how to assure technological progress within the country's technical base in pace with the demands of its productive sector.

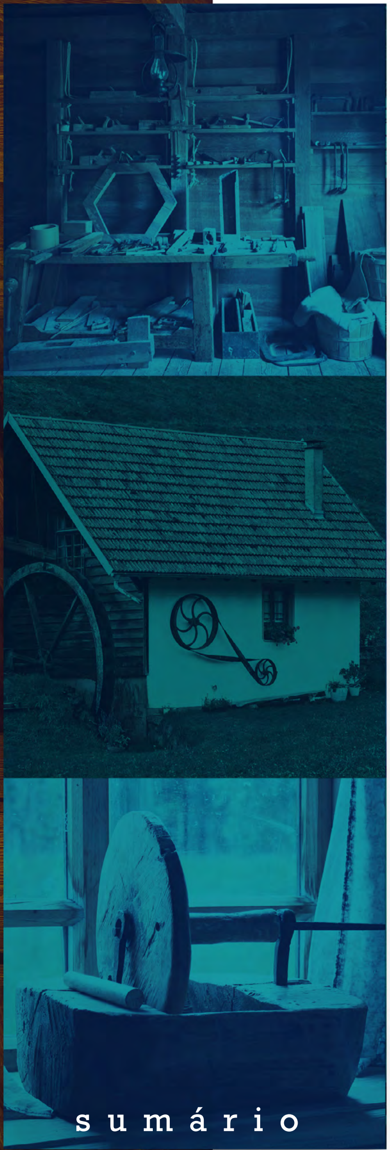


However, given the fact that the key elements of the technological process and their complex interrelationships with other social economic processes can only be disclosed when analysed over long periods of time, the research carried out for this thesis had to approach its case studies from a historical perspective.

The present work is further divided into two parts. Part One has a twofold objective: firstly, to review the relevant literature on the issue of technological change and the development process of the NIC's; secondly, to explore and sketch the concept of technological progress suggested above. In Chapter 1, the issue discussed with reference to the literature is whether developing countries can acquire an independent technological capability within their own process of capitalist economic development or whether they face constraints which retard or even eliminate the possibilities of doing this in an autonomous manner. For those who support the latter position (such as the literature on imperialism, ECLA's structural approach and the related theories of import-substitution and of course dependency theory) the technological variable tends to be either marginal or treated implicitly in the discussion on industrialization for the analysis being carried out.

For the supporters of the former view, one that is shared by this thesis, such possibilities do exist and are significant. However, it is essential to identify the conditions under which they could arise. To do this, it is essential to distinguish between discontinuities in the existing and the new paradigms - brought about by technological innovations - and discontinuities in the socio-economic structure, brought about by the process of development of capitalism.

The impacts and conflicts that quite often emerge with the introduction of foreign technologies in a Less Developed Country, are then discussed in this chapter. This is followed by a discussion of the literature on technical change and development, particularly that concerned with the empirical evidence of a 'learning' process in LDC's.

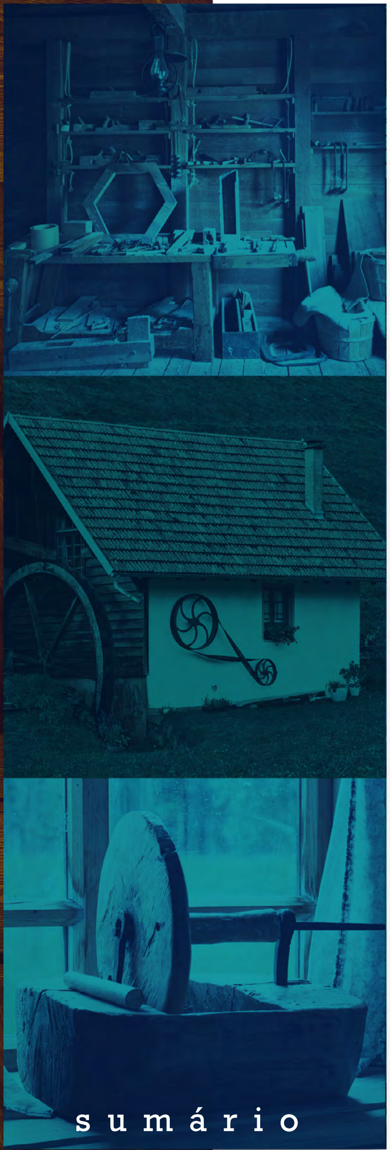


In Chapter 2, the core of the thesis' analytical framework is developed. Its central claim is that the development of an endogenous capability to generate technological (and scientific) knowledge is a necessary (albeit insufficient) condition for a developing country to overcome the negative impacts brought about by technological discontinuities. Moreover, it is a fundamental condition for a self-sustained process of capitalist development.

The Chapter starts with a discussion of the problems arising from the importation of foreign technology, showing that a process of innovation heavily based on foreign technology tends to disrupt and indeed can seriously constrain the growth of local R & D capabilities. Under such circumstances, an innovation could lead to a kind of non-creative destruction process in the endogenous technical base, as opposed to the creative process of destruction suggested by Schumpeter (SCHUMPETER, 1979).

In the developed countries changes in the technological paradigms are likely to occur without a significant disruption of the socio-economic structure, while for developing societies of the sort with which we are concerned, the introduction of a primary innovation (whether process or product) into their economies tends to induce ruptures in both the social fabric and the productive structures.

The last section presents an interpretative model to deal with the related issues of technological progress and development in the context of a peripheral economy. The proposed model takes up the concept of technological paradigm developed by Giovanni Dosi (DOSI, 1982) and develops it further. The concept of determination and models of determination elaborated by Erik Olin Wright (WRIGHT, 1978) are then adapted and applied to describe the dynamic of the technological paradigm.

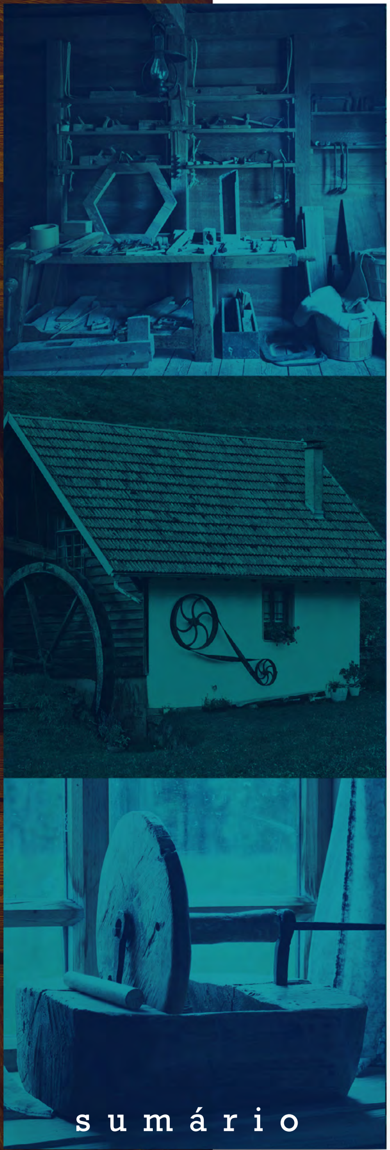


The resulting model is used to carry out an analysis of the process of industrialization of the State of Santa Catarina, a state in Southern Brazil. To apply such an analysis, this thesis focuses on a particular industry - the cassava agro-processing industry. It analyses the process of technological development that took place in the industry alongside of the main patterns of capital accumulation that occurred in that region. This is done in the Part Two of the thesis.

In Chapter 3, the context of the case studies is presented. This includes the reasons for the choice of the cassava agro-industry, in a Brazilian state, to explore the theoretical issues sketched above. A summary of the development of that industry is then presented from a historical perspective. Finally, the case studies settings, Itajai Valley and Orleans, are briefly described.

In Chapter 4, the patterns of the capital accumulation and technological progress processes that took place in Santa Catarina since the second half of last century are analysed. The analysis is based on a description of the processes of migration (mainly of Germans and Italians) to and settlement of Southern Brazil during that period. To grasp those processes, an analytical procedure is applied based on the works of Peter Kriedte, Hans Medick and Jürgen Schlumbohm (cf. KRIEDTE et al, 1981) concerned with the industrialization process during the second phase of transformation from feudalism to capitalism in Europe and, more particularly, in Germany. Here, the research concept of ‘proto-industrialization’, elaborated by those authors to investigate the development of industrial commodity production in the European countryside at the end of the eighteenth century, proved very fruitful.

Chapter 5 deals with the evolution of the cassava agro-industry in Santa Catarina, from a historical perspective covering a period of over one hundred years - from 1850 to 1980. The objective of this chapter is to illustrate, through a case study, how technological progress can be determined by the complex range of social, economic, and technical



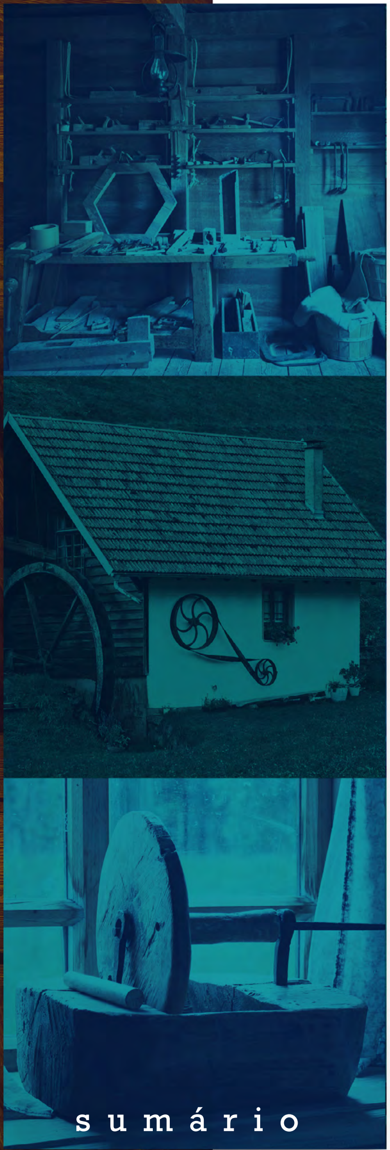
base structures in which it is embedded. One of the main arguments of the thesis is presented in this chapter, namely that a technological discontinuity will only induce discontinuities in the social and economic structures if the technical base cannot cope with the new technological paradigm in the short run. The introduction of the technologies to produce the chemically modified cassava starch in Brazil, in the mid ‘60s, illustrates quite well this point.

In Chapter 6, the potential impacts of the *Programa Nacional do Álcool - PNA* (Brazilian Alcohol Program) on the cassava agro-industrial complex are analysed. To meet the demands of the *PNA*, the cassava agro-industrial complex would have to go through a very intensive and broad process of technological changes. To a certain extent, such requirements would represent a technological discontinuity in the existing technical base. However, the constraints that have been imposed by the social and economic structures are such that no significant technological innovation can be produced by the existing local technical base. This means that the possibilities of an economic boom based on the further development of the cassava agro-industry because of the Alcohol Program, are quite remote. Finally, Chapter 7 presents a summary and the main conclusions of the thesis.

Part ONE

1

ECONOMIC DEVELOPMENT AND TECHNOLOGICAL PROGRESS IN PERIPHERAL ECONOMIES



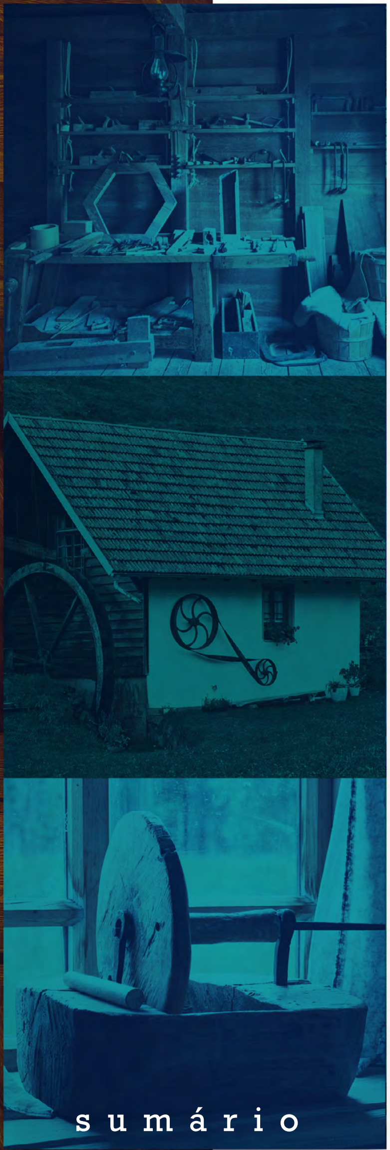
"The power of machinery is the same in every place, climate and seasons have little effect on it; goods made thereby will wear the same appearance, and be appropriated to the same purposes, whether made on the healthy shores of Britain, or in the fruitful but pestilential swamps of the East or West Indies." George Burges (1831?), Letters on the Unrestrained Use of Modern Machinery.

"When you have once introduced machinery into the locomotion of a country which possesses iron and coals you are unable to withhold it from its fabrications" Karl Marx (1853), The Future Results of British Rule in India.

"I do visualize electricity, ship-building, iron-works, machine making and the alike existing side by side with village handicrafts. But the order of dependency will be reversed. Hitherto, the industrialization has been so planned as to destroy the villages and the village crafts. In the State of the future, it will subserve the villages and their crafts. I do not share the socialist belief that centralization of the necessaries of life will conduce to common welfare, that is, where the centralized industries are planned and owned by the State." Mohandas Gandhi (1909), Sarvodaya Approach to Development.

INTRODUCTION

From the theoretical point of view, the thesis is principally concerned with the conditions under which an endogenous process of technological progress can take place in a peripheral capitalist economy. More specifically, this thesis seeks to explore two fundamental questions concerning that important issue: first, is it possible to have a process of capitalist development without a corresponding process of technological progress? Second, what are the conditions under which, in peripheral economies, the two processes can be present and allow a transition into a Newly Industrialized Country?



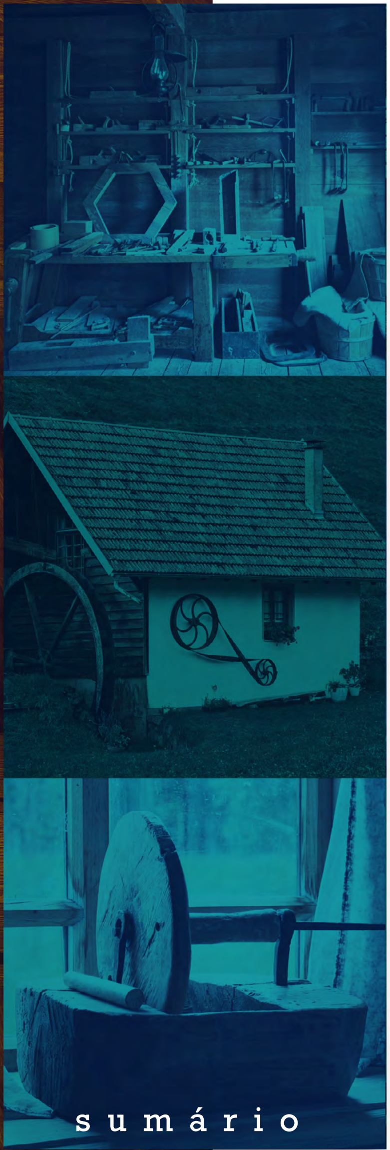
The first question is analysed in this Chapter and the second is dealt with in Chapter 2. Section 1.2 discuss some of the political issues concerned with development, most of them raised by the dependency school. Section 1.3 focuses on the debate on both the impacts and conflicts of foreign technology in Less Developed Countries. Finally, in section 1.4 the main approaches found in the literature on technical change in LDCs are discussed. Special emphasis is given to the so-called "learning" process.

TECHNOLOGY AND DEVELOPMENT: THE POLITICAL DEBATE

Ever since the First World War, some observers have considered imperialism as a worldwide calamity; a modern version of the Four Horsemen of the Apocalypse, spreading starvation, destruction, dictatorship, and economic stagnation in the Third World. The struggle against imperialism has united millions of people throughout the world and has led hundreds of thousands of them to die on the battlefields or in torture chambers.

Among intellectuals the view that imperialism is an obstacle to economic and cultural development - hence to technological progress - in Third World Countries has become so strong that it is shared not only by Marxists but also by a select set of economists belonging to the liberal school, particularly those concerned with the problem of development in LDCs (R. Prebisch, O. Sunkel, C. Furtado, etc.).

The analysis of the problems raised by the development of capitalism in economically backward countries - including the feasibility of that very development, has a long tradition in the Marxist school of

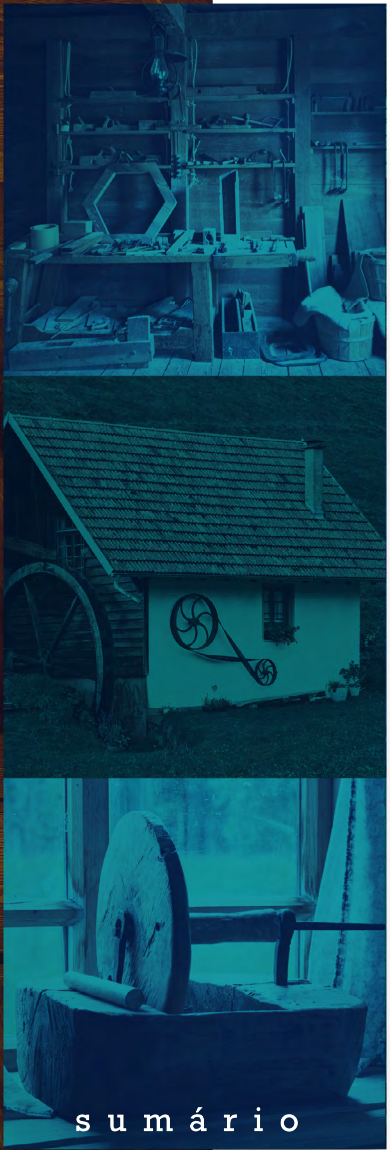


thought. Indeed, it is within the theoretical framework of imperialism that Marxist analyses have mostly been made[1].

Lenin's "Imperialism, the Highest Stage of Capitalism", one of the classical works on this subject, was mainly faced with the difficult task of explaining the development of capitalism in advanced countries and in particular the tendencies of that development in the world. Lenin's concern was to explore three major themes, namely: (I) the most important changes in the economic and political spheres of the advanced capitalist countries; (II) the changes and expansion of international capital and the role played by it in international relations; and finally, (III) the tendencies of the capitalist system in its monopoly or imperialist phase. However, no systematic analysis on the impact of the development of capitalism on the backward countries can be drawn out of this work.

The first attempt to produce a concrete analysis of the development of capitalism in a backward country was made by Lenin himself, in his subsequent and equally famous work, "The Development of Capitalism in Russia". In this work, written in 1899, Lenin shows how the development of capitalism in Russia was taking place at that time, articulating externally to the developed economies of western Europe and internally to the existing modes of production in Russia itself. In its essentials, this analysis represents what became the core of the dependency school. In other words, the debate was around the necessity and, more importantly, the feasibility of capitalist development in backward economies. As far as dependency analysis is concerned, the discussion of this rather controversial issue is relevant because dependency analysis in fact emerged in Latin America between the 1950s and 1960s in the context of an identical controversy (PALMA, 1978).

Accordingly, the emergence of new capitalist societies would not come as a direct result of a continuous process of destruction and replacement of non-capitalist structures of the backward economies,



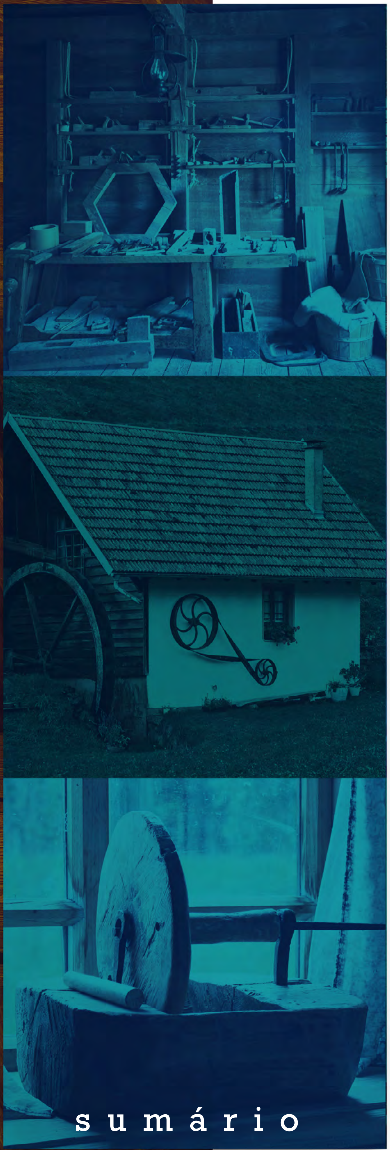
started, and transmitted from the advanced countries. Rather, they could come up from the tension between the pressures of international capital and the reactions of the old existing modes of production. The expansion of the capitalist system, therefore, would not take place linearly as if it were a historically progressive system, as it had been suggested, to some extent, in the Communist Manifesto:

> "The bourgeoisie, by the rapid improvement of all instruments of production, by the immensely facilitated means of communication (...) compels all nations, on pain of extinction, to adopt the bourgeois mode of production; it compels them to introduce what it calls civilization into their midst, i.e., to become bourgeois themselves. In one word, it creates a world after its own image." (K. MARX & F. ENGELS, 1977, p. 39).

Not even the improvement of 'all instruments of production' would be so rapid as it was preconceived by Marx and Engels in the Manifesto but, according to Lenin in his work on imperialism, the capitalist system in its monopoly phase has the tendency to stagnation and decay. Such a tendency, will consequently have a negative impact on the development of the productive forces, because still following Lenin's reasoning:

> "Since monopoly prices are established, even temporarily, the motive cause of technical and, consequently, of all other progress disappears to a certain extent and, further, the economic possibility arises of deliberately retarding technical progress." (LENIN, 1916, p. 240)[2].

However, it should be emphasized that Lenin did not claim the elimination of competition in the world market. The introduction of technical improvements in production, making possible a reduction of costs and an increase of profits, is an important process in the direction of change, as he has pointed out arguing against the idea of any kind of 'ultra-imperialism'. Yet, for the backward countries the perspective of a capitalist development in a near future had become diffuse. The

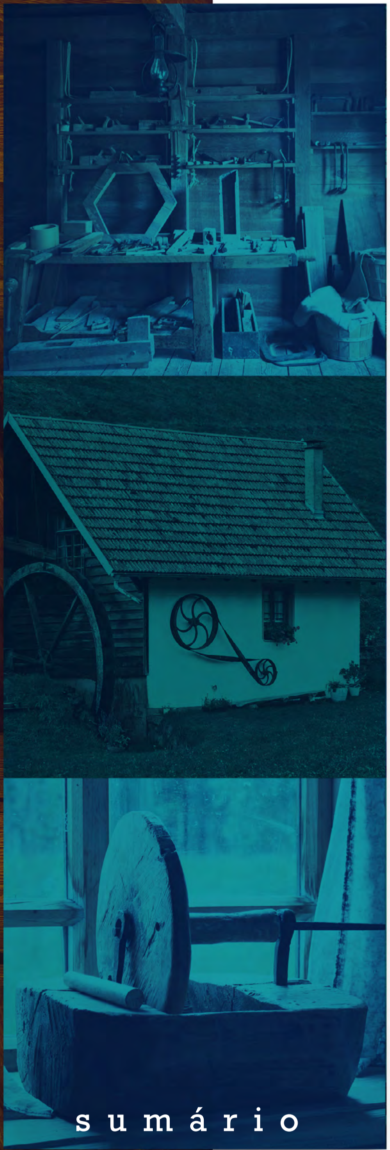


partitioning of the world, with the expansion of imperialism, led to the exploitation of those countries by the wealthy industrialized countries.

It is true that Marx and Engels never devoted themselves to any concrete and systematic analysis of the development of capitalism in a backward economy, thus making it hard to grasp their approach on that issue as best illustrated in Marx's rather controversial concept of the 'Asiatic mode of production'. On the other hand, it is equally true that Marx's theoretical works on the movement of capital do provide us with some key elements for the construction of such an approach[3].

From the point of view of capital, or from the concept of capital itself, the development of capitalism presupposes an expansion of the international market, there is a tendency to create a world market. However, such expansion, the widening of the sphere of circulation, could take place "whether the sphere itself is directly expanded or whether more points within it are created as points of production" (MARX, 1858, p. 407; emphasis in the original). Of course, the speed of propagation of a mode of production based on capital will depend on each concrete social formation in which it penetrates. Thus, the process of development of capitalism in backward economies is not simply a process of destruction and replacement of non-capitalist structures, but it has to take into account the tension, already mentioned above, between the internal and external, social, economic, and technical base structures. It is here that the development of an endogenous technological capability must play a crucial role. This point will be analysed in detail later.

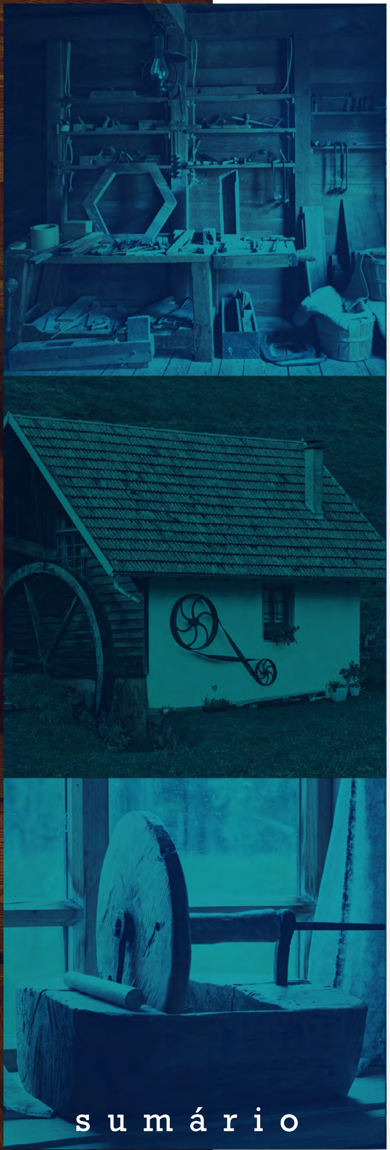
So far, we have two distinct views on the development of capitalism in backward countries. The first, as suggested by Marx and Engels in the "Manifesto", sees the expansion of capitalism as a result of the need of a constantly enlarging market for its products, a need that "chases the bourgeoisie over the whole surface of the globe", drawing all countries over the world "even the most barbarian" into civilization,



i.e., a bourgeois civilization. In other words, capitalism and capitalist products would be exported throughout the world. This view is what Gabriel Palma calls "capitalism as a historically progressive system" (PALMA, 1978, p. 885).

The second view contained in the classical conception of imperialism, is concerned with the development of capitalism in backward countries during the 'monopolistic' phase of the world capitalist system. The monopoly phase was compelling the advanced countries to impose restrictions on modern industrialization in the colonies. Although, such industrialization would eventually be possible when the colonial bonds were broken, and the national bourgeoisie took over the political power. However, this does not mean that those writers believed that the transition of a backward country, from its colonial status to an industrialized capitalist economy, could be made free of contradictions. After all, as Rosa Luxemburg had quite clearly stated, "imperialism is the political expression of the accumulation of capital in its competitive struggle for what remains still open of the non-capitalistic environment." (LUXEMBURG 1913, p. 446, emphasis added)[4].

The realization that such contradictions were much more complex than originally thought and that the process of capitalist development in a backward country would have to face increasing constraints, internally and externally, gradually brought about a new view of that process. Basically, the element of novelty of that approach was the recognition of the reactionary character of the dominant classes of backward countries which were opposed to the accomplishment of a 'bourgeois revolution' in their own countries. Those classes would then make alliances with the imperialist countries to abort any significant process of industrialization. Such theses proclaimed that imperialism retarded both capitalism and the development of the productive forces. The conclusion was that the classical view of imperialism should not be held any longer[5].



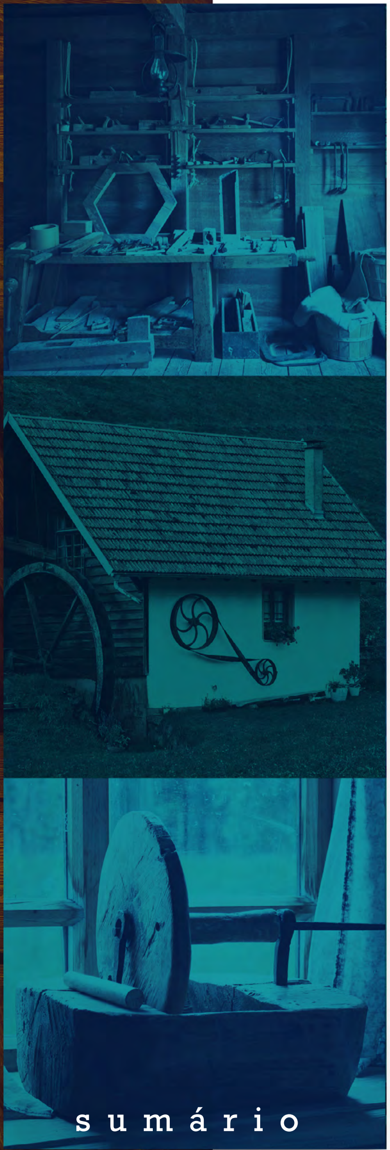
To fight imperialism was equivalent to fighting against what had became known as the 'feudal-imperialist' alliance. The struggle against such an alliance was then, at the same time, the struggle for industrialization.

As far as Latin America is concerned, the analysis of capitalist development, particularly regarding its process of industrialization, was carried out in its essentials within the theoretical and political framework just outlined above. Both ECLA's (United Nations Economic Commission for Latin America)[6] and the Latin America Left's economic analyses were inspired or developed according with those theses until the 1960s.

After the victory of the Cuban Revolution, in 1959, an old controversy between the guerrilla movement and the existing Cuban Communist Party regarding the character of that revolution was settled a few years later: the only feasible path left for a democratic and anti-imperialist revolution was the immediate transition to socialism. The so-called 'bourgeois revolution' should be bypassed altogether [7].

That was the political and intellectual background against which the dependency analysis arose in 1966 with Frank's article in the "Monthly Review", 'The development of Underdevelopment' (FRANK, 1966), which later became, in a much more elaborated form, his well-known "Capitalism and Underdevelopment in Latin America" (FRANK, 1968). Following Frank's approach on the development of Latin America capitalism, a distinction is usually made between two other lines of investigation within the dependency analysis framework.

The first, mostly represented by the works of Sunkel and Furtado, can be seen as an attempt to improve ECLA's analyses on Latin America development (FURTADO, 1968 and 1971; SUNKEL, 1971). The second, found for instance in the works of Cardoso and Faletto, focuses its analysis on the 'concrete situations of dependency' (CARDOSO, 1979).

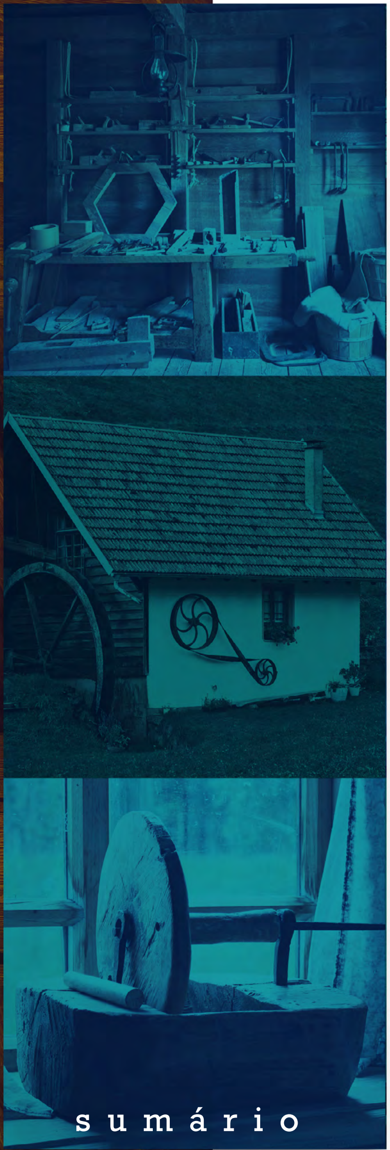


As known, Frank's dependency analysis was meant as a charge against both the so-called modernization theories and the development policies based on the monetary approach. It claimed a more radical view of that issue: by rejecting the possibility of any significant development in Latin America, particularly towards industrialization, and since the local bourgeoisie had not been able to implement its 'revolution', then there was no other way out of underdevelopment in Latin America other than towards an "armed revolution leading to socialist development" (FRANK, 1969, p. 318).

As far as technology is concerned, Frank has since pointed out, its increasing role in the metropolis-satellite relationship, worsening the underdevelopment of the satellite. Although he did not coin the term 'technological dependency', his realization that technology was becoming the basis of what he called 'metropolitan monopolist domination' should be acknowledged. Moreover, he foresaw some of the impact that such technological development would have on peripheral economies.

> "This technology is variously represented in automation, cybernetics, industrial technology; chemical technology - the substitution of the satellites' raw materials by metropolitan synthetics; agricultural technology - the import of food by the 'agricultural' satellites from the industrial metropolis; and, as always, military technology, including nuclear and chemical as well as anti-guerrilla warfare technology." (FRANK, 1969, p. 212).

Frank's remarks on that issue go further, claiming that the possibilities for a peripheral country to develop those kinds of technologies are quite remote, not to say nil. Such a difficult situation, he states, is worse "than it was for the same country to develop its own light or heavy industry at the time when these were the basis of metropolitan monopoly." (ibid).

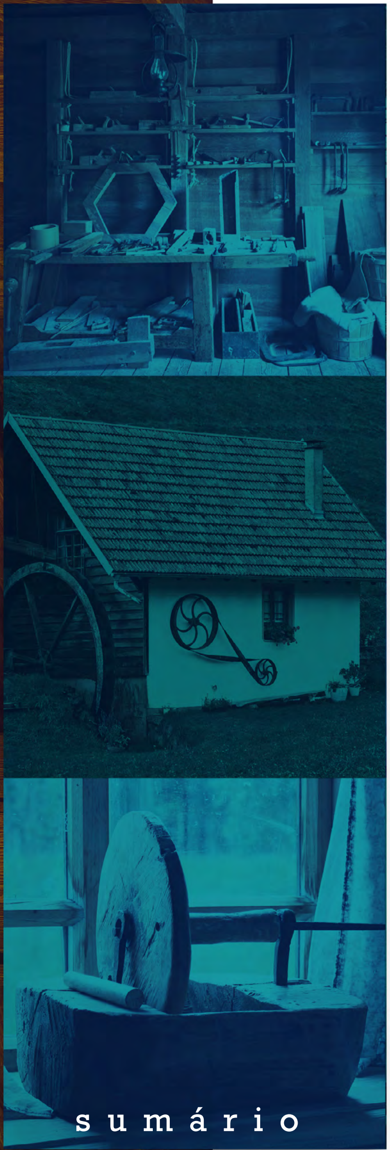


Unfortunately, Frank does not really develop an analysis of the issues related to the process of technological progress in a peripheral capitalist economy. Frank's concern about technology is just marginal to his main argument, which is to demonstrate the impossibility of a capitalist development in a "satellite country"[8].

The transition from an "agro-mercantile" economy to accumulation based on an urban-industrial economy, in Latin America and in Brazil more particularly, was one of the major contributions of Furtado's theoretical works. The design of a theory of underdevelopment and the basis of the Import Substitution Model were two other equally important contributions of Celso Furtado to the development of modern economic thought[9].

The basic works in which Furtado develops the fundamental ideas and concepts in his theory of underdevelopment and on the Import Substitution Model are "*Desenvolvimento e Subdesenvolvimento*" (FURTADO, 1961) and "*Dialética do Desenvolvimento*" (FURTADO, 1964). For him, the dynamics of underdevelopment is a process in itself and not a stage through which any presently developed capitalist economy has had to go through. In general terms, the Brazilian process of industrialization has been, in Furtado's view, oriented by the import substitution process and based (initially, at least) on the export of primary products which provided capital and markets. A similar pattern has been followed by other backward countries in Latin America in which a process of industrialization has taken place.

Nevertheless, the process of industrialization through import substitution led the country to adopt capital-intensive and often labour-saving technologies. These technologies, though adequate for developed economies, do not induce the economy to self-sustained growth since they do not generate enough employment for the abundant labour force available in the country. Under these circumstances, industrialization would employ relatively few workers



and pay low wages; such a structure does not allow the emergence of a strong domestic market. This argument, which represents the core of Furtado's thesis on underdevelopment, can be summarized, according to his own words, as follows:

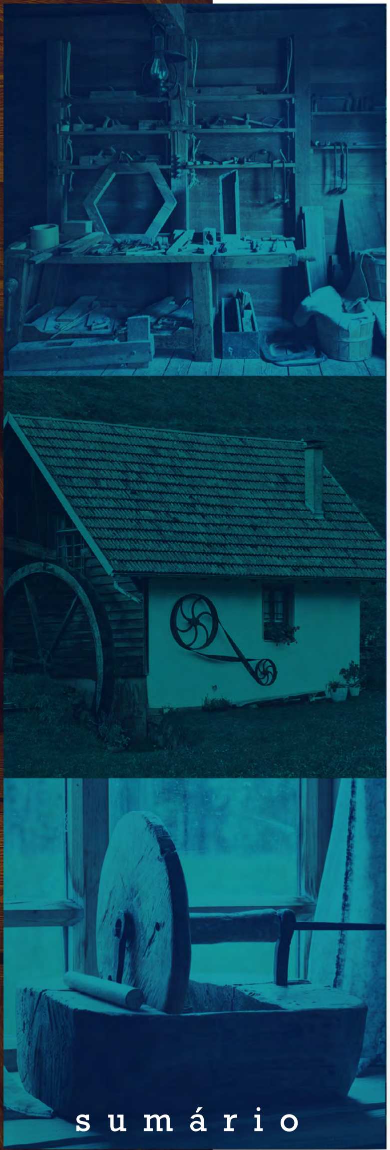
> "The primary causes of dualism are of economic nature. However, technological factors not only perpetuate such a situation but also worsen it. Moreover, those factors turn underdevelopment into a closed process that tends to self-generation." (FURTADO, 1971, p. 189).

Currently, there is a general agreement that there has been a significant process of industrial development in the Third World in the last decade. Also, it is generally agreed that such development began with a process of import substitution[10]. What is at stake now is both the nature and the impact of that kind of industrialization in the LDCs. In Brewer's words:

> "The central issue in debate is whether this sort of industrialization merely reproduces relations of dependence between centre and periphery in new forms (as Amin, Frank, Sutcliffe and others argue) or whether it marks the beginning of a breakdown of the centre-periphery division (as Warren argues)." (BREWER, 1980, p. 288).

Following that shift in the central debate over dependency, another item was brought into the discussions: technological dependence. For Furtado, as pointed out above, this issue became a key issue in the analysis of dependency. And this view is also shared by other dependency theorists (DOS SANTOS, 1970).

Ironically however, the dependency literature is not what could be called an ideal source of studies on technological change and innovation in Third World Countries. This kind of issue has been generally neglected in that literature.

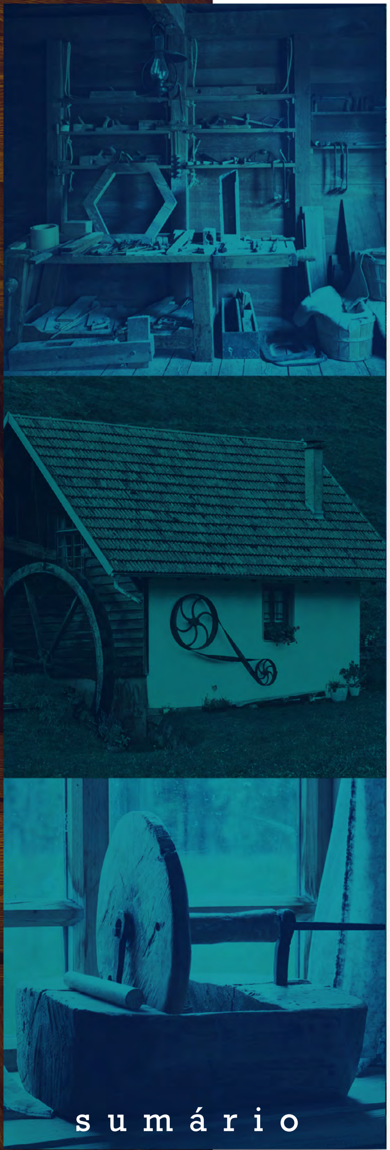


According to the analyses of the followers of the dependency school no significant industrial development should be expected in a peripheral economy, let alone endogenous technological development which, according to some of those economists, is regarded as the key resource for development. It is so important that in Furtado's view, for instance, "dependence can be said to be first and foremost technological" (FURTADO, 1983, p. 129, emphasis in the original).

For some authors, the underdeveloped countries should pursue a different road to development, based on alternative technologies. The basic reasoning for such approach, is that the introduction of foreign technologies into the economies of those countries induces the emergence of a market which is suitable for advanced-country products. According to Frances Stewart, one of the economists most critical of the adoption of advanced technologies in the LDCs, this kind of market imposes new requirements for consumption, as for example "for the standardised and western style dress, means of transport, wealth and education both lead to inequality in the society." (STEWART, 1978, p. 81).

As it has been discussed in the previous section, that kind of approach and its related propositions towards the so-called appropriate technologies do not help in understanding the actual processes of generation of technological knowledge in the LDC's or rather, the mechanisms through which such processes could be triggered. This seems to be far more important, especially in the long run, than the immediate effects or impact of foreign technologies on social and economic structures[11].

Seen from another point of view, Stewart's concern could be discussed as part of the debate on technology transfer, specially from the advanced industrialized countries to the Third World. The literature on that issue has steadily grown since the last decade, and it has been in the forefront of many international meetings for the promotion



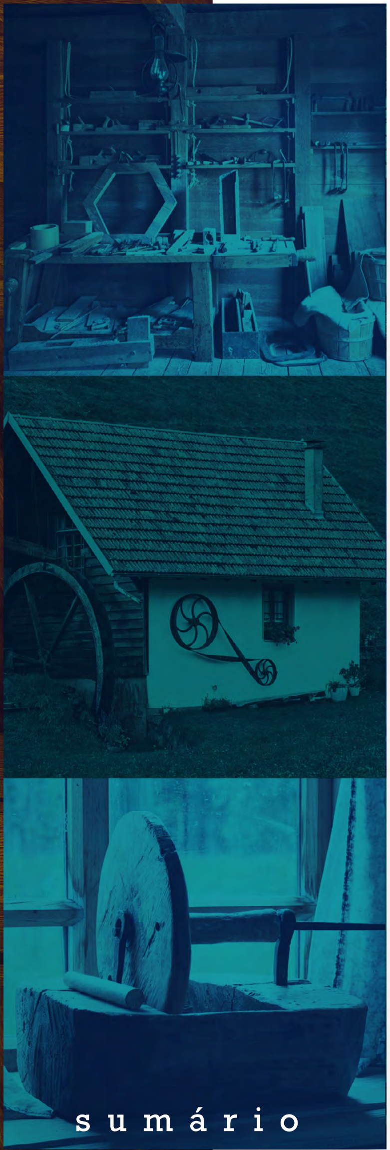
of development. Such debate has also stimulated the design of policy measures aimed at either controlling the transfer of technology (UNCTAD, 1972 and 1978), or opening the 'blackboxes' of the imported technological packages (JUNTA, 1976; STPI, 1978)[12].

Despite the great efforts made by International Agencies and other similar organizations, in promoting policies to use science and technology in a self-reliant industrial development (STPI, 1975 and 1978), the overall results are still below expectations (HERRERA, 1983).

Among the attempts to explain that failure, some have pointed to the lack of information on how those policies could achieve their aims. According to such critics, the 'learning' process in LDCs tends to be extremely weak (MAXWELL, 1981). Moreover, it seems that the literature tends to underestimate the actual technological capabilities available in those countries, because of the dependency paradigm (SOETE, 1981). The consequence for policymakers in the LDCs, is that they tend to overlook the concrete processes on which a strategy for industrial development could be based. As argued by Cooper and Hoffman:

> "There has been little analysis of conditions which are favourable to innovation and technological learning and the basis for policy is slender to say the least." (COOPER, C. & K. HOFFMAN, 1978, p. 34)

As far the 'technological dependency' argument is concerned, it has to be elaborated much more before it can be turned into a useful operational concept. Not only that, but the very concept of dependence, in general, has to be clarified, as stressed in recent critical reviews of the 'dependency theory' (PALMA, 1978; WARREN, 1980; BREWER, 1980). The concept of technological dependence, as it stands now, suffers not only from the lack of a sound theoretical basis, but also from the "extreme paucity of systematic empirical evidence about what is supposed to be involved." (BELL, M. and K. HOFFMAN, 1981). On this aspect, both the dependency analyses and the policies proposals



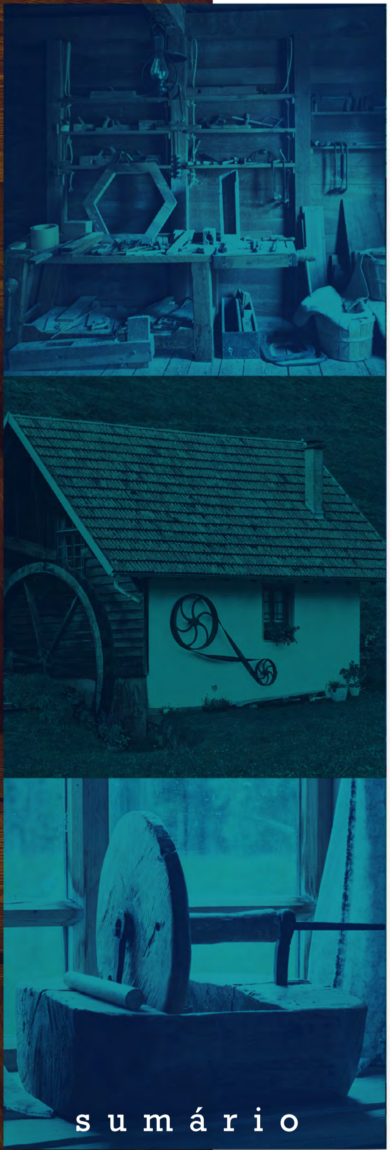
for self-reliant development share the same weakness, namely they have neglected the dynamics of the process of technological progress, particularly in the NICs.

Therefore, it is hardly surprising that such analyses have overlooked the role of the process of technology transfer in potentially increasing the existing capabilities of the importing country, which could use its advantage as a late comer (Soete, 1981). Even the Multinationals Corporations - MNCs, according with Arghiri Emmanuel in his rather controversial book "Appropriate or Underdeveloped Technology?", could play an important role in upgrading the local capabilities. In his own words:

"The contribution which is here involved is that which is not generally spoken about, and which is nevertheless fundamental; it is the MNC's indirect contribution, (...) the MNC will indirectly ensure 'technological transfer' by nothing other than the technical careers, both current and potential, which it will offer to local candidates, moreover by educational and research facilities that the careers thus stimulated may induce." (EMMANUEL, 1982, p. 56)

Without getting into such a controversial debate, there is an important issue which must be considered in this discussion: to what extent could foreign technologies be used as either a point of departure or to foster the development of LDCs? A priori it would appear that each technology should be considered in its own specificities and requirements.

From all this debate, one thing seems to be quite clear and undisputed: the need for more studies on concrete cases of technological development in LDCs, particularly those concerning the process of technology innovation and adoption. Quite recently, a number of studies have come up in the literature, focussing on different sectors and distinct issues: Katz's works on local process of technology generation in LDCs

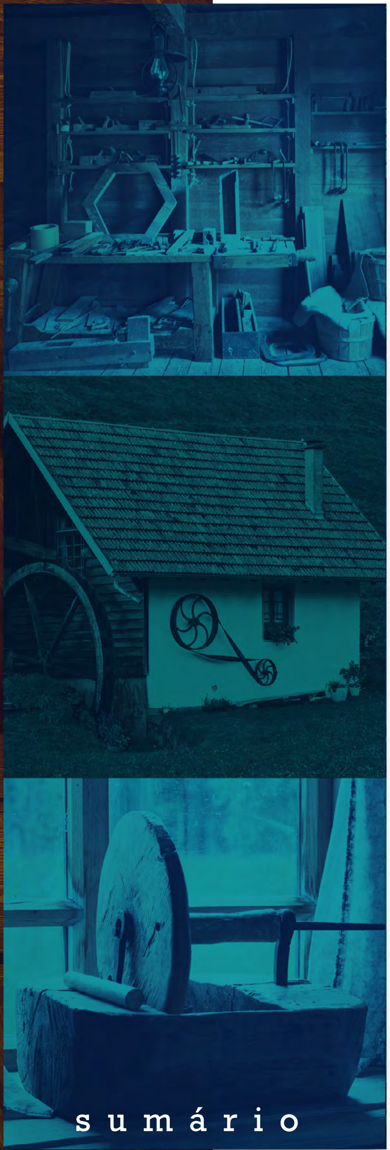


(KATZ, 1980); Maxwell's study on the Argentine Steelplant of Acindar (MAXWELL, 1977); Dahlman's analysis of the Brazilian Usiminas steel plant (DAHLMAN, 1978); Kim's analysis of technological development in South Korea (KIM, 1980); Schmitz' study on the labour process in small-scale manufacturing of Brazil (SCHMITZ, 1982); Tigre's study on the Brazilian computer industry (TIGRE, 1982); Teixeira's study on the Brazilian petrochemical industry (TEIXEIRA, 1985); Ferraz's study on the Brazilian shipbuilding industry (FERRAZ, 1984); among others.

All those studies have contributed to a better understanding of how technological knowledge and skills are built up in economies without a previous experience in the history of the industrialization process. There are, however, two important points, which have emerged from that literature and on which we are going to focus our attention in the following sections. The first is related to the need to carry out more empirical research on the historical processes of technical change in LDCs. The second, more theoretical, concerns the application of the concept of innovation, specially within the Schumpeterian framework, to LDCs.

TECHNOLOGY AND DEVELOPMENT: IMPACTS AND CONFLICTS

The process of technological progress brought about by the process of capitalist development has from time to time been accompanied by waves of protests and, sometimes, even by violent social reactions. Technological progress has affected the working-class since the early stages of industrial capitalism in the world, leading to social reactions, among which the so-called 'Swing Riots', in England, were one impressive example[13].

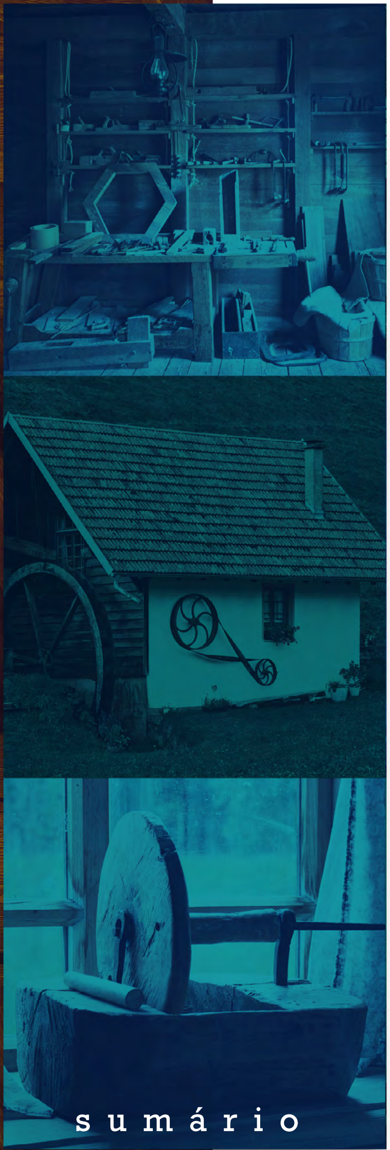


It is only relatively recently that the agenda of protest against technological progress has included new items such as industrial pollution, the arms race and nuclear armageddon, scientific-technocratic ideological domination, and, of course, the current nightmare of widespread unemployment due to automation[14].

As far as the Third World Countries are concerned, the dominant item on the protest agenda centres around a proposal which in its most radical version calls for the banishment from those countries of what have been labelled 'advanced-country technology', claiming that such technologies are inappropriate for their social, economic and cultural structures (for a review on such proposals see for instance WINNER, 1980).

Why are technologies from developed countries regarded as inappropriate for backward countries? First of all, it is important to bear in mind that such claims are quite different to the historical protests against technology in 16-17th century England. They have neither followed nor been brought about by any spontaneous social movement - with the only known exceptions being the Ghandian movement in India in the mid 1920s, to protect their handicraft textile production and, to some extent, China's Cultural Revolution. Apart from these exceptions no organized movement of the working class in the Third World has ever come out in protest against foreign technology. So far, such concern with the inappropriateness of technologies, for Third World Countries, has been mostly restricted to academic and technocratic spheres.

For those critics, the technology from developed countries is inappropriate because when it is transferred to Third World Countries the economies of those countries "are distorted in the effort to reproduce the sort of conditions for which the techniques were created." (STEWART, 1978, p. 60). Another equally critical view in this line is given by Furtado, in his comments to Emmanuel's provocative approach to appropriate



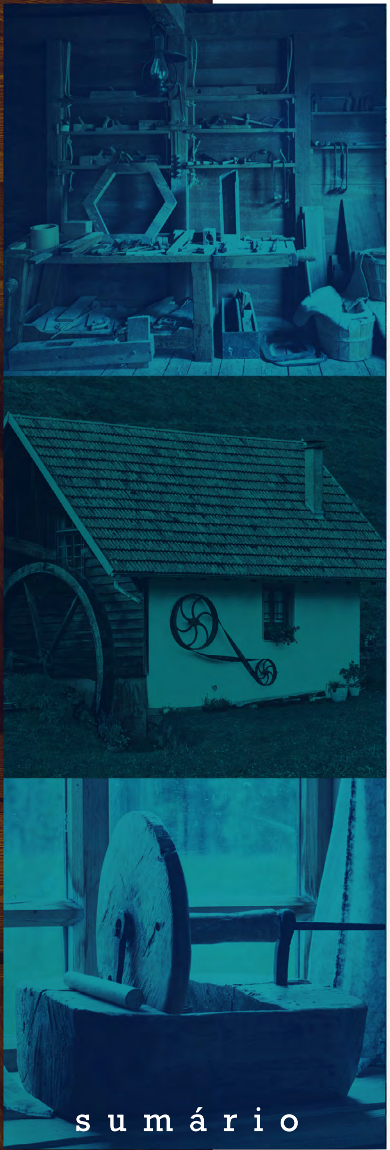
technology proposals and the role of multinational corporations (MNCs) in the Third World (EMMANUEL, I982).

According to Furtado, each technology has its own set of constraints associated with a social structure; therefore, if a technology which had been developed elsewhere is introduced into a dependent society, "the logic of the means can easily get the better of the logic of the ends." (in EMMANUEL I982, p. 120)

But if foreign technologies cannot be used as a point of departure for local development in backward countries, what then are the technical means that should be employed? Would the technology appropriate for Third World Countries have a different nature from those developed elsewhere? Does this argument therefore imply that there is a different logic underlying the technological progress brought about by capitalist development in the Third World?

The idea that endogenous development in the Third World is not only possible but necessary in order to break the prevailing vicious circle of inequality, poverty, starvation and disease present in these countries is not a new idea. Its origin can be traced back to nineteenth-century utopian socialists, within a quite different socio-economic context, such Robert Owen or Thomas Carlyle[15].

However, Gandhi's concept of development seems to be the first systematic attempt to produce an alternative approach for the development of a Third World country[16]. In Gandhi's Sarvodaya approach to development, policies designed to improve rural development and to generate more employment were assigned the highest priority in tackling India's poverty, that in Gandhi's view was the overriding problem in his country. The modern sector would also play its part in Gandhi's approach, but it would be a secondary role in support of the development of the traditional sector.

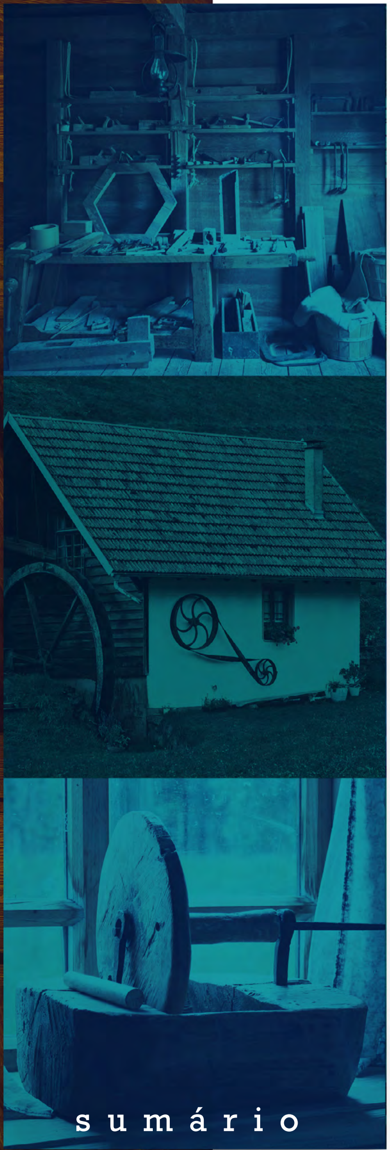


The strategy consisted of upgrading the existing techniques of production and in adjusting modern technology to the local needs and objectives. Scientific and technological research would be used for that purpose, but only as long as they were organically related to India's concrete problems and the search for solutions that were compatible to its social, economic and cultural structures[17].

What Gandhi had quite correctly realized was that, for a country like India, with an ancient culture and a very complex social structure, it would be too dangerous to accelerate the process of industrialization based on large-scale modern industries and imported technologies. The speed of such a process had to be kept tied to the pace of the process of social development in the country since both are organically related to each other.

However, what Gandhi would not have understood (or accepted), was that to properly carry on his Sarvodaya approach to development, the State would have had to play an important role in it. This would have been necessary because India's social and political forces were not sufficiently organized at that time to take over the control of their process of development in a truly democratic basis. Yet a strong State was the last thing that Gandhi wanted: "I look upon an increase in the power of the State with the greatest fear ... The State represents violence in a concentrated and organized form." (Quoted in BHATT, 1980, p. 173).[18] Actually, what Gandhi seems not to have understood was both the nature and the limits of the State:

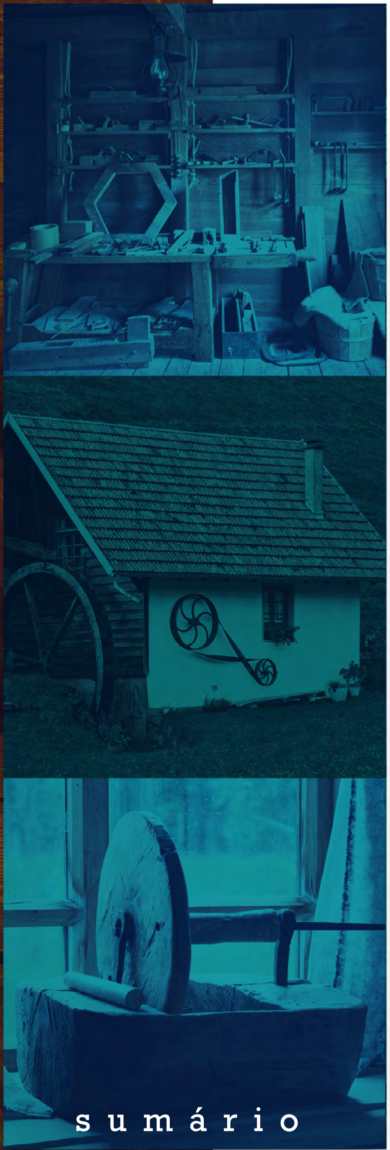
> "It is my firm conviction that if the State suppresses capitalism by violence, it will be caught in the coils of violence itself and fail to develop non-violence any time. What I would personally prefer, would be, not a centralization of power in the hands of the State but an extension of the sense of trusteeship; as in my opinion, the violence of private ownership is less injurious than the violence of the State. However, if it is unavoidable, I would support a minimum of State-ownership." (*ibid*., p. 173 - my emphasis)[19].



Unfortunately, Gandhi did not see his program fully implemented nor did it survive after his death in 1948. The strategy followed by Nehru was in sharp contrast to Gandhi's as it gave priority to large-scale, government-owned industrialization and the rapid development of a modern capital-goods sector based, if necessary, on imported technology. Cottage industry was to be tolerated, in the short run, as long as it could provide employment; but the modern industries would supplant the traditional sector. Yet, after more than twenty-five years of planned 'socialist' development, poverty and unemployment still remain India's major problem[20].

Gandhi's ideas on alternative industrialization and social development for a Third World Country were not only the first systematically produced (and, what is far more important, enriched with an intensive political praxis) but also one of the most original, in the sense that they were deeply rooted in India's culture. After that, no other similar proposal arose until towards the end of the 1960s, when in a quite different context, (away from the noisy protest marches in the US and Europe) the concern with the introduction of foreign technology into the Third World once again emerged.

The reappearance of the concept of appropriate technology (although for the first time with such label), applied to the so-called 'problem of underdevelopment', arose from the realization that industrial development in Third World Countries occurred within the sphere of direct influence of the developed capitalist economies. This process tended to worsen the already unequal income distribution, increasing and spreading poverty and ultimately starvation and disease in those countries. This happened primarily because the technologies adopted, being more or less the same as those used in the developed countries were therefore inappropriate to the very different conditions existing in developing countries. The chief cause of the inappropriateness was felt to be their capital-intensive nature. This meant that

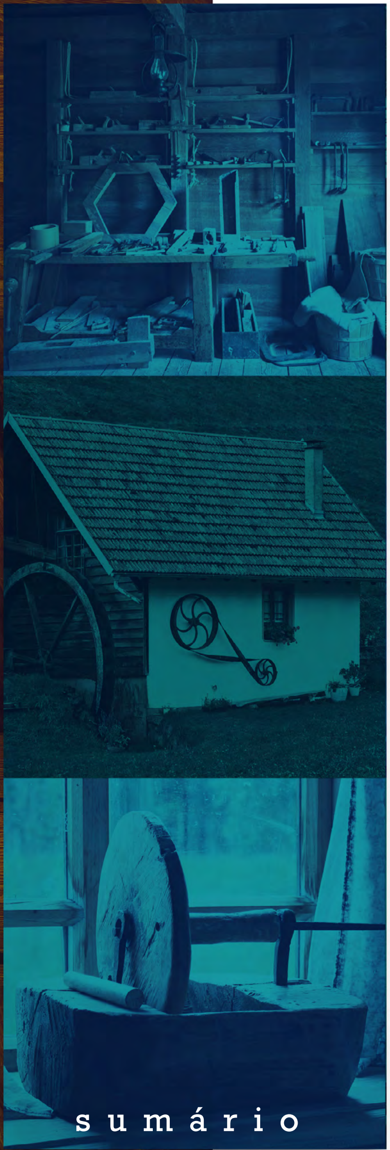


any industrial development that took place in these countries would be unable to generate sufficient jobs to keep pace with the growth of the labour force - immiserization of growing numbers of people was thought to be the inevitable result.

This situation is made worse by the fact that, still following the argument, such industrialization leads to the disruption of the traditional forms of production previously existing in those countries. The impact of industrialization also hits the rural areas whose population has migrated to urban areas - either as a consequence of the introduction of capital-intensive technologies in agricultural production or because it has been attracted by the possibility of better living conditions in the city. The outcome of such a process has been an expansion of the 'belts of poverty' that surround the cities[21].

Given such a critical picture, the proposals for alternatives or appropriate technologies have been presented as an optional path - although not necessarily a substitute - to the process of capitalist development in the Third World.

Schumacher's proposal of an endogenous development path is among the first of such proposals and it is certainly one of the best known. His concept of intermediate technology, a technology with a human face, as he called it, is a central notion in the alternative development he proposed. According to Schumacher, the solution for the acute problems faced by Third World countries, especially in rural areas, can be achieved with the application of intermediate technologies. The main characteristics of such technologies are that they have a quite simple technical conception (although not necessarily primitive), ease of maintenance, are based on the use of local resources (both human and natural), have low capital investment requirements and finally, that they can be used in small units of production[22].



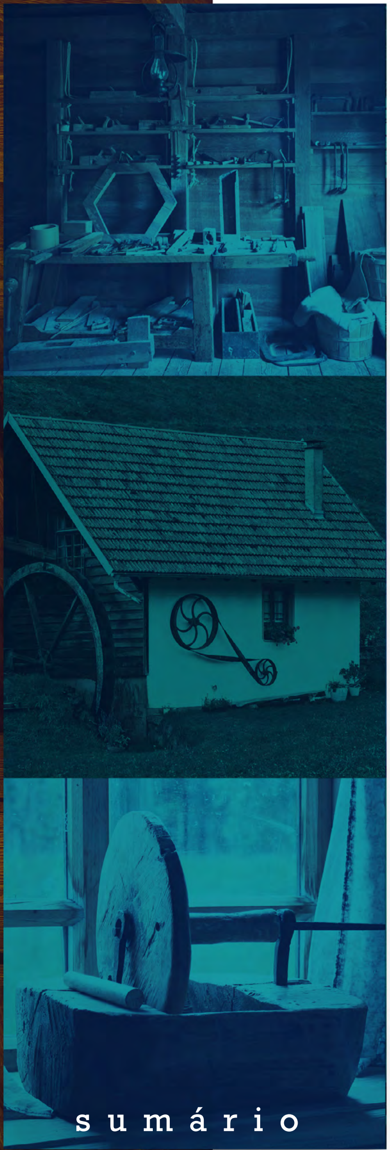
We shall not detail the endless list of appropriate technology concepts and their related development proposals as such a task would lead us far beyond our goal[23]. What is important to stress here is that, despite the good intentions of the advocates of appropriate technology, and all the effort and resources that have been poured into their development and dissemination, this movement has only made a limited and localized contribution to the process of Third World development.

The failure of those proposals to open an alternative path of development, based on appropriate technologies, resides in the fact that their analysis has been focused on the 'perverse effects' of capitalist development in the Third World. Moreover, such analyses usually focus only on the technologies themselves rather than on the surrounding context within the developing countries.

To break down the descriptive level in which that discussion is presently made, it is necessary to divert the focus of analysis from technology as such and to concentrate on the social, economic and cultural processes in which the technological progress is embedded.[24] This brings us back to the issues presented in the introduction to the thesis - the need to understand the conditions necessary to allow technological progress to be achieved on a self-sustained basis in a Newly Industrialized Country (NIC).

THE EMPIRICAL EVIDENCE: LEARNING THROUGH PIECEMEAL TECHNICAL CHANGES

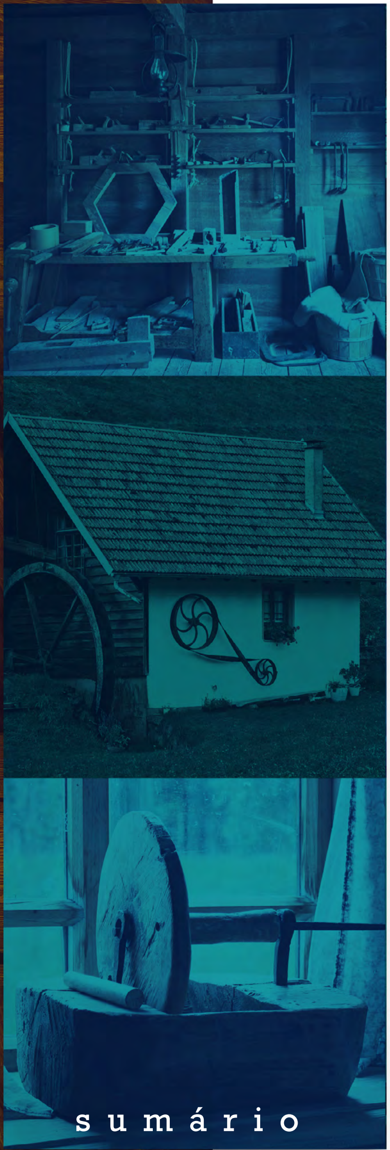
In the technology and development literature, the issue of innovation and technical change is often linked to the problems of technology



transfer. It is conventionally argued that developing countries have tended to be passive recipients of advanced country technology and as a result have failed to gain access to underlying technological knowhow. They gained only physical assets in the guise of plants and equipment but very often failed to acquire even the most rudimentary operating skills let alone higher-level skills related to carrying out technical change activities. It was argued that this poor performance in acquiring technology has been at least partly responsible for the failure of many Third World Countries to achieve a self-sustained economic growth.

The emergence of a small group of developing countries (the NICs) exhibiting high rates of economic growth created a new set of issues for the technology and development literature since it appeared that these countries had managed to escape from the path of dependent industrialization precisely by assimilating and effectively exploiting technology imported from the advanced countries not only to increase domestic output but to rapidly expand their level of manufactured exports well above historical rates and expectations. Indeed, when it is considered, for instance, that the NIC's share of manufactured products in world trade[25] increased more than twofold from 2.7% in 1970 to 5.7% in 1980, it becomes clear how important this new situation is. (CEPII, 1983).

In face of growing evidence underlining the importance and strength of the NICs' industrial sector, an extensive amount of research concerned with understanding the underlying sources of that steady economic performance was carried out in the mid to late Seventies. Some of the works emphasized the processes of learning and technical change in industrial development in LDCs (BELL, 1982a and 1982b; BELL & HOFFMAN, 1981; KATZ, 1980; TIGRE, 1982; TEIXEIRA, 1985; FERRAZ, 1984; among others), and others have focussed on the fact that a number of NICs have also become exporters of technology (LALL, 1980 and 1982; LALL *et alli*, 1984; KATZ & ABLIN, 1978).

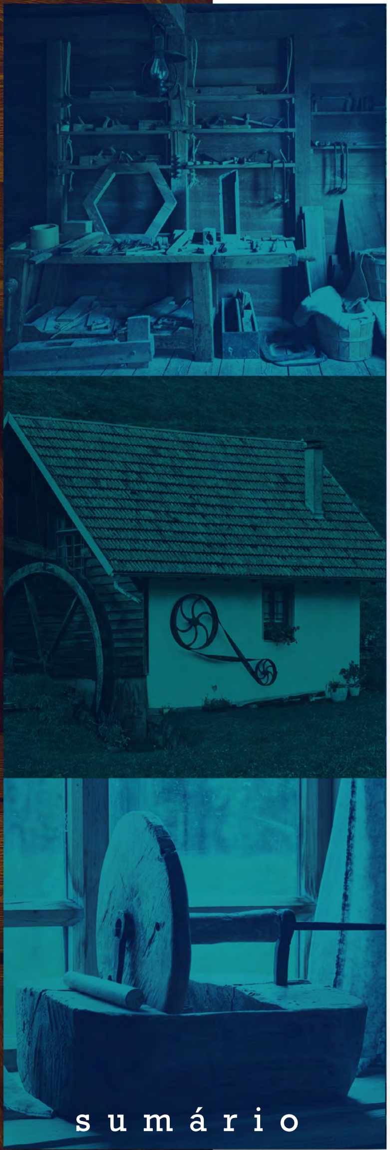


A common feature among those writers in this new body of literature has been a strong critique of the later versions of the dependency school concerned with technological dependency. That critique, based on solid empirical findings produced by those studies, calls for a re-appraisal of government policies which to some extent implicitly assume that kind of dependence. In Bell's words:

> "Besides generating discomfort for some, the revelation that technological learning can in fact take place in these apparently unpromising circumstances seems to have another effect. It appears to have rekindled interest in positive policy action in developing countries which might be designed to augment the rate at which learning occurs." (BELL, 1982b, p. 1).

However, what is to be understood by that learning process? Who or what social actor(s) is meant to learn through such a process and what is it he is supposed to learn? First of all, it is important to bear in mind that the majority of the work done on this subject has been carried out from the firm's point of view or, at the most, focussing on a specific industrial segment. In Lall's work, wherein the nature of innovation in developing countries is somewhat discussed (LALL, 1982; particularly Chapter 9), it is suggested that the learning process primarily occurs at firm level - including the acquisition of more sophisticated technological knowledge, which requires an understanding of the basic scientific and engineering principles involved. According to Lall, the difference at this stage of learning, which he calls "learning by design", is that it requires a separate R & D department in the firm (LALL, 1982, p. 67).

The accumulation of technological capacity, through "learning", is usually related to an increase in the managerial capacity of the firm, particularly in relation to the acquisition of technology and the capacity to undertake technical change. Even when it is proposed that there could be a wide range of learning mechanisms, such as those suggested by Bell[26], the analysis is also focussed on firm level performance in acquiring technology capacity (BELL, 1982b).

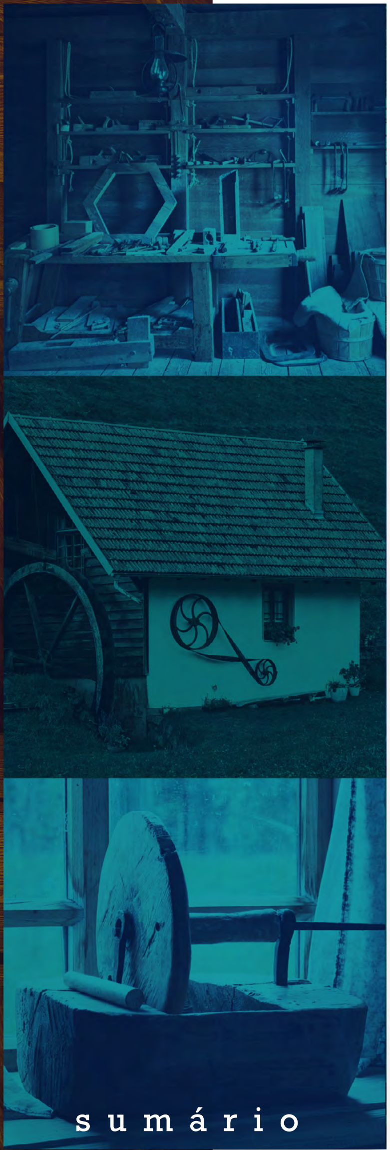


Another characteristic feature of the studies on technological change in the NICs is the emphasis given to the role of incremental technical changes, again carried out at firm level. Recent studies have pointed out that there are several strategies and different levels of complexity by which a firm can increase its change-capacity (BELL, 1982a; MAXWELL, 1981; SERCOVICH, 1984). The naive view of the traditional advocates of passive 'learning-by-doing' has been criticized as being of only limited use to explain the consistent growth firm level productivity that has been observed taking place over time in both the advanced countries and in a few of the NICs as well.

According to some authors, for a developing country industry, a firm's increment in technology would also correspond to an incremental change in the country's technological capability. Following such an evolutionary pattern, a firm tends to move, historically, from 'doing-by-imitation', a less knowledge-intensive kind of task, towards more sophisticated ones, like industrial engineering or, as Lall has called it, 'learning by design' (LALL, 1982).

To some extent, import substitution policies have implicitly assumed that kind of pattern, although such policies, which have had a great influence on post-war economic proposals for Third World industrialization, do not regard technological change as an essential part of it. Actually, this issue was not even discussed in those proposals. Nor it was in the first ECLA papers, which inspired them[27].

The great emphasis on the 'learning' process and, at the same time, the choice of the firm as the main framework for the analysis of technical change, have led some of the studies, found in this literature, to neglect both the sources of and the conditions for innovation in NICs, other than those of technical nature. It was already stressed in Chapter 1, that it is the capability to generate knowledge and to innovate that makes possible a steady process of industrialization in the long run.[28] Therefore, in the discussion that follows we set out to try to characterize

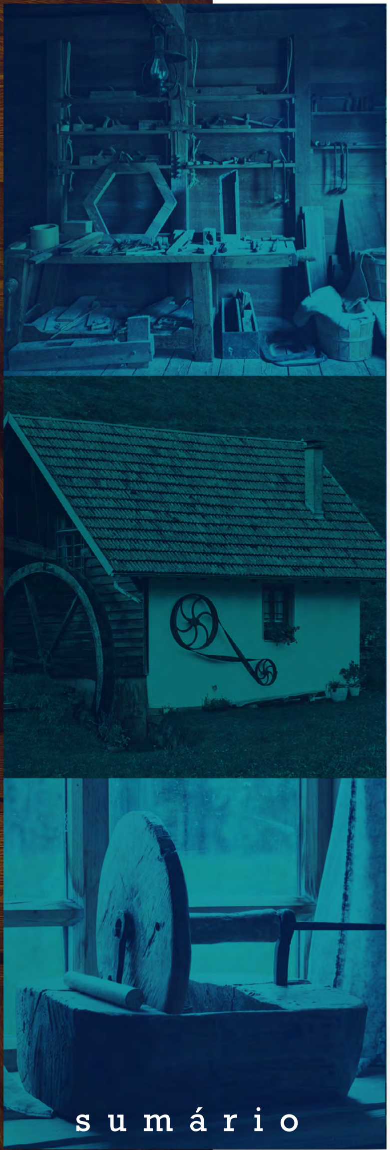


the innovation process that occurs in the NICs in a way that will be analytically useful to us in the rest of the thesis.

The first point we wish to make is the need to introduce the concept of a 'technical base'. This concept requires an operational formulation, if is to be applied as a useful tool of analysis. Some definitions, for instance, propose a passive concept of technical base as being one in which it appears as recipient of the existing stock of knowledge (ARAÚJO JR., 1982). In a similar approach, Salter's definition of a 'fund of knowledge' with different levels of complexity, also suggests the same notion of passivity (SALTER, 1969)[29].

It is necessary to further discuss the nature of the technical base for two reasons. First, we accept Schumpeter's view that the process of industrialization within a capitalist economy is characterized by a constant mutation that "incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one", (SCHUMPETER, 1979, p. 83 - emphasis in the original). Given this starting point it is difficult to understand how such a process could be based on a somewhat stable technical base. This fact has not presented, so far, any serious problem to current analyses mainly because they choose to view the firm as playing the main role in the innovation process hence the focus of much their analysis is on the firm and its internal activities. Much less attention is given to the conditions and functions of other spheres of activity in the broader cultural, social and scientific context that influence and interact with the productive sphere.

The second reason stems from the fact that we are dealing with an organic process. Thus, any analysis concerning a particular part of this process, such as a firm's strategy towards acquiring technological capacity, may indeed help to clarify details of mechanisms, but is inconclusive beyond that. And the thesis' major concern is precisely to understand some features of the general conditions for that

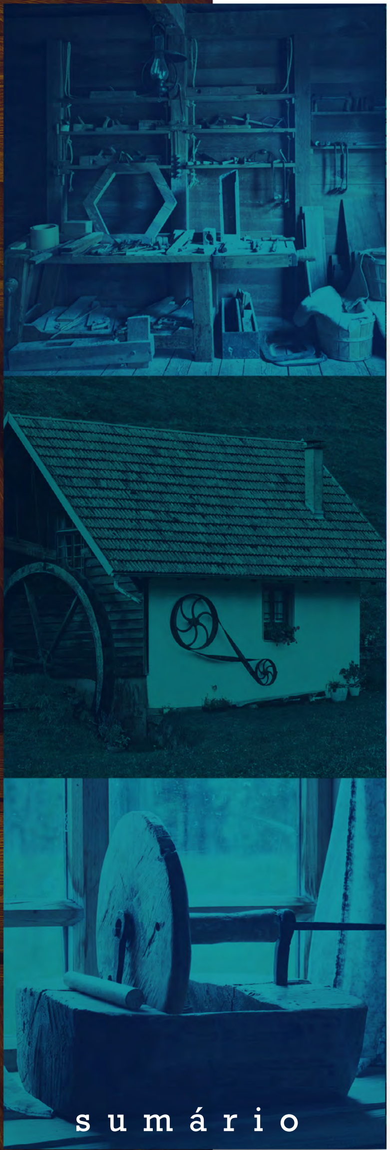


process, i.e., how the development of capitalism occurs in an NIC. Among such conditions, the capability to generate scientific and technological knowledge is an essential one - a sine qua non condition for the innovation process[30].

One important result of the points raised above concerns the so-called learning process in LDCs' firms, which was discussed at the beginning of this section. The evidence from empirical studies on this matter, shows that the majority of the technologies transferred from industrialized countries to LDCs or NICs, are technologies already in use in the supplier countries. At the most, they could represent a secondary innovation; a change in the existing technological paradigm. Therefore, from the point of view of the technical base of the supplier country, the learning activity of the recipient firms would be seen as a simple normal problem-solving activity, following a given technological trajectory within a given technological paradigm (DOSI, 1982).

However, when considered from the point of view of an LDC's technical base, such problem-solving activity could be seen as far from 'normal'. The technology in question, transferred from an industrialized country and seen to be of an entirely standard nature in that context, could represent, for the recipient LDC a completely new paradigm for the local technical base or, in our terms, a 'primary' innovation that will introduce a major discontinuity into that base.

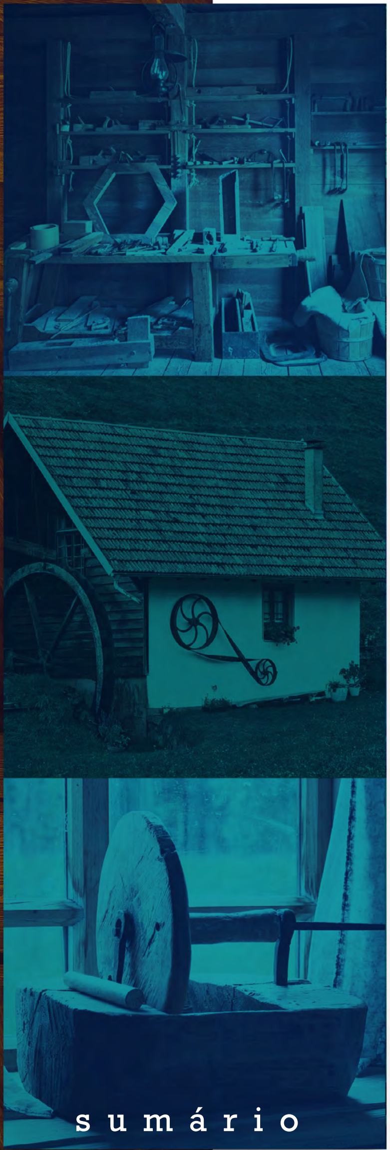
The central issue here is whether or not the LDC's technical base would be capable of coping with that 'innovation'. In other words, the question is whether the existing technical skills, the educational system, R & D departments, research institutions, consultant firms, engineering firms, information systems, university labs, etc., (assuming that they exist in the recipient country and that they interact[31]), would provide a solid technical foundation for the development of 'new' technologies. Thus, for the analysis of a firm's technological strategy or its internal learning process to yield insights of wider relevance, then it must be



situated within an understanding of the much broader process of development taking place within the local technical base.

The point is a simple one: technical change may well be occurring within an individual firm as, for instance, through the acquisition of "embodied" technology in equipment bought abroad. This could suggest that some form of capability-augmenting learning has taken place.

However unless the local technical base within which the firm is operating i.e., the country's endogenous scientific and technological capabilities, is able to respond positively towards new technological demands, the likely outcome of that firm's specific learning will only be an increasing demand for imported inputs, machinery and technical assistance - a process that, as pointed out elsewhere, can only result in growing indebtedness and reliance upon foreign investments (TEIXEIRA, 1985; FELIX, 1979).



NOTES TO CHAPTER 1

TECHNOLOGY AND DEVELOPMENT: THE POLITICAL DEBATE

[1] The works of R. Hilferding, "Finance Capital: a Study of the most recent development of capitalism" (HILFERDING, 1910), R. Luxemburg, "The Accumulation of Capital" (LUXEMBURG, 1910), N. Bukharin, "Imperialism and the World Economy" (BUKHARIN, 1915), and Lenin, "Imperialism, the Highest Stage of Capitalism" (LENIN, 1916) were the first important contributions to the study of imperialism within the Marxist tradition. Among those, Lenin's work has become one of the best-known theoretical works from the so-called 'classical writers' on imperialism. More than anything else, Lenin's work should be seen as an attempt to characterize the nature of his epoch, to draw guide-lines for the working-class movement, shocked by the events that had led to the First World War. His "Imperialism" was not written to be a contribution either to economics or to history (cf. KEMP, 1981), but rather to the understanding of the economic essence of imperialism, because unless this is studied, "it will be impossible to understand and appraise modern war and modern politics." (LENIN, 1977, p.170). Also Lenin's analysis of the tendency of imperialism to induce economically negative effects in the industrialized countries due to monopolization, between 1870 and 1914, has been contested by recent studies which show a different picture of that period, with "rising overall growth rates, significant agriculture advances, higher living standards, and the emergence of a new phase of technological progress." (WARREN, 1980, p. 8).

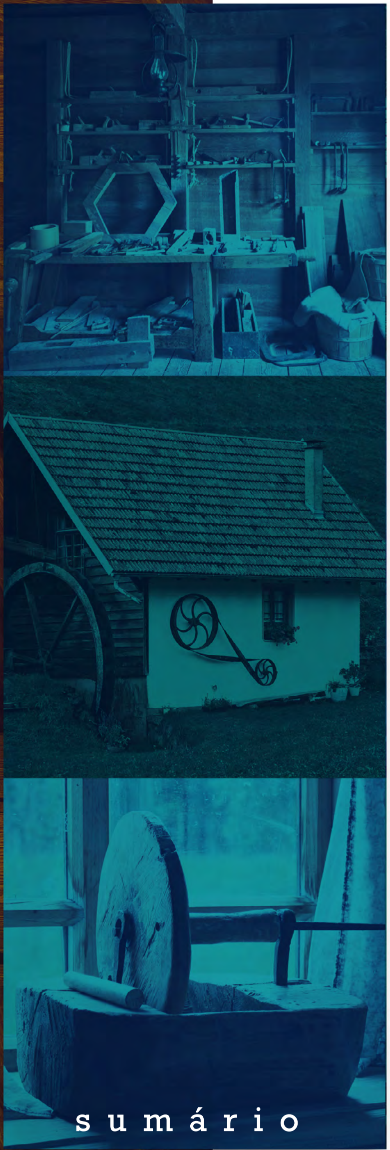
[2] To a certain extent, it could be said that Lenin anticipated Schumpeter's analysis on long business cycles, by giving here one of the main reasons for the stability of up-swing periods.

[3] Although Marx did not produced any systematic study on the development of capitalism in a backward economy (or rather, the possibility of such a development), his despatches on China, India, Mexico, the Middle East, and North Africa, at the time he was a regular London correspondent of the "New York Daily Tribune", provide us with important insights on that issue (see, for instance, AVINERI, 1969).

[4] It is interesting to note that there is an 'other side of the coin' of the political expression of imperialism, which is pointed out, for instance, by Marx & Engels in their Manifesto: "The bourgeoisie, wherever it has got the upper hand, has put an end to all feudal, patriarchal, idyllic relations" (MARX & ENGELS, 1977 p. 38). In other words, imperialism while dragging countries all over the world into the capitalist system, it has also provided the necessary conditions for the political transformation of the archaic social and political structures of those countries.

[5] Those theses were proclaimed at the Sixth Congress of the Communist International (The Comintern), in 1928. That Congress was mostly concerned in explaining the Chinese disaster of 1927, and also in carrying on a general discussion on the national and colonial question. For a more detailed analysis of this issue see, for instance, WARREN, 1982; particularly in chapter 4.

[6] As it is well known, ECLA's theories were mostly concerned with the industrialization of Latin America in the context of an uneven relationship of Latin America countries to the central



countries. ECLA's approach overlooked not only the endogenous elements in the local process of capital accumulation and in the development of capitalist social relations (cf. CARDOSO DE MELLO, 1982) but, more specifically, the development of an endogenous technological capability with the process of industrialization (cf. ERBER, 1983). For a review of ECLA's theories and their criticisms, see RODRIGUEZ, 1981).

[7] Actually, the rationale behind the 'socialist revolution' was given, basically, by the needs of the accumulation of capital, and not by the needs of the working class (which, by the way, was relatively small as compared to the peasants, and politically disorganized). In other words, a 'socialist revolution' was necessary in order to liberate the production forces through an internally oriented economic development. That was the predominant view of the so-called theoreticians of underdevelopment, such as A. Frank, R. Debray, F. Fanon, and others (see ROXBOUROUGH, 1979).

[8] "Throughout, the peripheral countries have been the tail which has been waged by the metropolitan capitalist dog: They develop underdevelopment, particularly undeveloped agriculture, while the metropolis develops industry." (FRANK, 1969, p. 244).

[9] For a good review on Furtado's theoretical work see, for instance, Guido Mantega's "A Economia Política Brasileira" (MANTEGA, 1984).

[10] The claim that industrialization in NICs started with a process of import substitution is to be taken only with a grain of salt. In Latin America, for instance, long before the beginning of that process in the late fifties, some countries (Argentine, Brazil, among others) had already started their processes of industrialization. The point is that the industrial sector was not a determinant for the economy as a whole. Those countries were still agrarian economies.

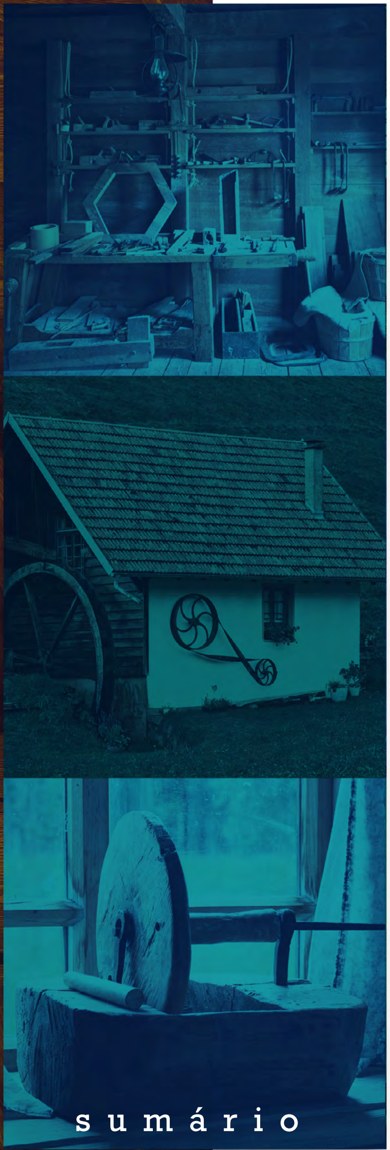
[11] Besides, there is nothing wrong with people in developing countries wanting to have the same living standards as in developed countries. The uneven income distribution is not a consequence of any technology adopted.

[12] Since 1976, for instance, attempts have been made to reach an agreement for an International Code of Conduct on the Transfer of Technology. The negotiations have been carried on within UNCTAD, but so far, no concrete result has come out. And it is unlikely to do so.

TECHNOLOGY AND DEVELOPMENT: IMPACTS AND CONFLICTS

[13] In this respect see, for instance, the interesting book edited by Maxime Berg "Technology and Toil in Nineteenth Century Britain" (BERG, 1979), which is a selection of documents of that time. Hobsbawm's "The Age of Revolution: Europe 1789-1848" (HOBSBAWM, 1961) gives also an impressive picture of the atmosphere.

[14] Theodore Roszak's "Where the Wasteland ends" (ROSZAK,1973) is undoubtedly an outstanding work in the counterculture movement. He also presents speculative proposals for the creation of self-sufficient communities, based on alternative technologies, friendship and cooperation. Despite its naivety, the counterculture movement and the proposals of alternative technologies for developed countries that arose from it played an important role



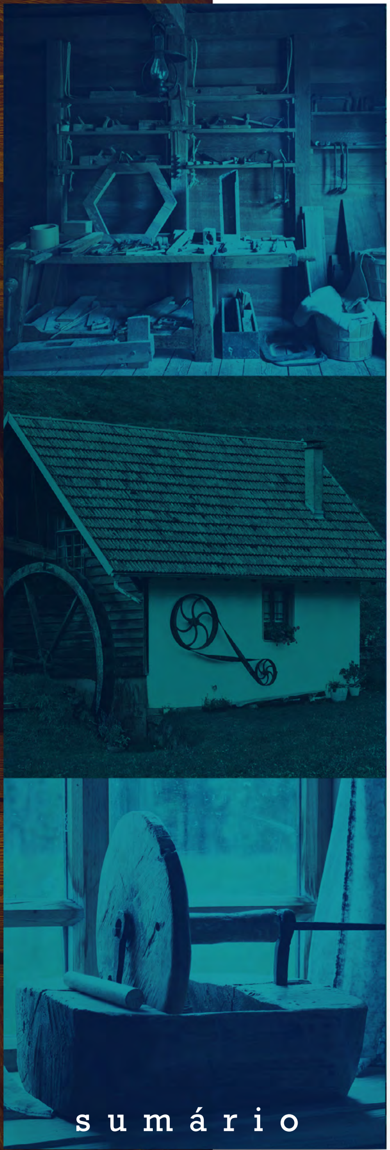
in the shaping of a whole generation, in which I include myself. The reasons for that were not due to its proposals but rather to the critical issues that it raised. As far as the movement itself is concerned, particularly to its proposal regarding appropriated technology, Winner's words could sound as a sympathetic epitaph: "its first purpose is not to produce energy from renewable resources but to generate hope from winds of despair." (WINNER, 1980, p.36). For a review of appropriated technology literature see, for instance, "Appropriated Technology and Social Values - A Critical Appraisal" (F.A. Long & A. Oleson ed., 1980). It is interesting to note that more recently a new line of critical approach to science and technology has been developed in this area, which has included into its analytical framework the historical connections between women's liberation issues, ecology and the repressive character of science and technology. The works of Brian Easlea, "Witch-hunting, Magic & the New Philosophy - an introduction to debates of the scientific revolution 1450-1750" (EASLEA, 1980) and C. Merchant, "The Death of Nature - women, ecology and the scientific revolution" (MERCHANT, 1980) are two good examples of this new approach.

[15] See, for example, Robert Owen, "A New View of Society" and "A Report to the Country of Lanark", ed. with an introduction by V. A. C. Gatrell (OWEN, 1970). Incidentally, Owen was the founder of the cooperation movement in England. According to Owen, isolation and competition were the main evils of his time; Therefore, in order to restore the ideals of brotherhood and citizenship he proposed the formation of self-contained communities, with property in common, and based on the principle of equal association. They did not work. An experience that the counterculture movements should have taken into account in the 1970s ...

[16] Gandhi's ideas were shaped during the period that he spent in South Africa (1893-1915), and they were published in local newspapers of the Indian community, such as "Indian Opinion" and "Young Indian". Gandhi's thought was deeply inspired by Hindu sacred books which were read by him during that time. He also read the Gospel, the Muslim sacred book and the works of Ruskin, Tolstoy and Thoreau, which quite impressed him. See, for instance, Bal R Nanda, "Mahatma Gandhi, a biography" (NANDA, 1958) or Nirmal K Bose, "Selections from Gandhi" (BOSE, 1957).

[17] It would be a mistake to regard Gandhi's approach as a sort of crude xenophobia. Gandhi himself was quite clear on this respect: "The broad definition of Swadeshi is the use of all home-made things to the exclusion of foreign things, in so far as such use is necessary for the protection of home- industry, more especially the industry without which India will become pauperized ...But even Swadeshi, like any other good thing, can be ridden to death. To reject foreign manufactures merely because they are foreign, and go on wasting national time and money in the promotion in one's country of manufactures for which it is not suited would be criminal folly, and a negation of the Swadeshi spirit ... Swadeshism is not a cult of hatred. It is a doctrine of selfless service, that has its roots in the purest ahimsa, i.e., love." (quoted in BHATT, 1980, pp. 172-173). In other words, what Gandhi had in mind was a policy to protect India's domestic industry from hard foreign competition. This is a well-known policy measure used by LDCs, for example, in their effort to foster import substitution programs.

[18] Actually, we have two distinct issues here. The first, related to the role of the State in a peripheral economy. As it is well known, in the so-called less developed countries - LDCs, the State has to play quite an important role to assure the necessary conditions for the development of a local process of capitalism; as far as the emergence of a process of industrialization is concerned, such support is absolutely crucial (see, for instance, ERBER, 1984; KATZ, 1980 LALL, 1982; and TEIXEIRA, 1985). This is a very important point and we will return to it in the following sections, particularly on the limits of the State in promoting



technological progress (this analysis is done in the last section of Chapter 2). The second, is a rather controversial issue, namely the social control of the State and of society's productive activities. The later requires a specific work to explore it in length.

[19] Gandhi's distrust of the State has at least two origins. One due to his actual experience as a second-rate citizen, under British rule. The other one has its roots in India's culture, in which each individual is seen as a unique manifestation of the Whole and as such must be respected. As for Gandhi, the State "while apparently doing good by minimizing exploitation, it does the greatest harm to mankind by destroying individuality which lies at the root of all progress ... The individual has a soul, but the State is a soulless machine ..." (quoted in BATH, 1980, p.173). That is why he could not have accepted Nehru's socialist path to development, which had its cornerstone in a strong State. On the other hand, he did not accept capitalism either. The answer, according to him, was: "... what is to be done? In trying to find out the solution of this riddle I have lighted on non-violence, non-cooperation and civil disobedience as the right and infallible means. The rich cannot accumulate wealth without the cooperation of the poor in society. If this knowledge were to penetrate into and spread amongst the poor, they would become strong and would learn how to free themselves by means of non-violence from the crushing inequalities which have brought them to the verge of starvation. All the capitalist will have an opportunity of becoming statutory trustees." (*ibid*., p.172). Such spontaneous movement of society had been criticized, in a quite different social context, years before Gandhi's 'solution'. In his "What is to Be Done?", written in 1902, Lenin points out: "But why, the reader will ask, does the spontaneous movement, the movement along the line of least resistance, lead to the domination of bourgeois ideology? For the simple reason that bourgeois ideology is far older in origin than socialist ideology, that it is more fully developed, and that it has at its disposal immeasurably more means of dissemination." (LENIN, 1978, p. 42).

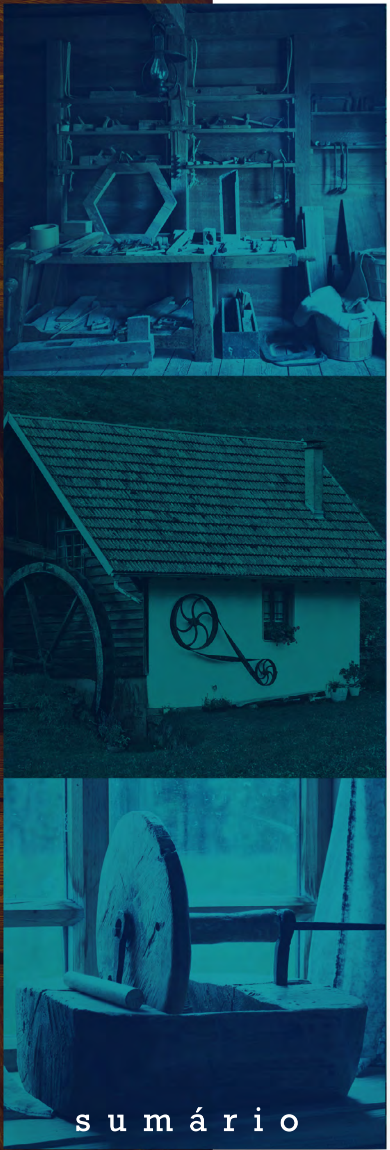
[20] For a discussion of the two alternative approaches to development in India - the "Sarvodaya" (Gandhi) and the alternative socialist (Nehru), see, for instance, V.V. Bhatt, "The Development Problem, Strategy and Technology Choice: Sarvodaya and Socialist Approaches in India", (BHATT, 1980) and Amilcar O. Herrera, "The Generation of Technologies in Rural Areas" (HERRERA, 1981).

[21] See, for instance, Susan George, "How the Other Half Dies - The Real Reasons for World Hunger" (GEORGE, 1978); Paul Harrison, "Inside the Third World" (HARRISON, 1979); and Peter Lloyd, "Slums of Hope? Shanty Towns of the Third World" (LLOYD 1979).

[22] Schumacher's concept of intermediate technology was first presented in a paper prepared in 1965 for the Conference on the Application of Science and Technology to the Development of Latin America - CASTAL, organized by UNESCO in Santiago, Chile (see SCHUMACHER, 1974). It is worthwhile mentioning that, twenty years later, the second conference of this kind, now including the Caribbean countries, had at the center of discussions the development and application of high-techs in the countries of the region (see CASTALAC II, Brasilia - Brazil, l985).

[23] For a survey of such proposals see: F A LONG & A OLESON, 1980; HERRERA, 1981; and R K DIWAN & D LIVINGSTON, 1979.

[24] In that respect, it is interesting to note the emergence of other concepts, also related to the process of capitalist development in the Third World - or, as some authors call it, the 'modernization process'. This is the case, for instance, of the concepts of 'informal sector' and 'small-scale production', which have been applied in the analyses of unemployment in the urban areas as well as in the analyses of agricultural production based on family labour. However, such concepts have also suffered from the lack of a sounder analytic



ground, remaining quite often on a naive and descriptive level (for a critical view of that kind of approach see, for instance, BIENEFELD, 1975; MOREIRA, 1981; GRAZIANO DA SILVA, 1981; and SCHMITZ, 1982).

THE EMPIRICAL EVIDENCE: LEARNING THROUGH PIECEMEAL TECHNICAL CHANGES

[25] The Newly Industrialized Countries considered here are: Mexico, Brazil, South Korea, Taiwan, Hong-Kong, and Singapore.

[26] In his "learning and the accumulation of industrial technological capacity in developing countries", M. Bell proposes six 'levels' of learning: Learning by operating; Learning by changing; System Performance Feedback; Learning by training; Learning by hiring; and, finally, learning by searching (BELL, 1982b). S. Lall suggests a simpler typology of learning: Learning by imitation and learning by design (LALL, 1982).

[27] See Palma, 1978.

[28] Obviously, the innovation process presupposes a process of capital accumulation and vice versa. The two processes are inseparable and fundamental parts of a more complex process. In Marx's words: "Nothing can emerge at the end of the process which did not appear as a presupposition and precondition at the beginning." (MARX, 1973, p. 304).

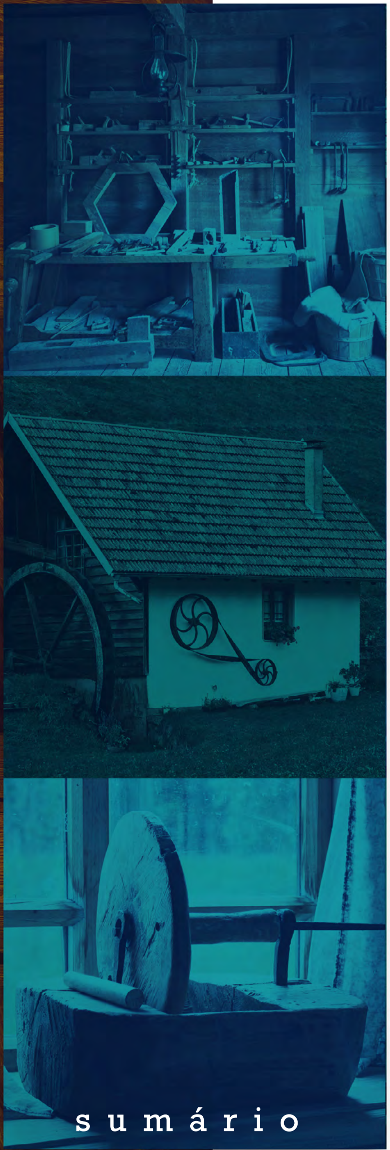
[29] See also the concept of 'technological regime' proposed by Nelson and Winter in their "In search of a useful theory of knowledge" (NELSON & WINTER, 1977).

[30] Another reason to argue against a passive notion of technical base is that the base itself is continuously transformed within the process of development of capitalism. In his chapter "On Machinery and Large-scale Industry", for instance, Marx made this point quite clearly.

[31] Clearly, it is also assumed that there is a whole range of government policies: from the support of basic scientific research to marketing mechanisms. The role of the State in the industrialization process of a NIC is absolutely fundamental to guarantee its very occurrence. (See, for instance, ERBER, 1977.)

2

TECHNOLOGICAL PROGRESS IN PERIPHERAL ECONOMIES: an interpretative model



"In making your exchanges with those countries you might give a commodity which cost two days' labour here for a commodity which cost one abroad, and this disadvantageous exchange would be the consequence of your own act for the commodity which you export, and which cost you two days' labour, would have cost only one if you had not rejected the use of machinery, the services of which your neighbours had more wisely appropriated to themselves." David Ricardo (1978), The Principles of Political Economy and Taxation.

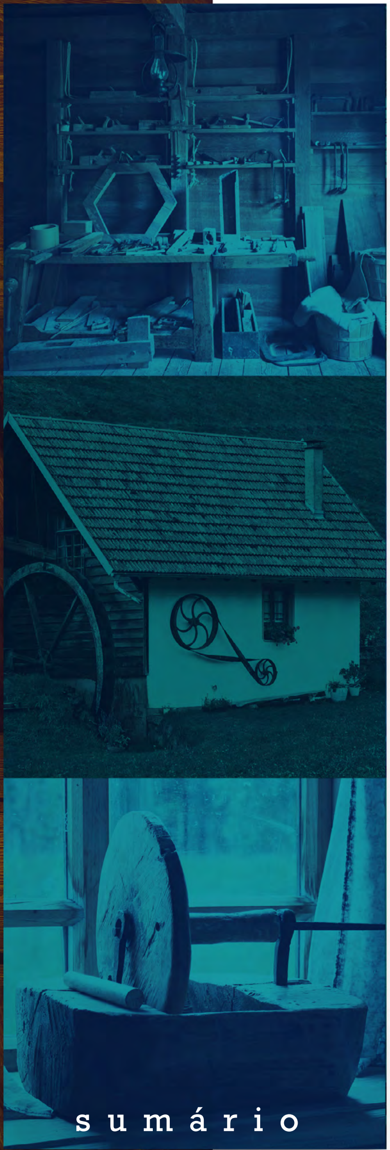
"Modern industry never views or treats the existing form of a production process as the definitive one. Its technical basis is therefore revolutionary, whereas all earlier modes of production were essentially conservative." Karl Marx (1976), The Capital - Volume 1.

"The path of technological change has never been exactly smooth, but the forces that regulate it have to be quite delicately balanced if the smooth continuation of the accumulation of capital is to be assured." David Harvey (1982), The Limits to Capital.

INTRODUCTION

This chapter has a twofold objective. The first is to identify the set of conditions which would allow the emergence of a process of technological progress in an LDC alongside a local process of industrialization. To achieve this objective, we are going to explore the application of the concept of innovation within the context of a peripheral economy.

As it was already suggested in the previous chapter, the development of a process of innovation presupposes the existence of a capability to generate technological and, increasingly more often, scientific knowledge. Such capability can be assessed with the help of the concept of technical base. This latter concept, as has been suggested, has to be developed further in order to be applied in a



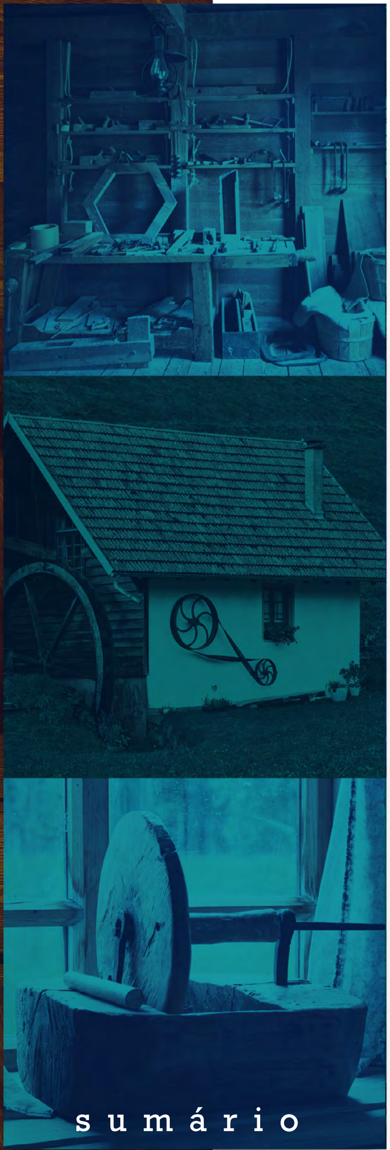
broader context concerned not only with the stock of knowledge but also with the capability to generate new knowledge.

The second and main objective of this chapter is to develop the thesis' analytical framework which will then be applied as a case study in Part Two. Here, the concepts of innovation are discussed and fully explored, together with the concept of technical base proposed in this thesis. A primary innovation, it is suggested, can be seen as a discontinuity in the existing technological paradigm (DOSI, 1982). Secondary innovations, following the proposed approach, correspond to changes of technological trajectories.

As long as the country's technical base is not sufficiently developed to cope with a primary innovation produced elsewhere, in the long run there will be a tendency for discontinuities in the economic and/or social structure. The occurrence of a sequence of discontinuities leads to a conflicting situation which is defined as a point of rupture.[32] Actually, this kind of discontinuity represents a whole series of socio-economic impacts brought about by a primary innovation that has been introduced in the local technical base.

The concept of a "selection environment", for instance, proposed by R. Nelson and S. Winter as a "useful theoretical organizer", can be seen as an attempt to access the influence of both the institutional and economic environment on a given flow of new innovations (NELSON & WINTER, 1977). However, this concept, as it was originally proposed, does not take into account the influence and/or impacts of a given innovation - either primary or secondary - on the "environment". This is precisely the kind of problem that a Newly Industrialized Country - NIC has to face quite often.

Furthermore, as discussed in detail later in this chapter, the kind of selection proposed in that concept is mostly built within a restricted economic framework which would not help much to explore the conditions for the emergence of an endogenous process



of technological progress in a NIC. In other words, if we are trying to understand the dynamics of that process, we should then also take into account its interaction with other processes from distinct spheres of society's activities.

In order to develop the analysis just suggested above, it is necessary to take into account the mutual influence of distinct, complex and yet related processes, belonging to the different spheres of social, economic and techno-scientific activities.

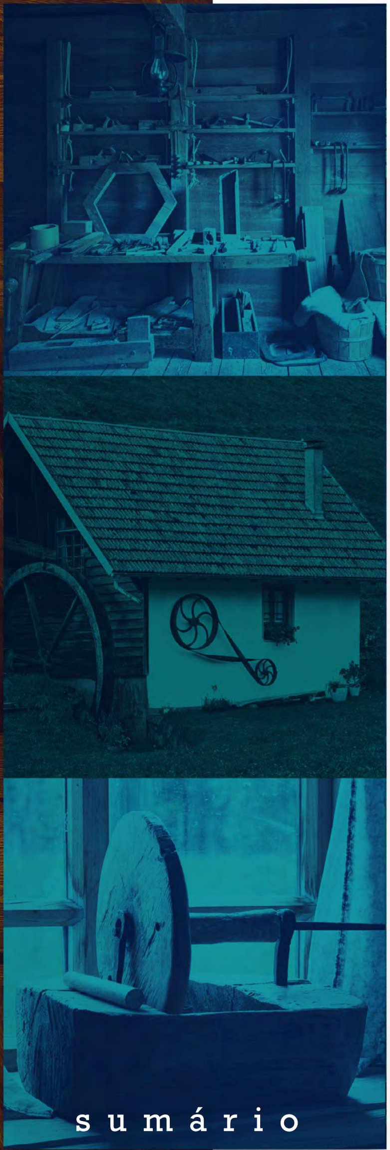
Moreover, to build a dynamic model to deal with these processes, it is crucial to identify the actual mechanisms through which they can influence one another. This is done, in Section 2.3, with the help of the model of determination proposed by Erik Wright (WRIGHT, 1978).

Section 2.2 introduces the concepts of discontinuity in technological paradigms (as proposed by Dosi) and discontinuity in the socio-economic structures. Both concepts are important for the model proposed in the next section.

Finally, Section 2.3 is devoted to the development of the thesis' analytical framework, as it was sketched above, and to build a interpretative model for technological progress in the context of a NIC. This last section also raises some problems of and limits to the application of the thesis' model in different socio-economic set-ups.

INNOVATIONS AND STRUCTURAL DISCONTINUITIES

In his classic study on innovation, "The Economics of Industrial Innovation", Freeman stresses the importance of Schumpeter's distinction between innovations and inventions, as being distinct



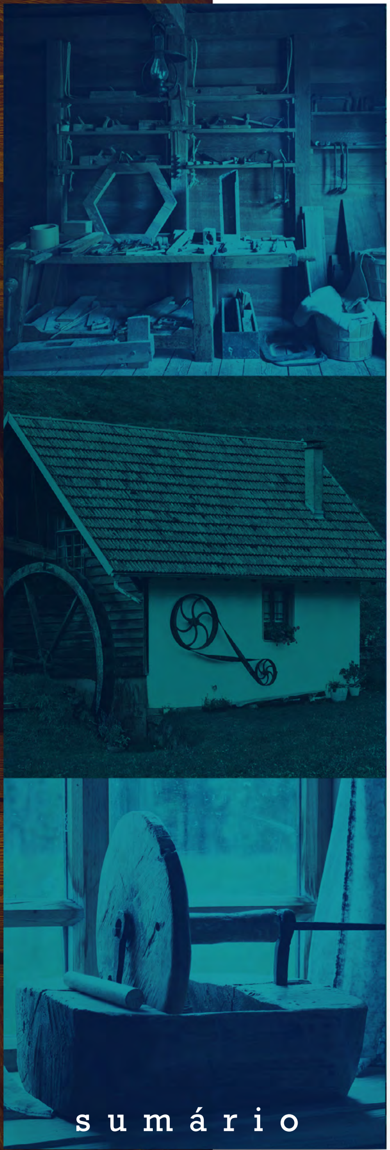
events and having different meanings for the economic activity (FREEMAN, 1977, p.20 and ff.). However, as Freeman points out, Schumpeter regarded the source of innovations as an exogenous variable to the economy, despite the fact that he had put them at the core of his analysis.

It seems that the reasons for this comes from the fact that in Schumpeter's view the generation of technical knowledge would be more properly analysed in the realm of social rather than economic processes. In his "Business Cycles", for instance, Schumpeter emphasized the distinction between invention and innovation[33]:

> "...the methods by which the one and the other work, belong to different spheres. The social process which produces inventions and the social process which produces innovations do not stand in any invariant relation to each other and such relation as they display is much more complex than appears at the first sight." (SCHUMPETER, 1939, p. 86 - emphasis added).

He might not have given too much attention to the sources of inventions, as Freeman has pointed out; yet he brought into the discussion a fundamental aspect of them, namely the social processes within which those inventions are generated. In other words, the production of new technological knowledge is not exclusively determined by economic factors. Only when an invention turns into an innovation it is "readily seen to be a distinct internal factor of change." (*ibid*)[34].

Such a remark points out to a key feature of the process of technological innovation: for this process to occur successfully presupposes the existence of a capability to generate technical knowledge that is in turn determined also by social factors. Although this is quite an obvious remark, it is surprising how many attempts have been made by economists from different schools of thought and ideology to design either theories or models of innovation primarily based on economic categories (SCHMOOKLER, 1966)[35].



From the point of view of the industrialized countries such approach is quite understandable, since in those countries the knowledge-creating activities of basic research, invention, research and development, together with the mechanisms of transfer and diffusion of the new knowledge into the productive system are already an integral part of the social and the economic structures. A new invention is, therefore, seen as a natural social event; another potential item for the already long list of patents.

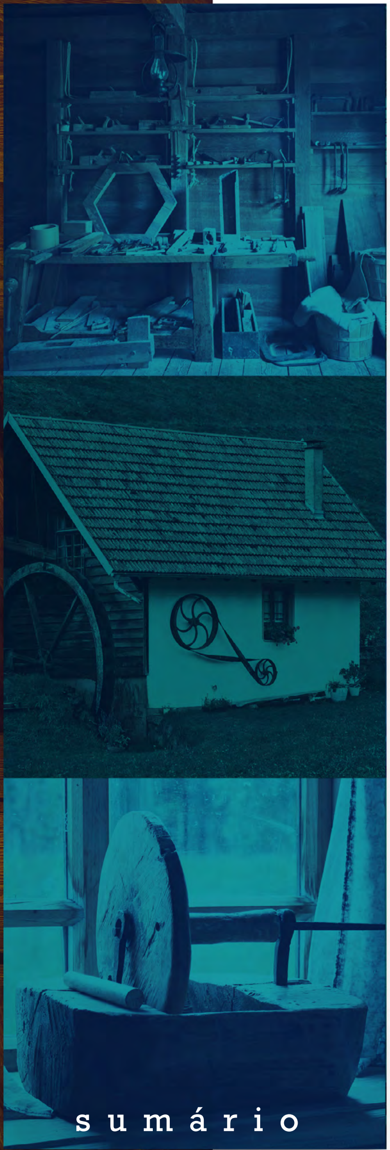
Actually, since the early times of the scientific revolution, the process of development of capitalism has had interactions with the process of development of science (even though the industrial revolution did not directly own its basic technological knowledge to science, as some authors have claimed (PRICE, 1965)).

Nevertheless, the latter provided the intellectual framework, the new rationale, which was quite well fitted to the emerging spirit of the times characterized, among other things, by competition for power and wealth, or the Faustian spirit of mastery (LANDES, 1978; MANTOUX, 1983).

To Schumpeter, since they were structurally and organically related, those processes had a much deeper connection. As he put forward in his "Capitalism, Socialism and Democracy":

> "Rising capitalism produced not only the mental attitude of modern science, the attitude that consists in asking certain questions and in going about answering them in a certain way, but also the men and the means." (SCHUMPETER, 1979; emphasis added).

The emerging capitalism was able to produce a new (and revolutionary) mental attitude related to its previous feudalistic social formation; the mature capitalism has also produced a (ideological) perception of its own process of development[36].



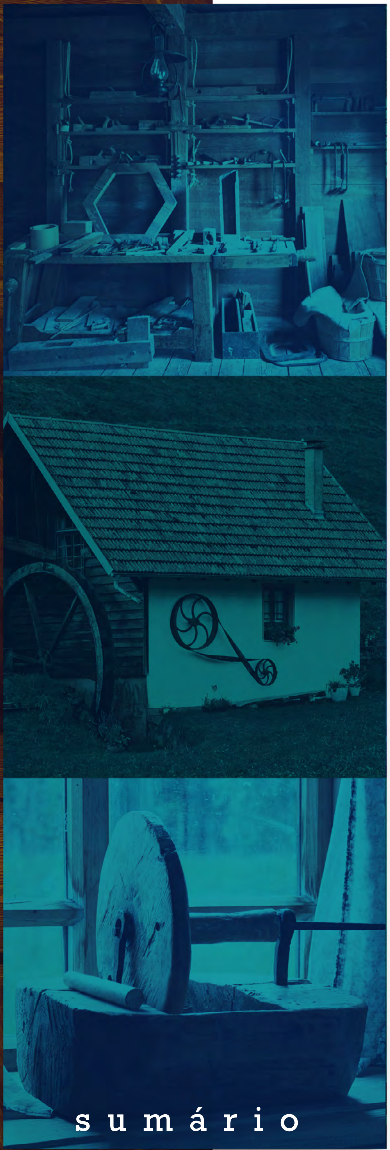
In that sense, it should be hardly surprising the view that claims that the technological progress shows no sharp break in continuity (JEWKES *et alli*, 1960) or that technical change is a result of adjustments in the production factors, being in the long run indifferent to whether they are capital-saving or labour-saving (BLAUG, 1960). Incidentally, in this way, the principle of neutrality of technical change, which is so dear to neo-classical economics, can be preserved.

The specialized literature on technological progress, which has increased significantly during the two last decades, is very rich in theoretical analyses, monographs and case studies, ranging from different economic sectors to industrial branches and countries - most of them belonging to the industrialized world. Roughly, this literature could be split into two groups. The first, concerned with the effects of technical change, either economic or social. The other one, with a more restricted subject, has focused its studies on the process of technical change as such. The latter is more empirical and presents a great variety of specific case studies. The former, has a more theoretical nature.

A number of good surveys of that literature has been produced, which have been discussed exhaustively and comprehensively in its different approaches (HAHN and MATTHEWS, 1964; KENNEDY and THIRLWALL, 1972; NELSON, 1959; NELSON and WINTER, 1977; ROSENBERG and MOWERY, 1979). Those surveys are very helpful not only to map out the discussions but also to highlight the main issues involved.

For the time being, however, there is a specific issue which will draw our attention in this section, namely the complex interplays between innovations and both the economic and social structures.

R. Nelson and S. Winter, for instance, in their paper “In search of an useful theory of innovation”, propose the concept of a ‘selection environment’ with which they point out to the need of a more elaborate

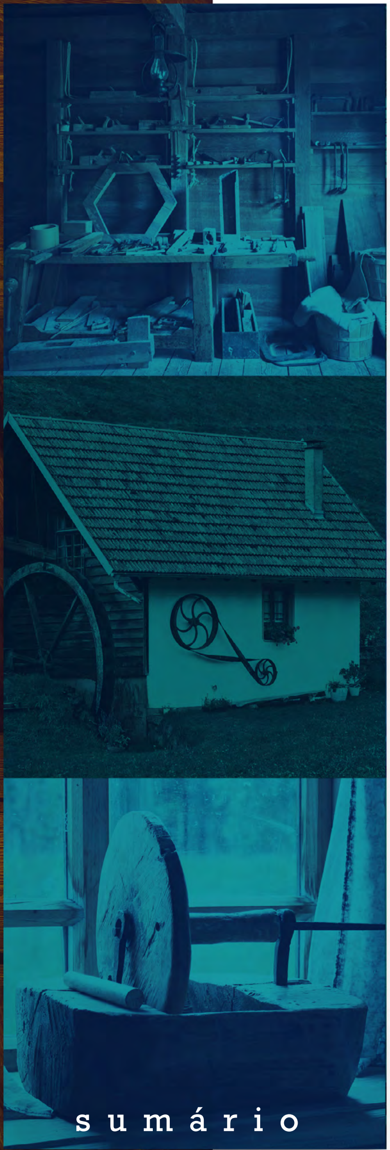


theoretical devices to explain the complex interactions of the process of innovation (NELSON & WINTER, 1977). The concept of selection suggested in that paper was designed to take into account the institutional and economic environment influence on the path of productivity growth generated by any given innovation, and also to indicate the environment determination to the very direction of R & D activities.

Actually, one of the requirements for a useful theory of innovation, according to Nelson and Winter, is precisely that its formulation should be "capable of encompassing considerable institutional complexity and variety." (*ibid*., p. 70). Another important characteristic of innovations, still according to these authors, is that such activities involve "considerable uncertainty both before it is ready for introduction to the economy, and even after it is introduced, and thus we view the innovation process as involving a continuing disequilibrium." (*ibid*., p. 48).

In this respect, the Rosenberg and Mowery's study, an important critical survey of the so-called "demand-pull" theories of innovation, also points out the need to take into account others factors and stimuli which are more important than market demand to the innovation process. Particularly, they claim that a theory of innovation should be able to compare of the performance of industries and nations; It should also focus on the interfirm relationships, against a more precise historical background.

Undoubtedly, the recognition of the stochastic evolutionary nature of innovation (Nelson & Winter), and the effort to identify the wide range of complex processes that are related with the activities of technological innovation, stressing in particular the variety of interplays with their socio-economic environment (Nelson & Winter, Rosenberg & Mowery), represent an important contribution to the construction of a theory of innovation. However, to make that contribution more effective it is necessary to take a step further to identify some of the mechanisms through which such interplays can actually take place.



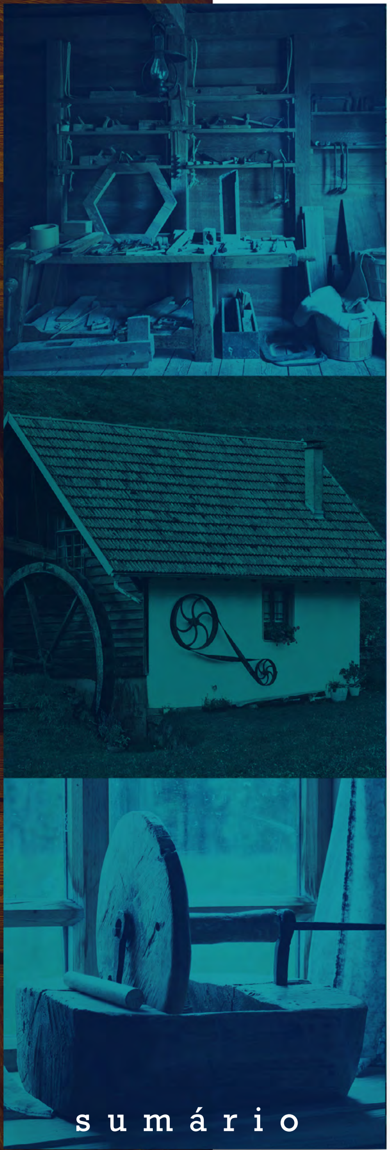
The concept of primary innovation developed by José Tavares de Araújo Junior, in his study on the glass industry (ARAÚJO JR., 1982), is a useful operational concept to clarify distinct types of innovation and to help in the assessment of their likely impact on the social and economic structures. According to him, Schumpeter's notion of creative destruction imposes a new criterion for the type of innovations, different from the one which Araújo calls "the Ricardian paradigm"[37]. Basically, there are two kinds of innovations: primary and secondary, defined by him as follows:

> "Primary innovations are those that lead to a rupture of the basic principles of the present technical base, giving way to the process of creative destruction. Secondary innovations are those designed to increase the efficiency of the productive routes in use, introducing only marginal changes in their main lines." (ARAÚJO JR., 1982, p. 5)[38]

The second type of innovation accounts for the so-called incremental technical progress on the existing products or processes. As for the first, it requires a better understanding of the concept of technical base in order to fully grasp its importance, particularly within the context of this thesis.

Usually, technical base is regarded as a stock of knowledge upon which techniques of production are based. Salter, for instance, suggested that, at any time, there is a fund of knowledge, ranging from basic scientific principles to the craftsman's rules of thumb, which provides all necessary technical information for production (SALTER, 1969). To José Tavares, a technical base represents not only the stock of accumulated knowledge but also a knowledge that has been built on by the main principles of the organization of the labour process necessary to the production of commodities.

At first sight the concepts of technical base, as sketched above, resemble the concept of technological paradigm (more particularly in relation to Araújo's). However, such similarity vanishes when we have



to deal with the process of technological progress in a broader socio-economic perspective. Actually, those concepts of technical base were designed to describe, within the microeconomic level, the technical capacity of an industrial branch rather than the technological capability of a country, whether developed or not.

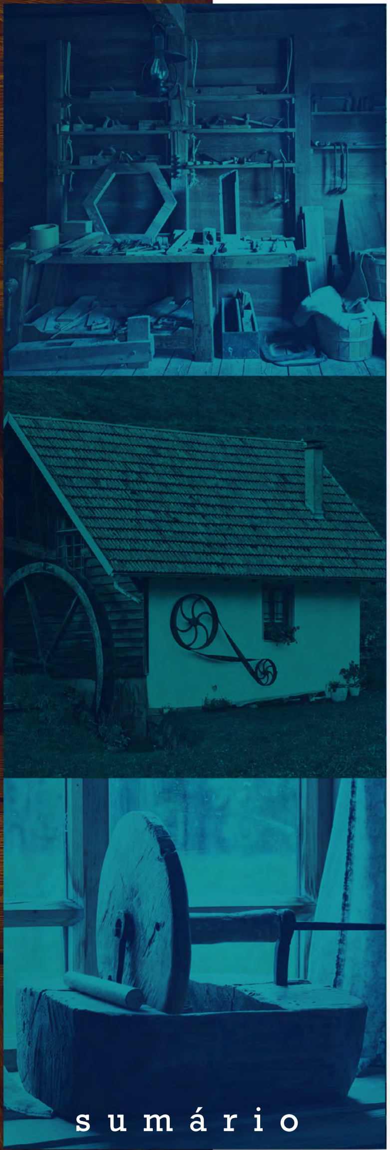
Such a distinction is crucial when we are dealing with a Newly Industrialized Country - NIC, in which the social processes of knowledge generation cannot be taken for granted. The importance of a broader definition of technical base, especially for the design of scientific & technological policies for developing countries, was recognized, for instance, by Fabio Celso Guimarães in a recent paper. In that paper, he introduces the concept of "national technical basis", which

> "...should not be confused with the intensity and broadness of the activities capable of generating technological innovations, but rather it should be related to all things that could be determinant for the national technological capability. This is fundamental in order to analyse technology policies and, above all, to define their object." (GUIMARÃES, 1984, p. 3)

Accordingly, that approach is justified by the fact that in the NICs the "conditions for the introduction of technical progress are not endogenously determined" (PEREIRA, 1976; quoted in GUIMARÃES, *op. cit*.). Such conditions, it is suggested, are shaped by the insertion of the country in the international economy.

However, a country's insertion in the international economy is not by itself a reason to justify the kind of technological dependency suggested above. Under certain circumstances, it would account for only part of the problem.

The central question still remains untouched, namely the very possibility of (and the need for) an endogenous process of technological innovations in order to make viable a self-sustained process of capitalist development. Unless it were assumed that



capitalism as such could not flourish in those countries (i.e. the NICs). If this is the case, the reasons for that should then be put forward by the authors that share such a point of view.

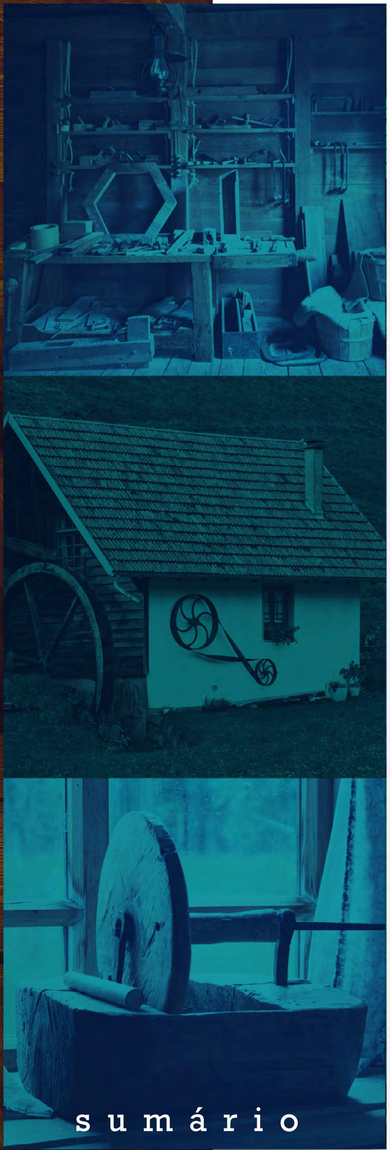
What is at stake here is the possibility of development of the very process of capitalism in countries other than the industrialized ones. This brings back to our discussion the two central questions that we put forward at the beginning of this chapter: firstly, is it possible to have a process of capitalist development without its corresponding process of technological progress?[39] secondly, what are the conditions under which, in peripheral economies, the two processes can be present and allow a transition into a Newly Industrialized Country?

Throughout Chapter 1, we surveyed different approaches to the first question, particularly those related with the issue of development in peripheral economies. In this section, we have focused on the role of technological innovations in capitalist development and the connections with their social and economic structures.

The distinction between primary and secondary innovation, as developed by José Tavares (ARAÚJO JR., 1982) was also introduced in this section, and the importance of the primary innovations within the context of our discussion was stressed.

The reasons are that those innovations not only introduce discontinuities into the current technical base, but also induce, in the long run, discontinuities into the social and economic structures. It has been suggested that in order to deal with these processes it would be necessary to use an expanded concept of technical base.

Until the end of this chapter we are going to elaborate on such expanded concept and identify some of the conditions for transition, i.e., the macro socio-economic conditions under which a NIC could have a self-sustained process of capitalist development.



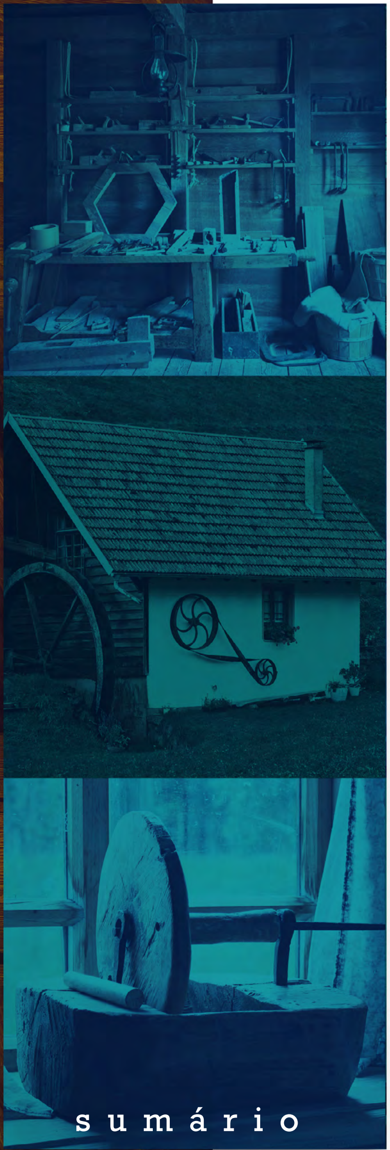
TECHNOLOGICAL PROGRESS: ACCUMULATION AND DISCONTINUITY

In this section we explore the thesis' central concern, namely the process of innovation in a peripheral capitalist economy. To be more precise, our main concern here is with the general conditions for innovation in a Newly Industrialized Country or, as it has also been called, a latecomer industrialization (HIRSCHAMN, 1968; CARDOSO DE MELLO, 1982). The relevance of the issue for this thesis is due to the fact that it is intimately related with technological progress which, as it was discussed in the last section, can be seen as an essential feature of the development of capitalism.

This section will take into account two aspects of the process of innovation. The first is concerned with the basic elements of innovation and the general conditions for technological progress in a developed capitalist economy[40]. The second aspect is related to the discussion of the major constraints, for that process, in the context of a peripheral economy.

Economic (neoclassical) theory has traditionally defined technical progress in terms of a shift in the production function for each commodity, and/or in terms of the increasing number of new commodities (SALTER, 1969). More recently, a number of authors have placed a great deal of emphasis on the importance of the incremental character of that progress, in which the cumulative effect of minor technical changes is of major significance (HOLLANDER, 1965).

Schumpeter accepts the mainstream definition of innovation as being determined in economic terms, as a shift in the production function (SCHUMPETER, 1939). However, for Schumpeter innovation and invention were not activities that could be explained or whose effects could be confined to the economic sphere. Moreover,



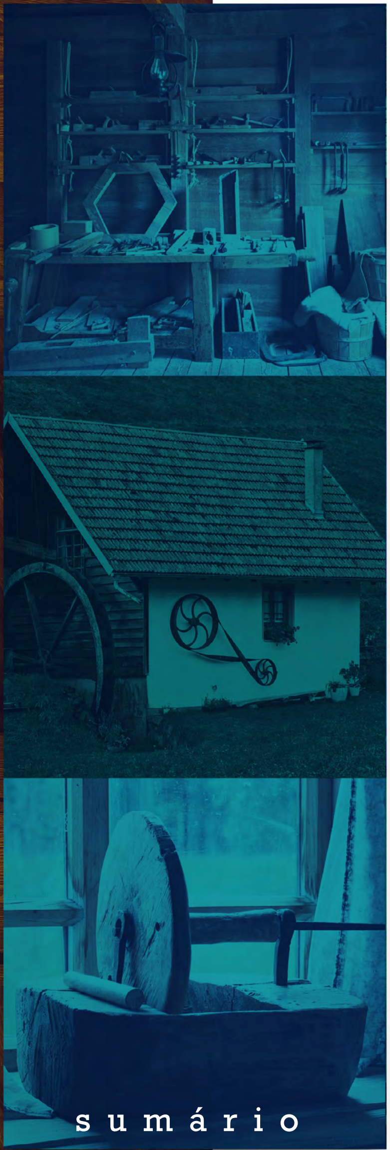
in his conception of Economic Evolution, to which innovation is absolutely essential, technological progress is not seen as “naturally” smooth, but rather as a cyclical process which produces instability in the economic world.

For Marx as well, technology as such is meaningless, it has to be related to the specific mode of production of which it is an indissoluble part. Seen from that perspective, all progress in civilization alongside the development of capitalism results in an increase in the powers of the social production. (MARX, 1973, p. 308). And that social production, according to Marx, incorporating the results of science, inventions, division and combination of labour, improved means of communication, machinery, etc. only increases the objective power standing over labour: in other words, the productive power of capital. The development of capital tends to subsume the entire production process as the technological application of science, in which direct labour appears as a mere moment[41].

The development of the powers of social production, as Marx called it, presupposes therefore the progress of technology or the application of science to production (MARX, 1973, p. 705). It is the increasing power of knowledge, objectified as fixed capital, that indicates the level of development of the general social knowledge as a direct force of production. In Marx’s own words, it indicates:

> “To what degree the powers of social production have been produced, not only in the form of knowledge, but also as immediate organs of social practice, of the real-life process.” (MARX, 1973, p. 706 - emphasis added)

The second point is perhaps more controversial. It concerns the role of science in the development of the productive forces or, more precisely, the place of science in relation to economic structure. In other words, what is at stake here is whether science belongs to the productive forces (and is therefore part of the technical base) or whether



it is part of the superstructure (ideological).[43] One possible origin for such controversy is Marx's assertions on the relationship of science and capital, put forward in "Capital". There, Marx suggests a somewhat utilitarian view of science with respect to capital, as for instance in one passage of the famous Unedited Chapter, 'Results of the Immediate Process of Production', in which he concludes by saying that:

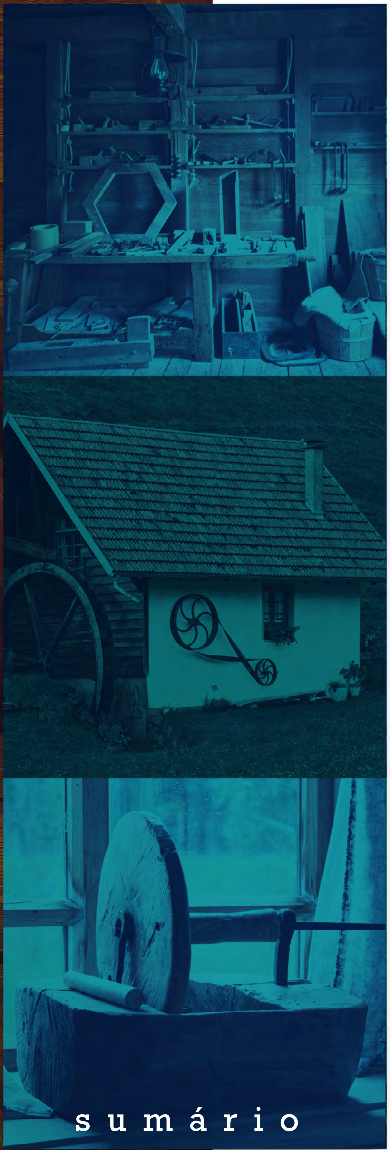
> "This entire development of the productive forces of socialized labour (in contrast to the more or less isolated labour of individuals), and together with it the use of science (the general product of social development), in the immediate process of production, takes the form of the productive power of capital." (MARX, 1976, p. 1024 - emphasis in the original)

Contrasting with that approach, which is predominant in the "Capital"[44], Marx suggests, in "Grundrisse", a deeper interplay between science, production and the development of capital:

> "As with the transformation of value into capital, so does it appear in the further development of capital, that it presupposes a certain given historical development of the productive forces on one side - science too [is] among these forces - and, on the other, drives and forces them further onwards." (MARX, 1977, p. 699 - emphasis added)[45].

What is important to bear in mind from that debate, is that the development of capital, within the development of large scale industry, depends increasingly on the general state of science and the progress of technology more than on the direct labour time spent on production (MARX, 1977; see also note 34 above). This remark is a upon which the central theoretical concern of this thesis is focused - the process of innovation in a peripheral capitalist economy.

In order to propose the concept of technological progress, suggested at the beginning of this section, it is first necessary to define technical base in a way that is consistent with the theoretical framework sketched above.

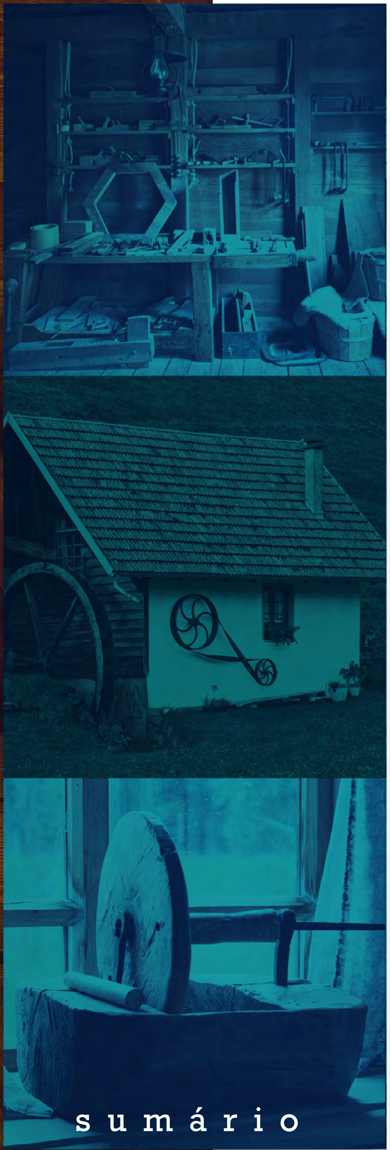


The definition of technical base, as we have already stressed, should not simply indicate a technological capacity, i.e., the accumulated knowledge, possessed either by an institution (private or public) or by an individual. Rather, it has to refer to a more comprehensive pool of actual or potential capabilities. Therefore, it should include a wide range of processes and social agents. To some extent, our definition is based on Marx's concept of the 'powers of the social production'. Roughly, it can be seen as an attempt to make that concept more operational for the purpose of the thesis.

In general terms, a technical base can be defined as the social capability to generate and/or to develop new knowledge - either scientific or technological. A technical base is said to be consistent with a given technology if it can cope with the technological problems defined by the corresponding technological paradigm. In other words, it would be consistent if it could provide a solid ground for the development of, at least, more than one of the possible technological trajectories within its paradigm.

Thus, in our scheme, technological progress can be defined as an increase in the capabilities, scientific and/or technological, of the technical base either to generate or to develop new innovations for the production system. A technological progress is said to be continuous if it develops along a given set of technological trajectories, following the pattern of 'normal' problem solving activities on the grounds of a technological paradigm (DOSI, 1982, p. 152). A secondary innovation could be seen as a change of trajectories within the same paradigm.

Eventually the scientific and/or technological development of the technical base brings about a radically new technology, a primary innovation, with a distinct "model" and a "pattern" of solution of an equally distinct set of technological problems, which will conform a new technological paradigm (DOSI, 1982). This event defines a point of discontinuity in the general process of development of the technical

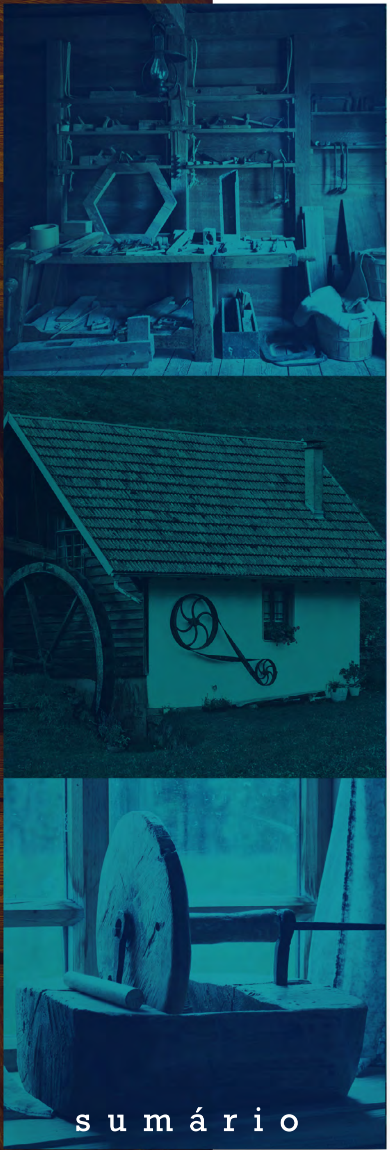


base. It should be noted here that a primary innovation can be developed in a given country's technical base and be somehow introduced in another country's production system.[46] In this case we basically have two possible scenarios. In the first, the technical base of the recipient country could eventually catch-up with the new technological level; it already has the potential to do the job and its ability to do this depends on the nature of the political and economic decisions taken in the course of formulating the country's industrial policy[47].

In the second scenario, the recipient country is in a weaker position as its technical base cannot even provide the potential to catch-up with the foreign technology. The result of this situation can be a combination of an increasing dependence on the import of inputs, capital goods and raw material to allow the foreign technology to be operated; and simultaneous with this the existing firms which make up the local technical base may begin to disappear[48].

The present discussion on technological progress would be incomplete were it to ignore the social and economic determinants of that process. When such a process is an integral part of the development of capitalism, as argued here, the understanding of the key mechanisms through which the interplay between technical base, the economic structure and the social structure takes place, is of crucial importance[49].

As it stands now, the wide range of interrelations suggested above as being the determinants of both the level and the direction of technological progress require an adequate balance between the different levels of complexity involved. In other words, since our concepts of technical base and technological progress are associated with both the highly theoretical Marxian categories and the empirically based variables, the problem remains of how to make the logic of the theory itself more explicit in our empirical investigation[50].

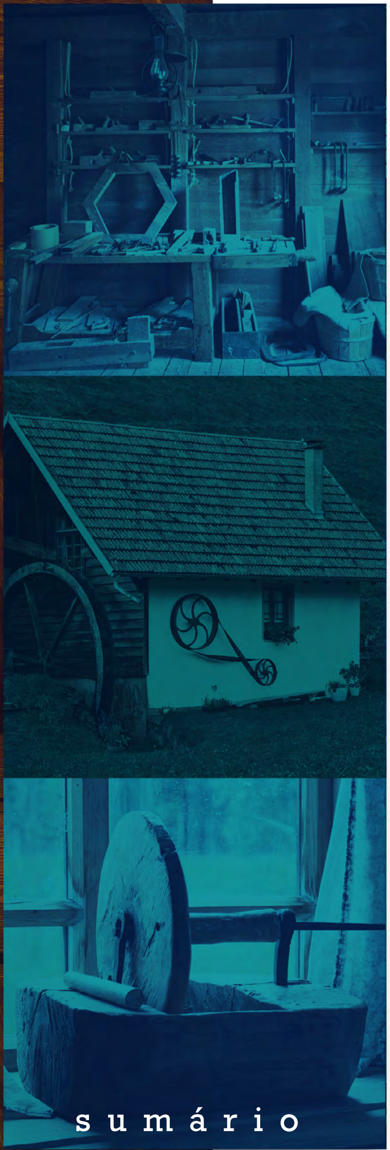


However, for the purposes of this thesis such theoretical discussions would lead far beyond the objectives of this chapter. What is needed here is a kind of heuristic device which can be used to guide empirical research and, above all, help to understand its results. The concepts of "models of determination" proposed by Erik Wright, which were designed to deal with the "causal relations between the structural categories of Marxist theory", seems to be more suitable for this purpose (WRIGHT, 1978)[51].

Very briefly, the models of determination can be defined as schematic representations of the complex interconnections of the various modes of determination involved in a given structural process (WRIGHT, 1978, p. 15); a "mode of determination" represents a distinct relationship of determination among the structural Marxist categories and between those categories and the empirical variables (*ibid*).

What follows then is a provisional attempt to elaborate a model, that can be termed as 'model of determination of technological progress', in which the interrelations already mentioned between technical basis, social structure and economic structure could be explicitly described. This model, based on Wright's proposal, contains five principal elements: social structure, economic structure, class struggle, technical basis, and the technological progress. These elements are then connected through different kinds of causal relations or, as Wright has called them, modes of determination. For the immediate purposes of the suggested model, only four modes of determination, out of the six defined by Wright (WRIGHT, 1978; see also WRIGHT, 1981)[52], are particularly important:

Structural limitation, in which one structure or element systematically sets limits of possible variation on another structure or element. Within those limits, there is a variety of possible outcomes, but the limits themselves are determinate.



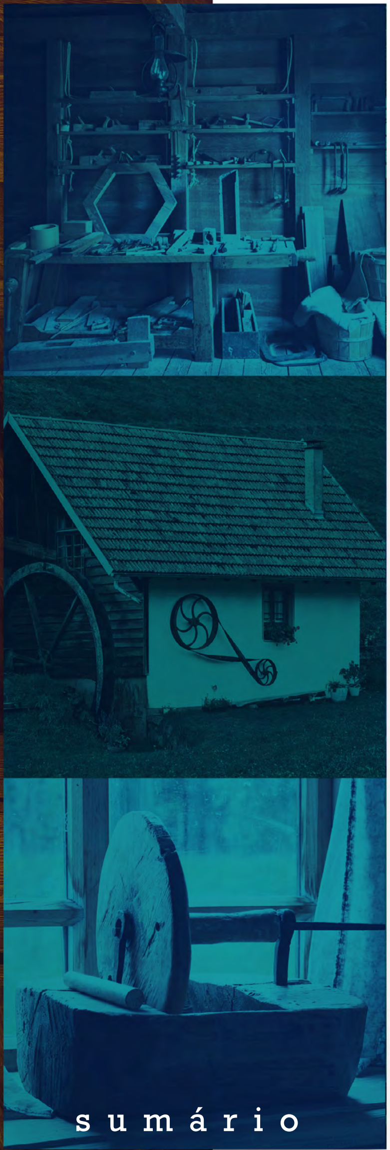
Selection, of specific outcomes from a range of structurally limited possibilities. In a sense, this is a mode of determination which establishes limits within limits. Depending upon the specific process being investigated, there could be several nested layers of such selection process.

Reproduction, is a more complex kind of limiting process. to say that one structure functions to reproduce another implies that the reproducing structure prevents the reproduced structure from changing in certain fundamental ways.

Transformation is the mode of determination by which class struggle (practices) directly affect the processes of structural limitation and selection. Transformation represents the dialectical character of patterns of determination[53].

An example that illustrates the structural limitation is given by the 'plantation economic system', which prevailed during the first couple of centuries of the colonial economy in Brazil. Given the nature of the socioeconomic relationships - between masters and slaves and landlords and peasants, defined within a complex economic system dominated by the exported-oriented latifundia - the flourishing of industrialized urban areas, even of small-scale, family-based industries, was structurally impossible within that economic system. The emergence of a representative democracy with universal suffrage as a form of political organization, was also structurally impossible.

Selection is a mode of determination which comprises those social mechanisms that concretely determine ranges of outcomes, or even specific results. However, this kind of second order limitation occurs only within a structurally limited range of possibilities. The selection mechanisms also embody strong restrictions on the specific outcomes among those that are possible. In this way, a selection can either be 'negative', in the sense that its mechanisms

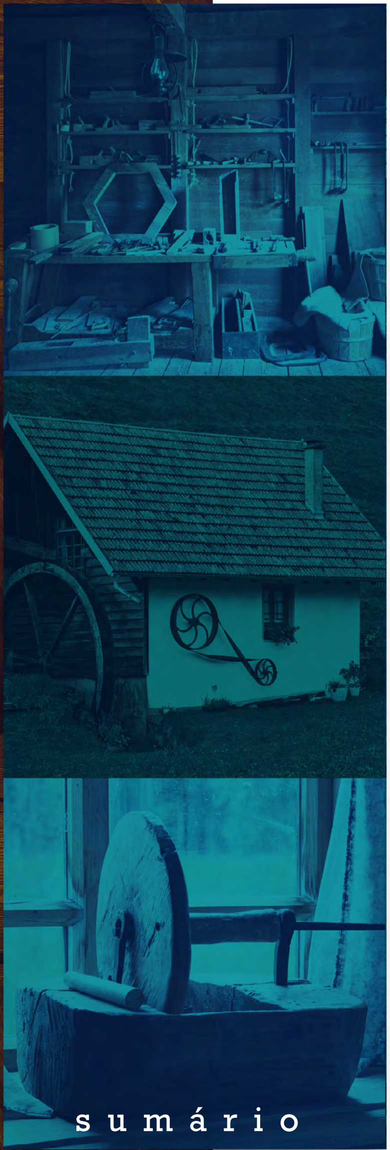


exclude certain possibilities, or ‘positive’, when involving those which determine a specific outcome. A good example can be drawn from Dosi’s concept of technological paradigm (DOSI, 1982), which is defined as a pattern of solutions comprising a set of selections of: (I) technological problems, (II) principles from natural science, and (III) material technologies. He also proposes that a technological paradigm defines a “positive heuristic” and a “negative heuristic”, in the sense that it prescribes the directions to be pursued or to be neglected by technological change (*ibid*., p. 152). However, according to his model such selection mechanisms are exclusively based on the internal determinants of the paradigm; in other words, it is a selection from technical (or sometimes scientific) constraints.

Economic variables are indeed considered in Dosi’s model, being regarded as economic criteria, a kind of selector, to define more precisely “the actual path followed inside a much bigger set of possible ones.” (*ibid*., p. 153). Such selectors can operate at each level, “from research to production-related technological efforts” (*ibid*., p. 155). Yet, the relationships between a given paradigm and its economic and social environment, although acknowledged in the model, are not theoretically related, since the categories used in the model do not require technological progress as a logical necessity.

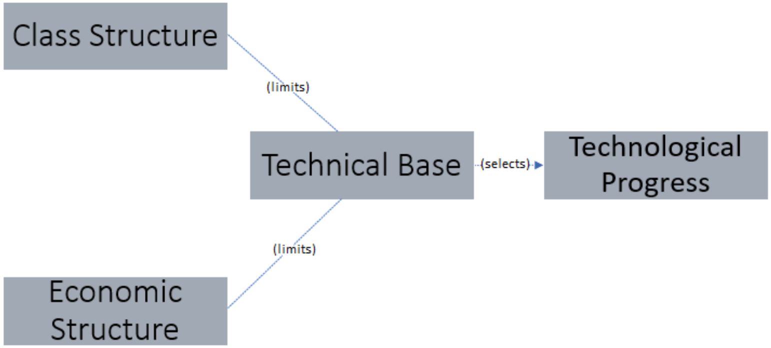
As we have already discussed in the previous section, the concept of ‘selection environment’ proposed by R. Nelson and S. Winter suffers from that same problem. More particularly, the reasons for the existence of ‘natural trajectories’, a concept also proposed by those authors (NELSON & WINTER, 1877), for certain technologies but not for others will remain an open question until the very mechanisms through which the society actually selects the direction of technological progress had been theoretically identified.

The model that has been proposed here, based on Wright’s concept of modes of determination, can be seen as an attempt to



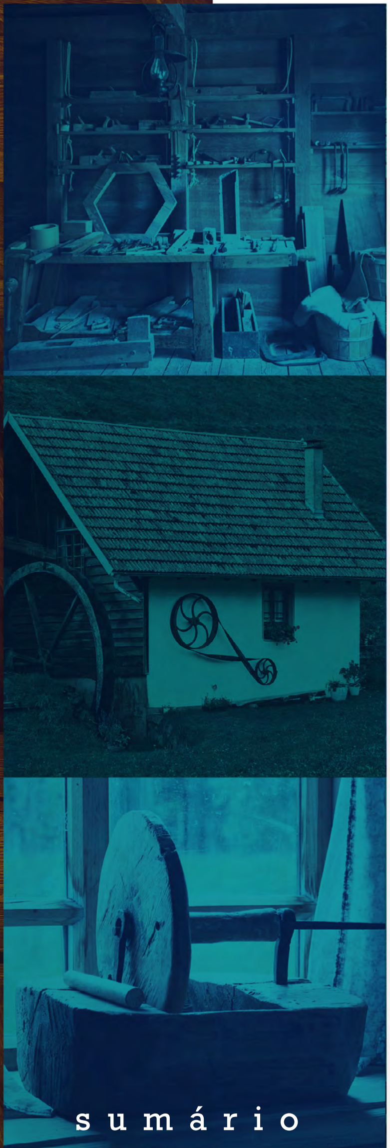
overcome that gap. In this model, the direction of technological progress is selected by the general level of development of the technical base (as defined above). The technical base, in turn, is structurally determined by the social and economic structures. These patterns of determination are illustrated by the diagram below, which represents a simplified version of the model.

Figure 2.1 - The model of determination of technological progress - I. (simplified version).



Note that the model above is compatible with Dosi's; the important difference is that it makes explicit those "fundamental economic factors" which select the emergence of new technologies (DOSI, 1982, p. 157). The selection of either a technological trajectory (technical progress as defined by Dosi) or the direction of mutation (i.e. of a new paradigm) is made through the technical base and within the already given structural limits.

As represented by figure 2.1, above, the model does not encompass the broader and more complex range of determinations among those elements. For instance, there is no embodied mechanism for restructuring the elements in the model. In order to make the model more operative and to give it an internal dynamic, a new mode of



determination has been introduced, namely the notion of transformation. According to Wright, this mode of determination represents a process through which the practices of individuals and classes act to transform elements within a social process (WRIGHT, 1981, p. 53).

In Wright's model, the only source of transformation is the class struggle; it transforms a wide range of elements in the social process, including the process itself. Through the class struggles, for instance, the level of real wages, the technical conditions of production and the very class structure are changed (MARGLIN, 1974). When the profits are low, the capitalist class will bring about such a transformation by selecting a new technological trajectory (secondary innovation) or by pushing R & D activities towards a new technological paradigm (primary innovation)- the technical conditions of production, i.e., the technical base. This kind of transformation accounts for the Ricardian paradigm, i.e., the basic contradiction between capital and labour.

There is, however, another capitalist drive towards technological change, namely the need to constantly revolutionize the instruments of production and constantly destroy and create new structures. This essential feature of capitalism, in which innovation plays a central role, has also to be taken into account by the model. The source of this transformation, as regards the Schumpeterian paradigm, is the process of technological progress itself. Clearly, there is a strong interplay between these two modes of determination, which are to a great extent complementary.

Figure 2.2, on the next page, presents a more elaborated and expanded version of the proposed model. This version is built in the matrix form, which allows a better representation of all possible mutual influences and determinations of the structural categories considered in the model.

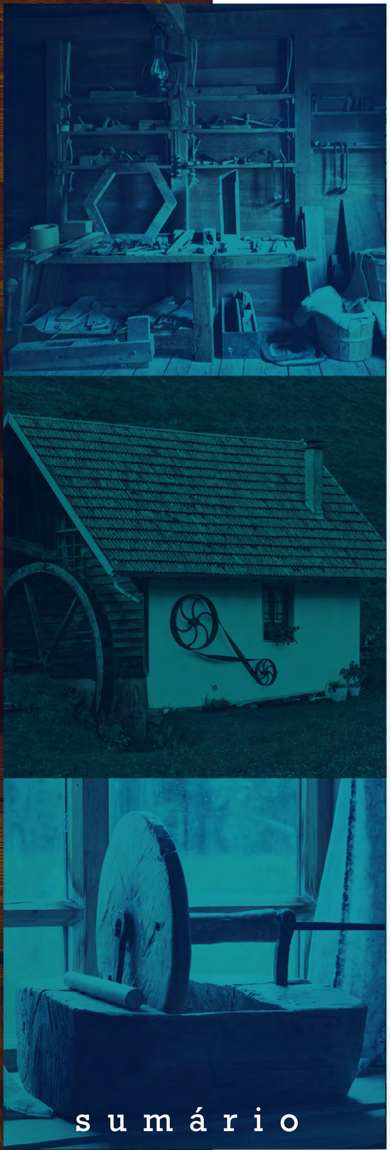


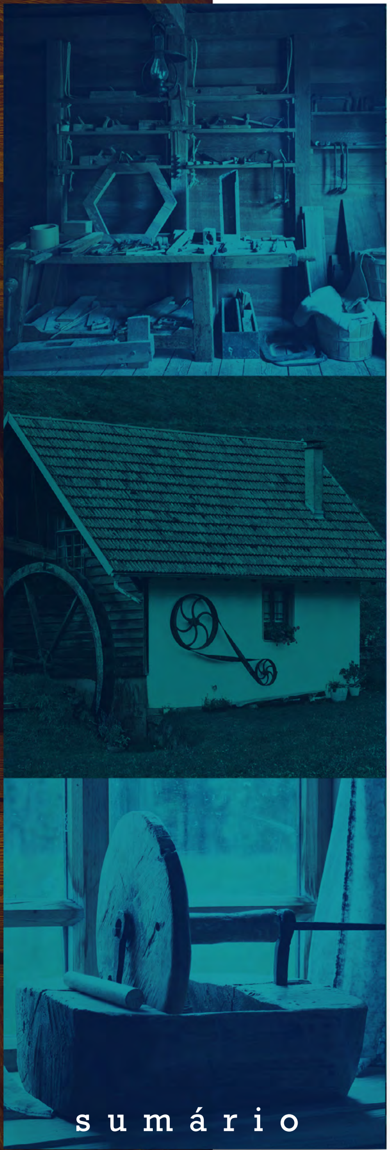
Figure 2.2 - Model of determination of technological progress - II.

	Class Structure	Economic Structure	Technical Base	Technological Progress	Class Struggle
Class Structure	REPRODUCES	REPRODUCES	LIMITS	SELECTS	LIMITS
Economic Structure	REPRODUCES	REPRODUCES	LIMITS	SELECTS	LIMITS
Technical Base	LIMITS	LIMITS	LIMITS	SELECTS	SELECTS
Technological Progress	TRANSFORMS	TRANSFORMS	TRANSFORMS	TRANSFORMS	TRANSFORMS
Class Struggle	TRANSFORMS	TRANSFORMS	TRANSFORMS	TRANSFORMS	TRANSFORMS

Undoubtedly, the model proposed here is at a very preliminary stage of development. Some critical elements are totally absent from the model. The role of the State, for instance, which is extremely important in the process of industrialization of NICs, has not been covered by the model. Another equally critical element is the relationship between the NICs and the developed countries, particularly concerning the technology import issue. It should also be noted that a number of connections between the elements of the model have not been specified (particularly those referring to the other modes of determination - see note 52).

At this point, it is especially important to stress again that the proposed model is, at its current stage of development, a simple heuristic device to guide the research analysis. In this sense, the diagrams which have been drawn from it, despite their highly mechanical appearance that suggest a non-historical approach are chiefly designed, as Wright points out, to explicitly lay out the logic of relations to be explored in a particular historical investigation.

However, due to the simplistic character of the model proposed here, it cannot be directly applied to any case. Regarding the thesis's case study, for instance, some adjustment has to be made in order to achieve the necessary correspondence with its concrete social and economic conditions.



More specifically, during the first Orleans' and Blumenau's historical periods, the actual effects of class struggle, on both their economic and class structures - and by extension on their technical base, have to be seen with a pinch of salt.

On the other hand, as will be described in subsequent chapters, the differences between the evolution of the social, economic and technical structures of Orleans and Blumenau clearly show that the model may be successfully used to evaluated the possibilities of endogenous technological development.

NOTES TO CHAPTER 2

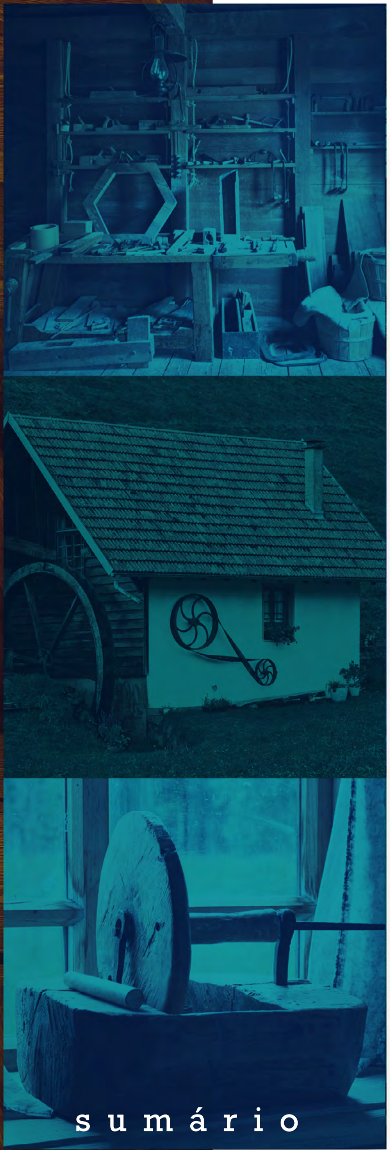
INTRODUCTION

[32] Note that no value judgment is made here; it is only argued that changes can occur and that they can be irreversible. It is also important to bear in mind that there is no claim regarding the exclusiveness of the causes of such changes. Discontinuities can be brought about by factors other than non-technical changes. Finally, the time lag between those discontinuities will depend on the specificities of the industrial branch in question. All these points are discussed at length in Section 2.3.

INNOVATIONS AND STRUCTURAL DISCONTINUITIES

[33] When he draws the distinction between invention and innovation, Schumpeter makes a sharp statement about their nature: "even where innovation consists in giving effect, by business action, to a particular invention which has either emerged autonomously or has been made specially with a view to a given business purpose and in response to a given business situation, the making of an invention and the carrying out of the corresponding innovation are, economically and socially, two entirely different things." (Schumpeter, 1939, p. 85, emphasis added)

[34] In respect to the sources of innovations, Freeman complains that at the time that Schumpeter wrote there was already an organized R & D system. Therefore, he should not have ignored it (FREEMAN, 1974, p. 22). This claim, I am afraid, does not do justice to Schumpeter's knowledge of that issue. In his comments on the future of capitalism, for instance, he made a somewhat nostalgic remark on the diminishing importance of entrepreneurs in getting



innovations made: "it is much easier now than it has been in the past to do things that lie outside familiar routine - innovation itself is being reduced to routine. Technological progress is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable ways." (SCHUMPETER, 1979, p. 132). From a different point of view, Marx made a similar remark in his "Grundrisse": " the development of machinery along this path [that is, arising directly out of science] occurs only when large industry has already reached a higher stage, and all the sciences have been pressed into service of capital; and when, secondly, the available machinery itself already provides great capabilities. Invention then becomes a business, and the application of science to direct production itself becomes a prospect which determines and solicits it." (MARX, 1977, p. 704).

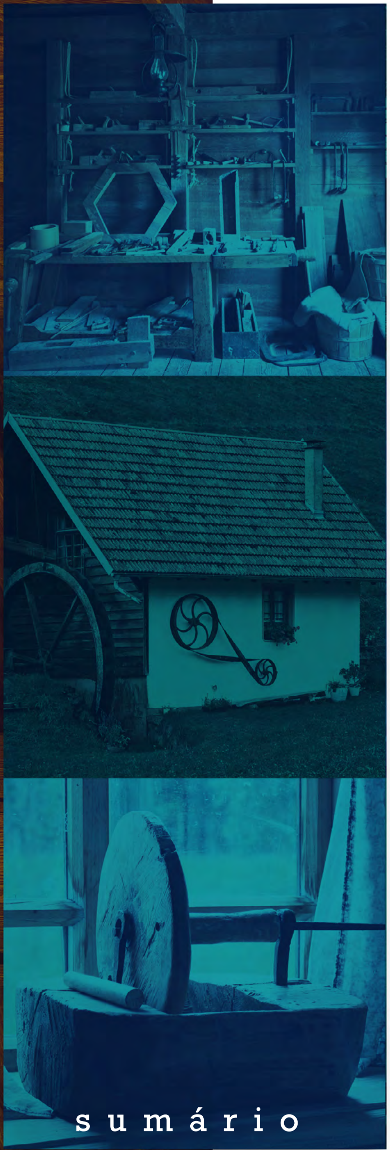
[35] Apart from works which could be labelled as 'classical', specially those of Ricardo, Marx and Schumpeter, a distinct approach can be found in Gilfillan's "The Sociology of Invention" (GILFILLAN, 1935); or, in a more recent analysis of American capitalism, in Noble's "America by Design" (NOBLE, 1977).

[36] "The so-called historical presentation of development is founded, as a rule, on the fact that the latest form regards the previous ones as steps leading up to itself, and, since it is only rarely and only under quite specific conditions able to criticize itself - leaving aside, of course, the historical periods which appear to themselves as times of decadence - it always conceives them one-sidedly." (MARX, 1977, p. 106).

[37] In Araújo's definition, Ricardian's innovations are those customarily classified according with their effect on inputs efficiency: labour-saving, capital-saving and neutral.

[38] This definition has a twofold objective. Firstly, to combine the current analyses on innovations and the Marxist tradition on this matter, to which technical change is the outcome of contradiction between labour and capital. This is the best-known approach within the Marxist tradition, and it is in line with the Ricardian paradigm. There is, however, a second approach in Marx's works which has been discussed in Marxist thought in the last decade only, specially in the literature on the labour process (see for instance, BRAVERMAN, 1974). According to this second approach, technical progress is the essential mechanism through which capitalism transforms itself, making possible its development (ARAÚJO JR., 1982; ROSENBERG, 1976a). Among Marx's work see, specially, his "Grundrisse" (MARX, 1977), and his originally planned Part Seven of Volume 1 of Capital, the "Results of the Immediate Process of Production" (MARX, 1976). Chapter 15, "Machinery and Large-Scale Industry", of the same volume, also gives us Marx's view on the key role of technical progress for the development of capitalism. Secondly, to account for the Schumpeterian notion of creative destruction which is achieved with the help of the concept of competition. For José Tavares, the binomial technical base/competition represents one of the cornerstones of his theoretical model, with which he analyses the evolution of the glass industry. Accordingly, when a new innovation (primary or secondary) is brought into the production process, it causes an unbalance in the technical base which, in turn, induces new forms of competition in the long run. And this process goes on. On the basis of this model, he proposes that the Kondratieff Cycles should be understood as technological cycles rather than economical (ARAÚJO JR., 1982; see specially the Chapter 3).

[39] According to Schumpeter, technological progress is at the heart of capitalist development; It is "what capitalism consists in and what every capitalist concern has got to live in." (SCHUMPETER, 1979, p. 83). See also note 38 above.



TECHNOLOGICAL PROGRESS: ACCUMULATION AND DISCONTINUITY

[40] The approach to be followed here is in line with Marx's remark that the study of capital should be the starting-point as well as the finishing-point, and must be dealt with before any other mode of production. In his own words: "Bourgeois society is the most developed and the most complex historical organization of production. The categories which express its relations, the comprehension of its structure, thereby also allow insights into the structure and the relations of production of all the vanished social formations out of whose ruins and elements it built itself up." (MARX, 1973, p. 105)

[41] It is interesting to note that Marx's use of the term 'technology' or "technological application of science" refers rather to the application of the "science of mechanics" than anything else. In "Capital", for instance, he defines the "modern science of technology" as resulting from the fact that "technology discovered the few grand fundamental forms of motion" etc. (MARX, 1976, p. 616 ff.)

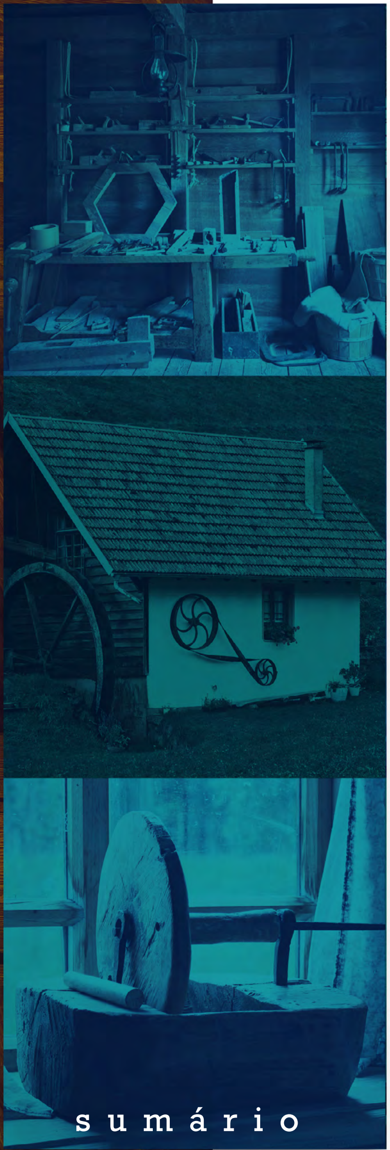
[42] The second view has been mainly discussed in the literature on the labour process. See also Section 1.5 above.

[43] For a critical review of Marx's notion of history, particularly on historical materialism, which that debate refers to, see G. A. Cohen "Karl Marx's Theory of History - A Defence" (COHEN, 1979) and Melvin Rader "Marx's Interpretation of History" (RADER, 1979).

[44] One possible explanation for those distinct views on science in relation to capital might be due to the fact that Marx is referring to different historical moments. When he claims in "Capital", for instance, that "science, generally speaking, costs the capitalist nothing, a fact that by no means prevents him from exploiting it" (MARX, 1976 p. 508 ft.) and in the "Grundrisse" says that science is too a productive force and that "invention then becomes a business, and the application of science to direct production itself becomes a prospect which determines and solicits it" , he was dealing with two distinct moments of the development of capital. In the first, discussed in "Capital", he is concerned with the earlier stages of capitalism and with the transition towards large-scale industry, while in the "Grundrisse" Marx focuses his discussion on science referring mainly to its trends alongside the development of capitalism. There is one passage in "Capital" which is very clear in that respect: "If we assume capitalist production, then, with all other circumstances remaining the same, and the length of the working day a given factor, the quantity of surplus labour will vary according to the natural conditions within which labour is carried on, in particular the fertility of the soil. But it by no means follows, inversely, that the most fertile soil is the most fitted for the growth of the capitalist mode of production. The latter presupposes the domination of man over nature." (MARX, 1976, p. 648 ff - emphasis added). In other words, it presupposes a certain level of development of man's instruments and modes of labour as well as the knowledge (science) of how to bring a natural force under control of society.

[45] Note that here Marx is not referring to science in general but, more specially, to natural science whose development is in turn related to the development of material production (MARX, 1973, p. 705).

[46] We could even develop this model further and think in terms of an international technical basis, representing the frontier of the scientific and technological development. But this would lead us beyond the scope of the thesis.



[47] The work of Francisco Teixeira on the development of the Brazilian petrochemical industry (TEIXEIRA, 1985) and Paulo Tigre's study on the Brazilian computer industry (TIGRE, 1982) are two good examples to illustrate that point.

[48] The literature on technical change as well as on economic anthropology is very rich in case studies on the negative impacts of foreign technology upon a village or a country (see, for instance: EPSTEIN, 1962; SALISBURY, 1962; STEWART, 1978; etc.). A good insight on this issue can be found in the Manfred Bienelfeld study on Tanzania "The Informal Sector and Peripheral Capitalism: The case of Tanzania" : " The tentative framework of this paper assumes that many small scale operators are engaged in a process of production and of technological development but their ability to develop cumulatively over extended periods is limited: by their being exploited through the terms of trade; by their dependence on large scale industry for inputs (often illegally obtained); and by the fact that when the markets they serve grow beyond a certain size this will not be a gradual but accelerating stimulus to further development of the forces of production. Instead it will trigger a discontinuous shift to 'international' technology which will incorporate this market by virtue of its efficiency and/ or its market power" (BIENELFELD, 1975, p. 56).

[49] Tavares, for instance, defines technological progress in industrial capitalism as the outcome of the interactions between the technical base and the forms of competition. Clearly, this definition accounts only for the economic aspects of such determination (TAVARES, 1982).

[50] This question is not an entirely new one; in a distinct context and also with a distinct formulation, it has been the object of consideration by the so-called structuralists Marxists. The Althusserian concepts of over-determination and structural causality, for instance, can be seen as an effort, although restricted to the theoretical sphere, to tackle that question. The concept of overdetermination, proposed by Althusser, was designed to account for the following question: with what concept are we to think the determination of either an element or a structure by a structure? (ALTHUSSER & BALIBAR, 1977, p. 188). This question is related to his concern with the formulation of a concept of structural causality.

[51] Wright's basic question, which has led him to elaborate the models of determination, can be defined as an enquire into the implications that the new forms of contradiction have been posed by the advanced monopoly capitalism to the relationship between the State and the process of class formation (WRIGHT, 1978).

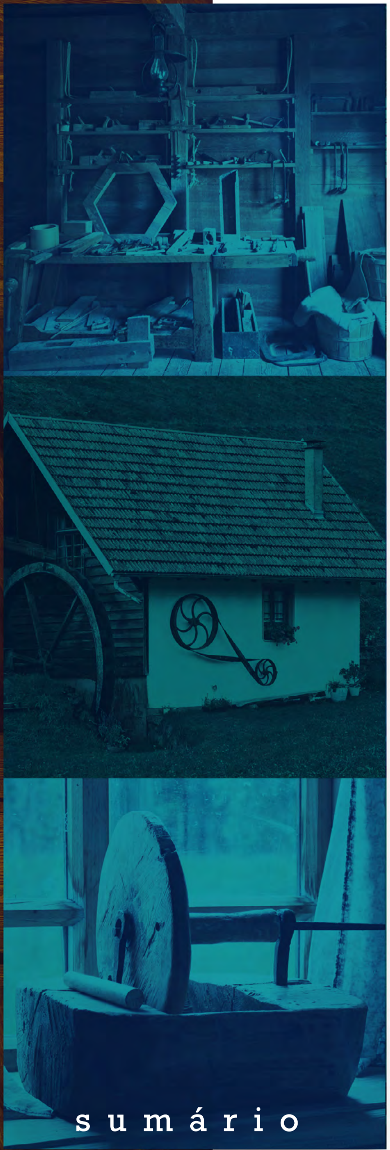
[52] According to Wright, there are at least six modes of determination within the global concept of structural causality: structural limitation, selection, reproduction/non-reproduction, limits of functional compatibility, transformation and mediation (WRIGHT, 1978).

[53] The concept of class struggle used by Wright follows Poulantzas's theory of structural determination of class. Accordingly, there are three basic premises for the analysis of class struggle: I) classes cannot be defined outside of class struggle, II) classes designate objective positions in the social division of labour, and III) classes also are structurally determined not only at the economic level, but at the political and ideological level.

Part TWO

3

THE CASE STUDY: the cassava agro-industry in Brazil



"Lá na casa de farinha / Jogam de qualquer maneira / Às vezes até misturam / Mandioca com macaxeira / Ali tudo perde a casca / Na faca da raspadeira."

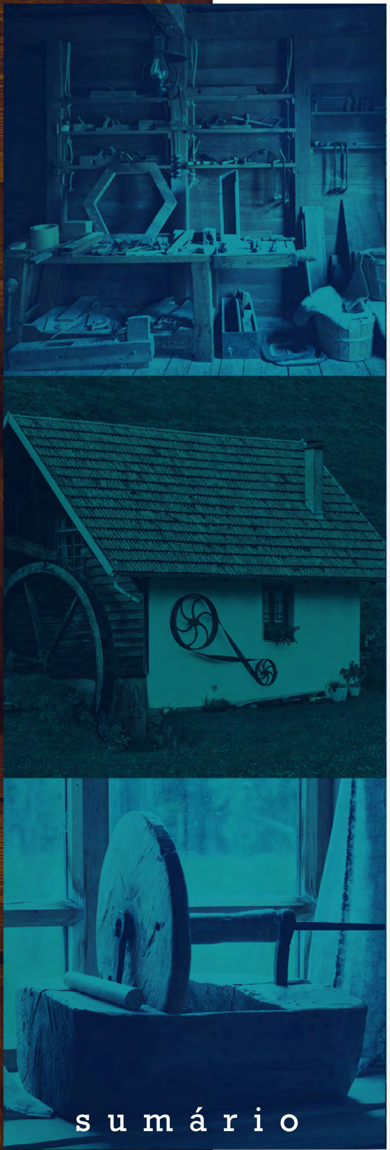
"There in the flour house / They throw anyway / Sometimes they even mix / Cassava with macaxeira / There everything loses its husk / In the scraper knife." (Enéias Tavares dos Santos, a Brazilian bard)

INTRODUCTION

The case study on the history of the cassava agro-industry in Brazil, which is developed in Part Two of this thesis, seeks to explore the main theoretical issues that were raised in the first part and to assess the potentialities of the model that was sketched in Section 2.3. The history of the Brazilian cassava agro-industry and particularly of the cassava starch industry, illustrates quite well how a process of interaction between a given technical basis and the corresponding stages of capital accumulation can affect the very development of that basis.

Actually, the cassava starch industry illustrates the history of a broader process of industrialization that has taken place in the Southern region of Brazil since the last quarter of Nineteenth Century. The collected data cover a period of over one hundred years, from 1850 to 1980, and focus on two areas in the State of Santa Catarina: Orleans and the Itajaí Valley.

The objective of this chapter is to introduce the main characteristics of the cassava agro-industry in Brazil and the distinct pattern of development that it has taken in those Southern areas. A brief overview of the history of this industry is presented, especially the part concerning its beginning in Santa Catarina. Finally, a

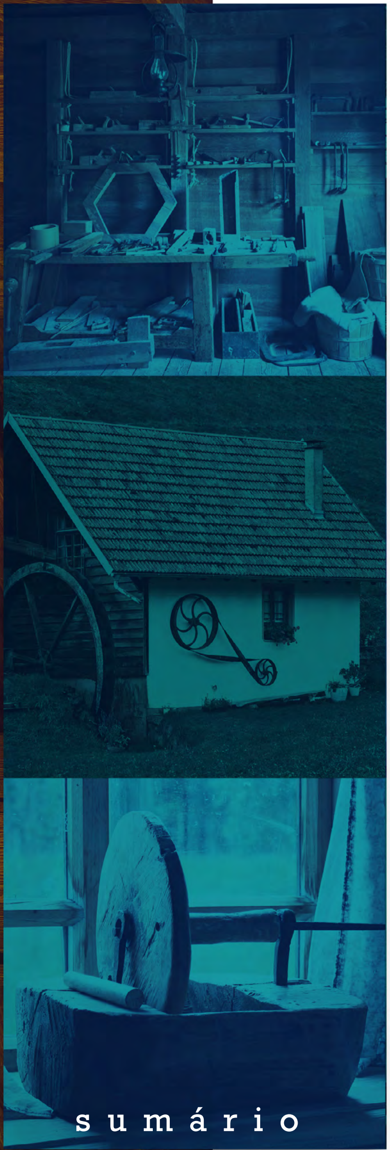


summary description of the case studies settings is given in the last section of this chapter.

WHY THE CASSAVA AGRO-INDUSTRY?

Originally, the research project was designed to analyse the potential technological demands that had been brought about by the Brazilian Alcohol Program - *PNA* (launched in November 1975) on the cassava agro-industry in Brazil. The basic question then was to study the effective capacity of response of the existing technical basis to such demands. The idea behind this proposal was that such a study could be an excellent opportunity to explore some obstacles and constraints to the technological development of a traditional industry in the context of a peripheral economy.

Very briefly, the situation was as follows: on the one hand, the economic and technological changes to the existing cassava agro-industry required by the Alcohol Program were so deep that they would represent the development of a new technological paradigm. On the other hand, there was an industry whose basic raw material was mostly produced on the basis of small plantation units, which, according to the 1970 Brazilian Census, had an average cultivated area of 10 hectares[54] and spread all over the country. These were generally organized on a family basis (or even sometimes on a communal basis), and were often not officially registered. Briefly, the traditional Brazilian cassava agro-industry had hardly changed from its historical level, characterized by a subsistence production. Considering that the minimal initial investment for an alcohol distillery, with a nominal production capacity of 120,000 liters/day, using sugarcane as raw material (which is Brazil's oldest agro-industry as well as a well-established capital-goods industry), would be around

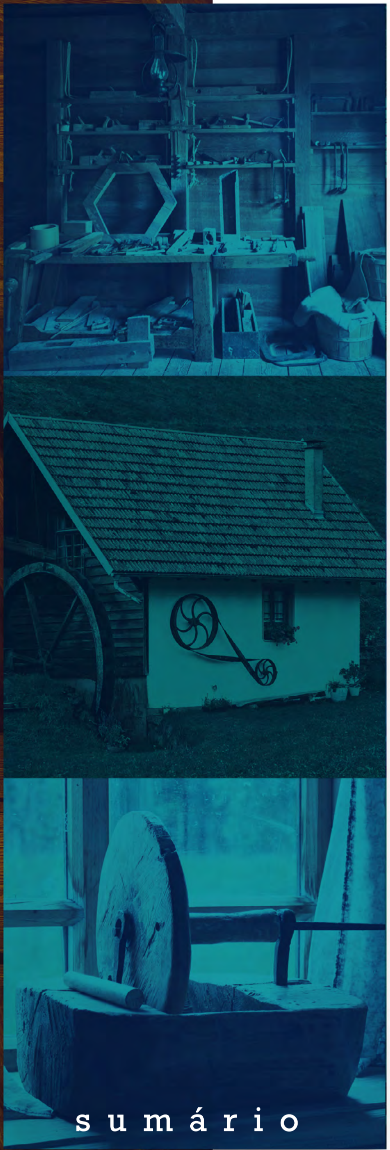


US$1.2 million (June/1978 figures)[55]. It is possible to have a rough idea of the scale of the changes which were required by that program.

Therefore, the Alcohol Program had imposed a tremendous challenge to that traditional industry as well as to its related social and economic structures. Everything considered and contrary to government expectations at that time[56], the prospect should not be very optimistic - to say the least. The most likely outcome of such an impact would be a chain-reaction leading to a discontinuity in the endogenous process of economic evolution or, as it was defined in Chapter 2, a point of rupture.

To carry out this research, two areas in the State of Santa Catarina, situated in the Southern region of Brazil, were chosen (see Map I on page 106). The selection of these two areas - the municipality of Orleans and the Southern coastland of that State - was basically determined by the existence of large historical files on the process of settlements in the first area, Orleans, which was started in 1880 with the migration of Italian and German families to that area (*CNRC*, 1979). The second area, according with the *PNA* official documents (*BRASIL. MIC/STI*, 1979), would be the site for the setting up of two alcohol distilleries using cassava as raw material, towards the end of 1980.

However, when the field-work started in November 1980, the two planned distilleries had not yet been set up in that area. Even after the one-year field work had been completed, those distilleries had still not been approved by the local financing agent (the State Bank for Development). This was not an isolated fact. On the contrary, due to reasons that will be discussed in Chapter 6, the use of cassava as raw material for alcohol production has not been widely implemented, as the original program foresaw. Up to this moment, the share of cassava alcohol production is relatively insignificant (in 1980, the alcohol distilleries based on sugar-cane represented 95.5% of the total projects approved by the *PNA*;

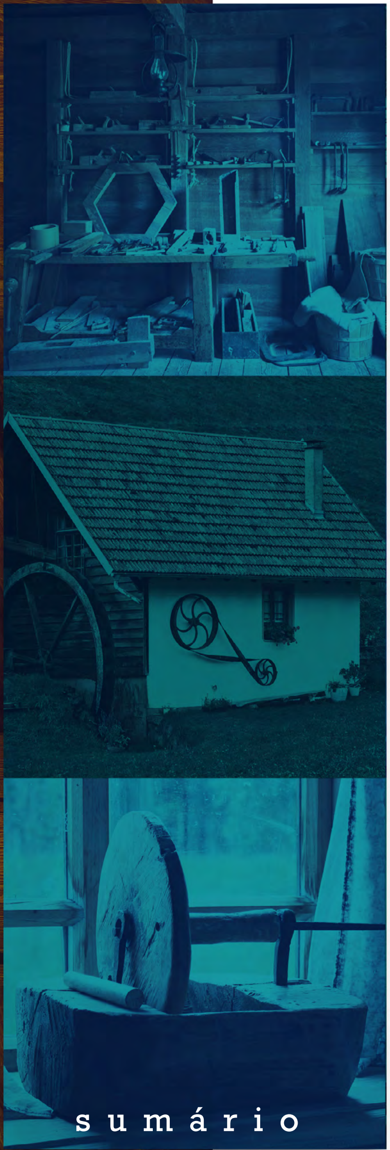


BRASIL. MIC/STI, 1979 p. 8). The original research project had to be reconsidered in the light of those facts.

During the preliminary phase of the field-work, the review of the documents relating to the history of Santa Catarina, especially to its economic aspects, focused on the process of industrialization that had taken place in a Northeastern area of that State, called Itajaí Valley. According to the documents, the process of settlement had started about the same time as Orleans' and, apparently, had also followed a similar pattern of colonization.

Nevertheless, the most puzzling aspect concerning the development of Itajaí Valley came from the fact that despite those similarities, which include the origin of the immigrants, Orleans' development did not reach the same stage of industrialization as that of the Itajaí Valley. Actually, the opposite had occurred. At the beginning of its settlement, Orleans had an active petty agro-industrial production, mostly run on a family basis. That proto-industrialization phase, which will be fully discussed in the next chapter, had flourished until 1895 thereafter becoming stagnant, until the beginning of the last decade, when a new phase of agricultural development, based on tobacco production, almost completely banished any trace of the previous phase.

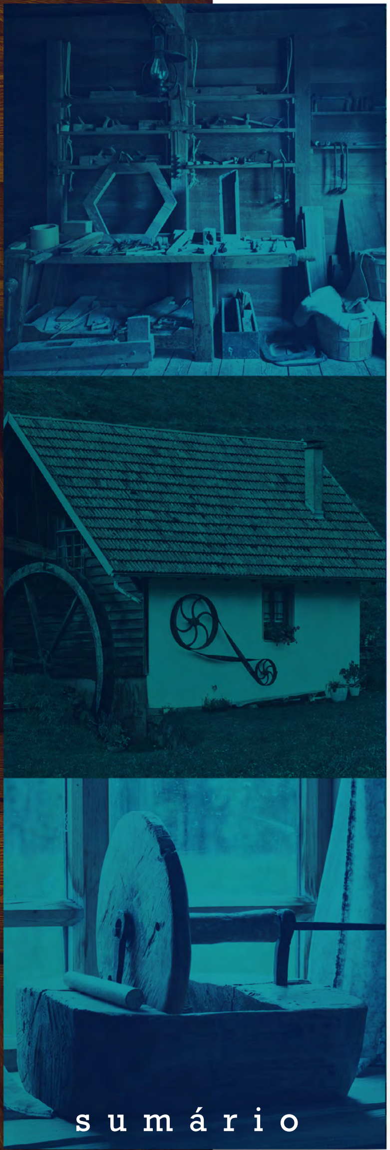
The development of Itajaí Valley had also brought about a flourishing proto-industrialization process but instead of becoming stagnant, as Orleans' did, after 1895 there began a transition towards a steady process of industrialization. Currently, Itajaí Valley is the most important and diversified industrialized region of the State of Santa Catarina. Its industries cover a wide range of products, such as foodstuff, textiles, clothing, industrial and agricultural machinery, metal, furniture, china, electrical equipment, etc. According to the 1980 census, there were 1,725 industrial plants (figures from the Microregion of Colônia de Blumenau), employing over 66,000 people.



As far as the cassava agro-industry is concerned, it has also developed alongside that process of industrialization, following the same pattern. For this industry, the transition from proto-industrialization to industrialization occurred in 1917, when the first cassava starch industry was set up in the region. Since then, this industry has grown and at the same time has undergone a significant process of technological changes.

The thesis research project was then modified in order to explore those two processes of development and to seek to understand why Itajaí's development did succeed and went further in its industrialization, while Orleans' didn't. In its essentials, the related issues of this reformulated research project are those concerning the thesis' second central question, namely what are the conditions in peripheral economies under which the processes, of capitalist development and of technological progress, can be present and allow a transition towards a Newly Industrialized Country? Clearly, the context defined by the case studies is much more restricted than for a country's economy as a whole, as the question suggests. However, by focussing on specific areas, which have not only a similar historical background but also a similar physical environment, it is possible to concentrate on the economic, social and technical conditions of those processes. Moreover, assuming that each case study could be treated as having its own technical basis (this is quite a plausible assumption, since the two settlements were initially almost totally isolated for a period of thirty years, their only contact with the 'external world' being made through tradesmen), it would be possible by way of a comparative analysis to identify the key elements in the interplay of those two technical bases and their corresponding processes of economic development.

A research methodology (see appendix 1) was then designed to carry on a historical analysis of the development of the cassava



agro-industry in both areas, Orleans and Itajaí Valley, against the background of the industrialization process of the later.

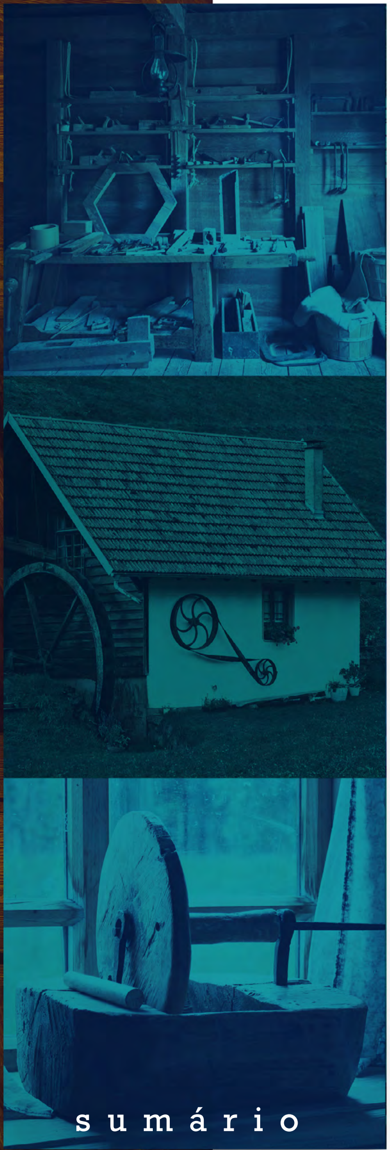
HISTORICAL NOTES

Cassava (or manioc) was one of the first domesticated plants in the New World. There, following a pattern similar to that of West Asia, most of these early domesticated plants were vegetatively propagated tuberous species, rich in starch[57]. It seems that Brazil, Argentina, Peru and Chile were the oldest centers of plant domestication and primitive agriculture in South America. The records found suggest that around the year 3000 BC, or even earlier, there were settled tribes already engaged in growing a variety of crops (BENNETT & BIRD, 1964; MASON, 1969; SAUER, 1969; VAVILOV, 1949).

The Amazonian lowland region has also been suggested as being the area in which cassava cultivation was first introduced by local tribes. Regardless of where this crop originally began in that region, it was widely diffused due to the complex network of tropical rivers, which permitted a great mobility to canoe travellers.

In 1500, when the Portuguese settlers arrived in the New World to start their commercial enterprise, they found a widely diffused tropical agriculture pattern among local tribes. This pattern, according to some authors, was mainly characterized by “semi-nomadism, the slash and burn method of clearing fields, the psychological importance of hunting, fishing and warfare, a weak political structure based on band organization, and a number of distinctive crafts” (BENNETT & BIRD, 1964, p. 24).

Agriculture was the main economic activity around which the tribe’s life was organized in the tropical forest, although its agricultural techniques were relatively primitive[58]. Cassava was the main crop

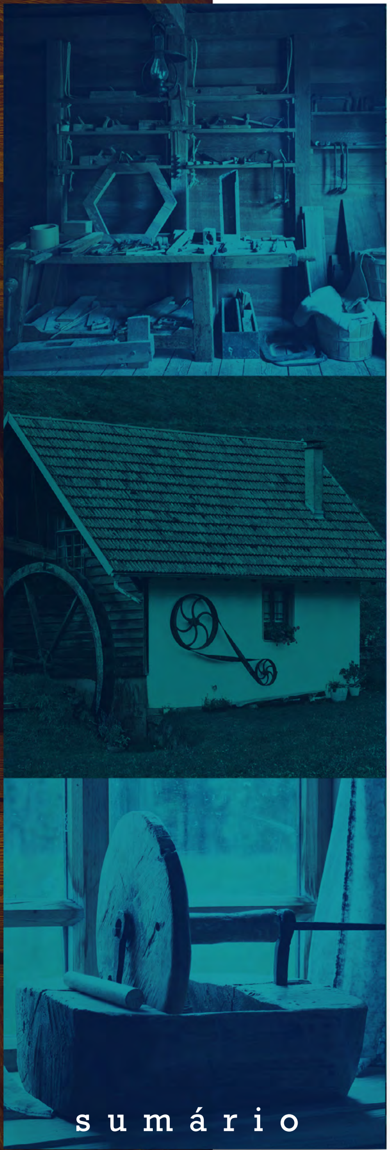


and one of the most important items of the diet of the endogenous population (PINTO, 1938). This was basically due to its adaptability to practically any kind of soil and exceptional hardiness, allied to its high nutritive value, which resembles that of cereals[59].

The establishment of a Portuguese colony in tropical South America had two main objectives: the exploitation of the land's natural resources and the production of sugar and tobacco. By and large, it was an externally oriented objective (or, in economic terms, an export oriented economy), seeking to provide valuable commodities for the growing European market (FURTADO, 1963; PRADO JR., 1967). The colony's economy was totally subordinated to the production of export-oriented commodities based upon large one-crop plantations, using slaves as the basic labour force. Everything else, even those activities necessary to sustain that objective, such as the production of foodstuffs, were of secondary priority. The production of sugar and tobacco, by large-scale agro-industrial enterprises absorbed the great part of the available resources and the settlers' efforts.

For that reason, the existence of a food crop with a good nutritive value, easily adaptable to almost any kind of soil and very hardy was extremely convenient for the Portuguese settlers who badly needed foodstuff to feed themselves and their large labour force. Also, cassava growing and processing techniques were quite simple and well disseminated among the endogenous population. The Portuguese learned and diffused those techniques throughout the colony.

Three hundred years later, when the first immigrants arrived in Santa Catarina to start a new life, they found those same techniques almost unchanged and they also decided to adopt cassava as an item in their daily diet. The "bread of the tropics", as the Portuguese use to call it. However, a new phase in the economic and technological history of cassava agro-industry was about to begin. In this thesis, the main features of that history will be explored.



THE CASE STUDY SETTINGS: BLUMENAU AND ORLEANS

The two areas chosen to carry out the research field work are located in the state of Santa Catarina in the Southern region of Brazil. The first area coincides with the municipality of Orleans (a municipality is represented by a local administrative urban center and its surrounding hinterland). The second area, Itajaí Valley, corresponds to the microregions of Colônia de Blumenau, Colonial do Itajaí do Norte and Colonial do Alto Itajaí, as defined by the *Instituto Brasileiro de Geografia e Estatística* - IBGE (Brazilian Institute of Geography and Statistics). These microregions comprise thirty-six municipalities (see Map 3.1).

The hydrographical basin of the Itajaí Valley extends over an area of 15,000 square kilometers and is located between the parallels 65 25’30” and 27 52’15” South and the meridians 48’37’20” and 50 21’50” East of Greenwich. Around ninety per cent of the Itajaí basin landscape is very irregular, with hills reaching up to 1,000 meters. Such topography does not allow large-scale agriculture but is quite well suited to the traditional cultivation techniques brought by the immigrants.

Average temperatures range from 24.5 degrees Celsius during the summer to 15.6 Celsius during the winter. Although the valley is located in a temperate zone, it has a warm and rainy summer with occasional torrential rains and heavy flooding.

The municipality of Orleans is located in the Rio do Norte Valley, at a distance of approximately 160 km south of Blumenau. Its topography is as irregular as Blumenau’s, being also surrounded by relatively high mountains, which range from 500 to 1,200 meters. This area has the same climatic conditions of Itajaí Valley.

sumário

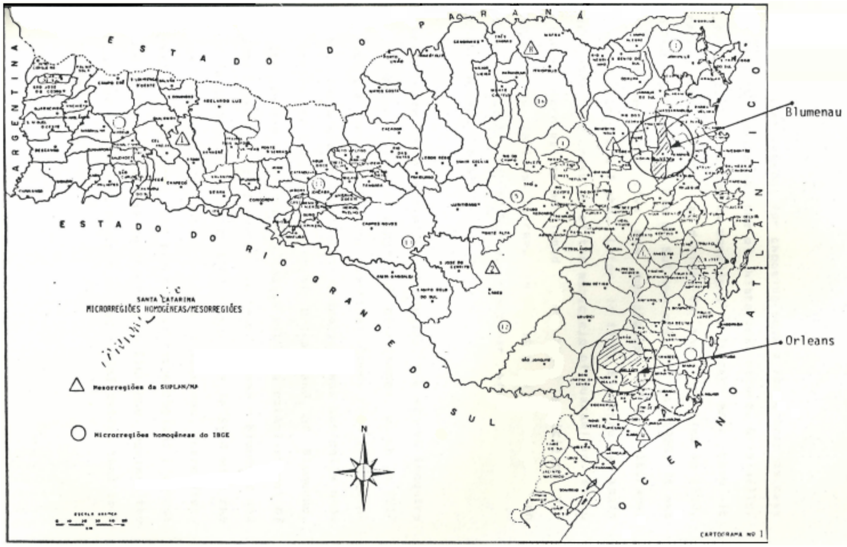
The unbalanced geographic distribution between the two case study areas can be explained in terms of the differentiated pattern of development which has taken place in the second area. As long as the cassava starch agro-industry experienced its period of expansion between 1940 to 1970 - especially during the Second World War - new firms settled all over the Itajaí Valley. Therefore, the geographic boundaries of the Itajaí Valley, as far as the thesis' case study is concerned, were defined by the expansion of the cassava starch agro-industry (see Chapter 5).

Map 3.1 - Map of Brazil showing major state and territory divisions of the country.

Map of Brazil showing major state and territory divisions of the country.

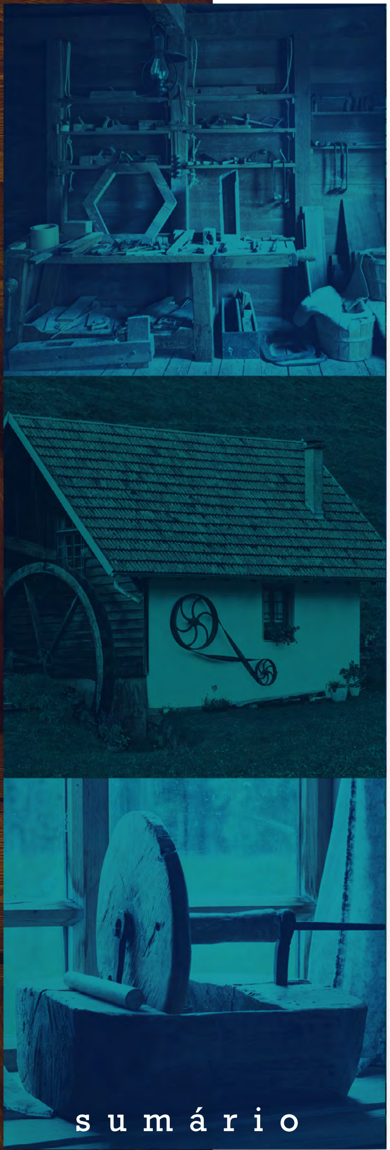
sumário

Map 3.2 - Map of Santa Catarina's microregions.



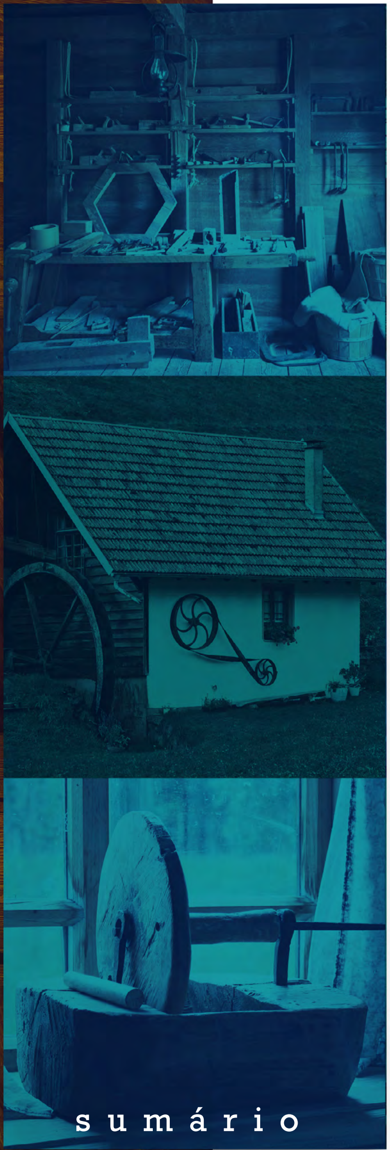
There is another reason for choosing such a large area as the case study setting, which is one of historical nature. Originally, the municipality of Blumenau comprised a larger area than it currently does. Blumenau was divided for the first time in 1930, when the municipality of Rio do Sul was created in 1935, it was further divided into five new municipalities: Gaspar, Ibirama, Indaial, Rodeio, and Timbo. Later, in 1949, Blumenau was again divided with the creation of the municipality of Guaramirim. As to the three microregions mentioned above, those municipalities are distributed as follows: Ibirama is situated in the microregion of Colonial do Itajaí do Norte; the other six are located in Colonial do Alto Itajaí.

It should also be noted that, historically, the starch industry had its beginning in the municipality of Blumenau, which in 1917 comprised the seven municipalities described above. From that point of view, the historical comparative analysis was basically made by referring to the



development of Orleans and of Blumenau, i.e., the period of time which begins with the establishment of the first immigrant settlements in those areas - Blumenau was founded in 1850 and Orleans in 1882 - and ends in 1914 with the start of the industrialization process in Blumenau. Thereafter, the research focuses on the process of technological progress followed by the cassava starch industry in Blumenau, against the background of the general process of industrialization that took place in the area.

Map 3.3 - Map of Itajaí-Açu river basin.



NOTES TO CHAPTER 3

WHY THE CASSAVA AGRO-INDUSTRY?

[54] According to the 1970 Brazilian census, the typical cassava cultivated area ranges from less tan one to less tan fifty hectares. Such areas represented 78% of the total cultivated area and accounted for about 78% of both the amount (ton) and value of cassava roots produced. In other words, the small-scale plantations not only predominate among cassava growing farmers but are also responsible for most of the production of tat crop.

[55] Exchange rate on 30tt Jun, 1978: US$1.00 = Cr$18.030.

[56] The Brazilian Alcohol Program (*Programa Nacional do Álcool – PNA*), in its original conception, proposed that “the program should contribute to the reduction of the uneven regional income distribution, since all regions met the minimum requirements for the production of necessary raw material, especially cassava” (BRAZIL. MIC/STI, 1979).

HISTORICAL NOTES

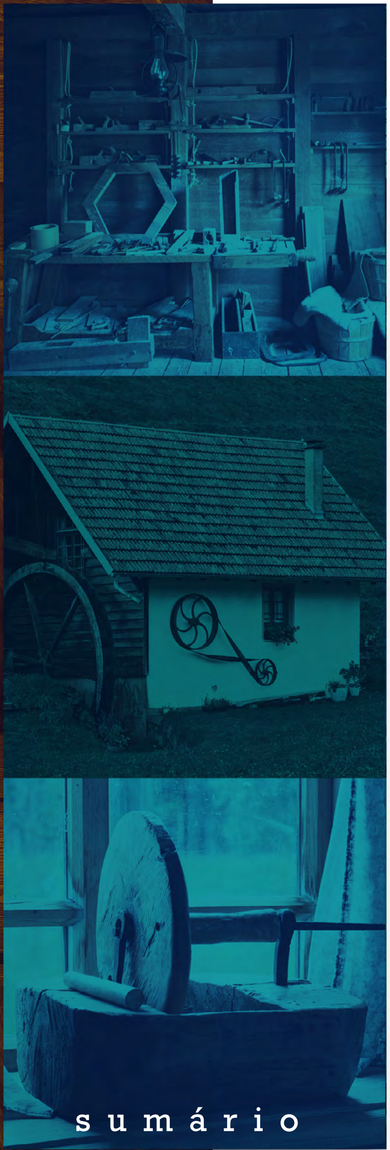
[57] The other plants were: sweet potato, yautia (xanthosoma), sorrel (molina), ullucu (ullucus tuberocus), and tuberous nasturtium (tropaeolum).

[58] Bennett claims that such lack of technical improvement was due to greater emphasis being placed on hunting by the Indians themselves. Je also suggests a quite interesting relationship between the level of technique and the religious and magical practices on the one hand, and the division of labour between men and women on the other: “except for the heavy labour of clearing the fields, agricultural work was left to women. Religious and magical practices surrounded hunting rater tan planting. As a consequence, agricultural techniques were not too advanced and because of wasteful methods, fields were utilized for a few seasons only.” (BENNET & BIRD, 1964, p. 25).

[59] Although cassava has a relatively high percentage of carbohydrates (tuber 32%; flour 85%) and calories (tuber 127/100g; flour 307/100g), its protein content is low. Hence, protein deficiency is common in tropical communities in which the staple food is cassava.

4

INDUSTRIALIZATION AND TECHNOLOGICAL PROGRESS IN THE STATE OF SANTA CATARINA



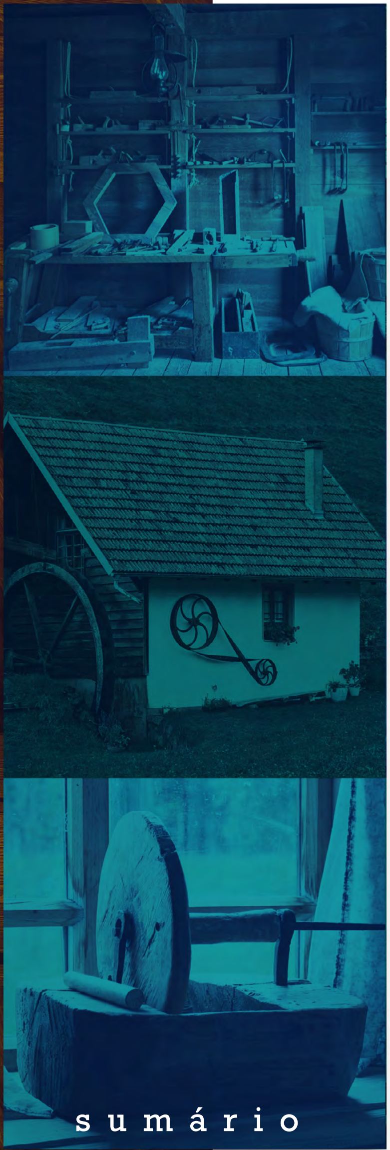
"The conditions and presuppositions of the becoming, or the arising, or capital presuppose precisely that it is not set in being but in becoming; they therefore disappear as real capital arises, capital which itself, on the basis on its own reality, posits the conditions of its realization." (MARX, 1977, p. 459)

"Proto-industrialization did indeed provide certain conditions for a capitalist industrialization; they were not however sufficient to actually introduce the process of industrialization. For the domestic system of production to be pushed into industrialization, a certain general framework was necessary, in addition to the internal contradictions or an impetus from outside." (KRIEDTE, 1981, p. 145 ff.)

INTRODUCTION

In general terms, the development of Santa Catarina can be divided into five distinct phases. The first, from 1600 to 1850, was characterized by largely subsistence level economic activity and only very loose ties with the main economic centers of the colony, such as Minas Gerais and São Paulo (CARDOSO, 1977; SANTA CATARINA-*CEAG/SC*, 1980 SOUTO, 1974).

The second phase, from 1850 to 1880, differs greatly from the first phase because it was characterized by an intense process of migration by Italian and German immigrants to the South of Brazil. This marks the beginning of what could be called the 'colonial economic system' and is discussed in more detail below (SEYFERT, 1974).[60] This phase was restricted to only some areas or the state, among which Orleans and Blumenau in the Itajaí Valley received a large share of those immigrants. It was during the second half of this period that the development of rural industries such as foodstuff, saw mills, and ceramics began to emerge. The process resembles the transition towards capitalism which occurred in some regions of Europe, particularly in Ger-



many over the nineteenth century. This transition process, whose main features are presented below, has been termed proto-industrialization in the literature (Kriedte *et alli*, 1981).

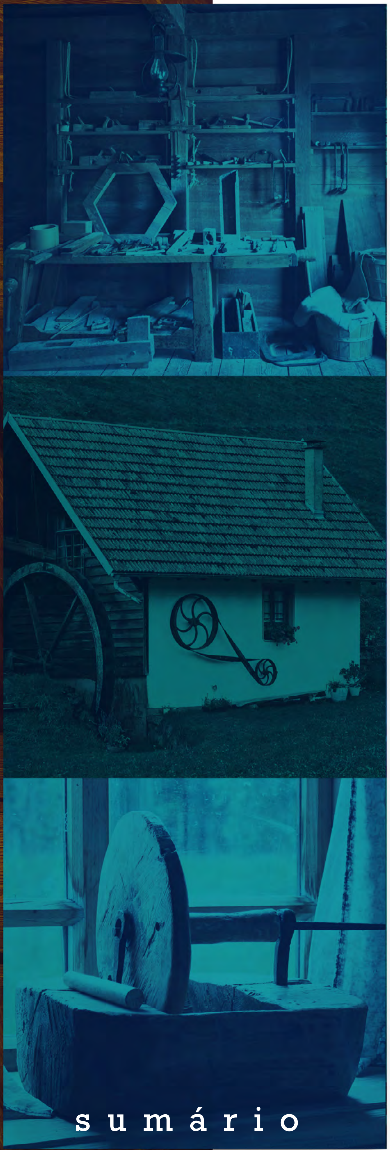
The third phase actually represented the transition period from proto-industrialization towards industrialization proper. It comprised the period from 1880 to 1914. It was during this period that the major differences between the processes of industrialization taking place in Orleans and Blumenau in the Itajaí Valley began to emerge, with Blumenau moving rapidly ahead and Orleans entering into a period of prolonged industrial stagnation.

During the fourth phase, from 1914 to 1960, there was what could be called a phase of consolidation or the industrial basis, during which a number of dynamic sectors were established, such as metal products, machinery and light capital goods production. In other regions of Santa Catarina, such as Joinville and, later, Lages, a steady process of industrialization also got under way.

Finally, the fifth phase covered the period from 1960 to 1980. During this phase the Brazilian industrialization process gained strength and was mostly centred in São Paulo and Rio de Janeiro. During this time, the industries of Santa Catarina, although they had already reached a mature stage, had to adjust to the new division of labour prevalent in the country and to face new forms of competition.

The primary concern of this chapter is to identify the main features of the process or industrialization that took place in the State of Santa Catarina and, in particular, in the case study areas, This process covers a period of over one hundred years, from 1850 to 1980, although the actual process of industrialization had only begun in 1880, when the first textile industries were set up in the Itajaí Valley.

In Section 3.1, an overview or the immigration process to the Southern Region of Brazil and particularly to Santa Catarina is shown.

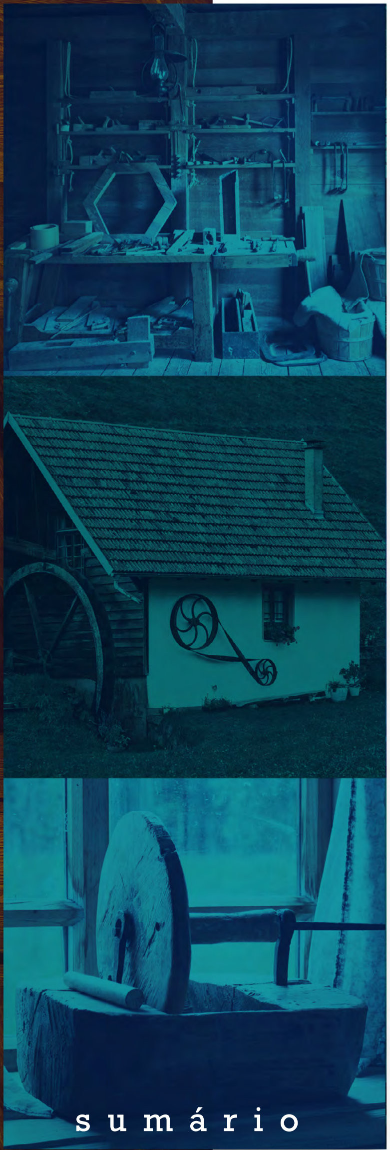


These migrators flows were mostly concentrated during the second-half of the nineteenth century up and continued until 1940. The settlement forms which resulted from such immigration are also briefly described. The proto-industrialization processes which took place in both Orleans and Blumenau (Itajaí Valley) and their distinct outcomes are presented in sections 4.3 and 4.4.

THE SETTLEMENTS IN SOUTHERN BRAZIL: 1850 – 1900

The economic exploitation of the territory of Santa Catarina, as well as the Brazilian Southern region in general, did not follow the Portuguese colonial pattern. Indeed, during the first centuries of the colony's development, 1550 to 1850, the main activity in Santa Catarina was defence, due to its strategic position in relation to the routes towards the Rio da Prata Bay, at that time under control or the Spanish Crown. Only a few settlements were founded, therefore, mostly along the coast and in the neighborhood of fortresses. During this period the main urban areas were São Francisco, Desterro and Laguna (see Map III), which were established in the second-half of the Seventeenth Century[61].

Nevertheless, such strategic importance meant that a significant number of troops had to be billeted in the region and an administrative structure was set up in those areas, especially in Desterro. Thus, during the eighteenth and throughout the nineteenth century, much economic activity was established to respond to the demands of the soldiers and administrators. Among them, the production of cassava flour (*farinha de mandioca*) was the most important, with its surplus being exported to other urban centers, particularly to Rio de Janeiro (MACHADO, 1979; SANTA CATARINA-*CEAG/SC*, 1980; SINGER, 1977). The average value of exported cassava flour represented about 35% the total exports or

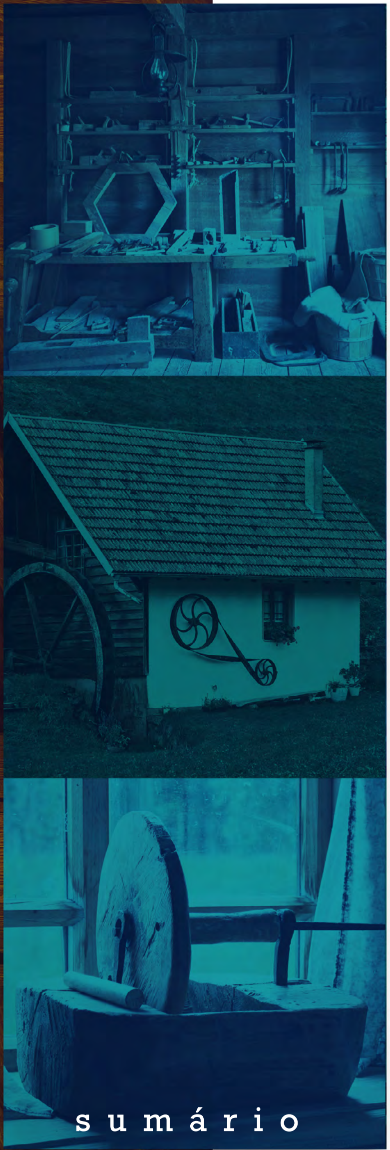


the State of Santa Catarina over the period. Certainly, this was a strong stimulus and weighed significantly on the immigrants' decision to carry on with the cassava agro-industry.

The second-half of the nineteenth century represented an important period for the Brazilian economic history, since some of the preconditions for the development of capitalism in this country arose during this period. In 1850, after considerable pressure from England, a royal decree prohibited any further slave trade (which had begun in 1810). In 1888 (the year that slavery was abolished in Brazil) a land act was enacted which regulated land transactions by the immigrants, who were now attracted not only to the possibility of becoming land owners in Brazil but also by the increasing need for free labor force in the Brazilian economy (FURTADO, 1977; PRADO JR., 1974).

For the State of Santa Catarina, the year of 1850 was also a turning point in its economic history. In that year the first waves of European immigrants started to arrive in the region, mostly coming from Germany and Italy. As it is well known, those two countries underwent a considerable political and socio-economic crisis at that time, which would last until the end of that century (HOBSBANM, 1962). Between 1820 and 1930, for instance, over 6 million Germans immigrated from their country, of which 200,000 came to Brazil. The others went to the United States (DAVIE, 1939, p. 66 ff. - cited in SINGER, 1977, p. 86).

The chief causes of immigration to Brazil from Europe before 1880 were the poor economic conditions in Europe and the constraints on land ownership. The immigrants, therefore, originated mainly from the peasantry, whose lands could not be fragmented any further; and craftsmen, unable to find a niche in the tight local markets. After the consolidation of the industrial revolution in Germany which started around 1865/70, the immigrants originated in other social segments: workers from domestic industries that had been set up during the proto-industrialization period and which had later been closed down due to the intense competition from large-scale industries; wage-laborer's



that had become redundant during that very serious conjuncture of economic crisis; and the petty-bourgeoisie, attracted by the possibilities offered by the New World.

The mechanics of the immigration process for individual migrants from specific countries (usually Germany, Italy and France) to Brazil was usually organized by a firm based in the immigrants' country of origin and often known by formal names such as the 'Colonization Company'. The procedure usually followed was that the Colonization Company would arrange a contract with the recipient country through which the company committed itself to bringing a certain number of immigrants into that country, over a given period of time. By that contract, the Colonization Company also committed itself to providing all the infrastructure services, including health and education, required by the immigrants as well as to undertaking the administration of the immigrant settlement.

The government of the recipient country, on the other hand, was obliged to offer a given piece of land to the company and to pass a given amount of money to each immigrant. Other subventions were also given, such as payment for each kilometer of road built in the settlement area, for communication systems, etc. Undoubtedly, this was a very risky business, whose success depended upon the very success of the colony; the more a settlement grew and more migrants were attracted to it, the more valuable the land became and the faster the investment pay itself off (SINGER, 1977).

As far as Santa Catarina is concerned, the German migration to Blumenau represented about 16 of the total German immigrants that arrived in Brazil from 1850 to 1880, or 7,651 immigrants that went to Blumenau. For the period from 1850 to 1932, German immigration to Blumenau was 8.6% the total arriving in Brazil (see Figures 4.1 and 4.2 below).

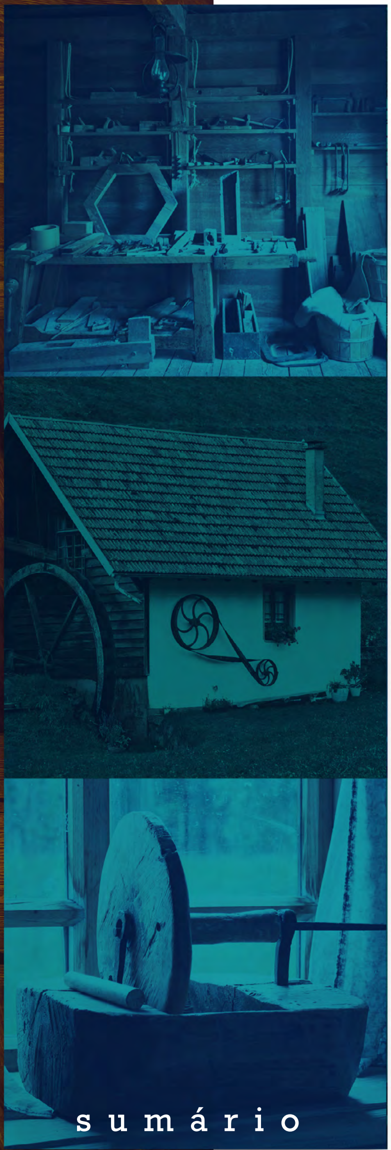


Figure 4.1 - German Immigration to Brazil 1820/1947.

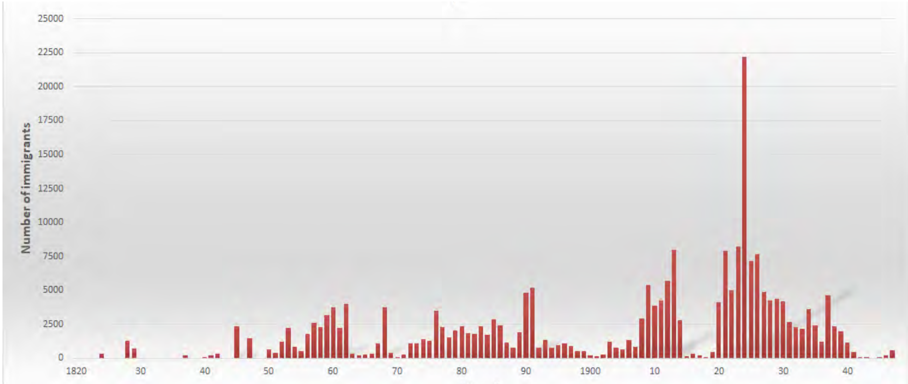
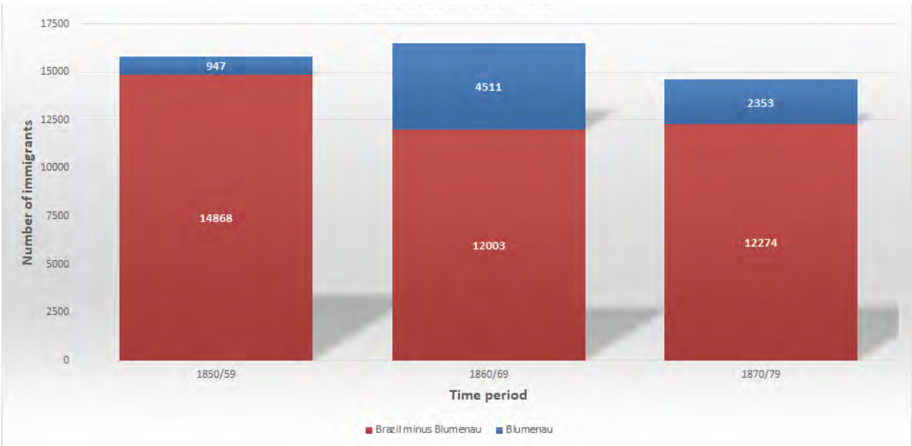
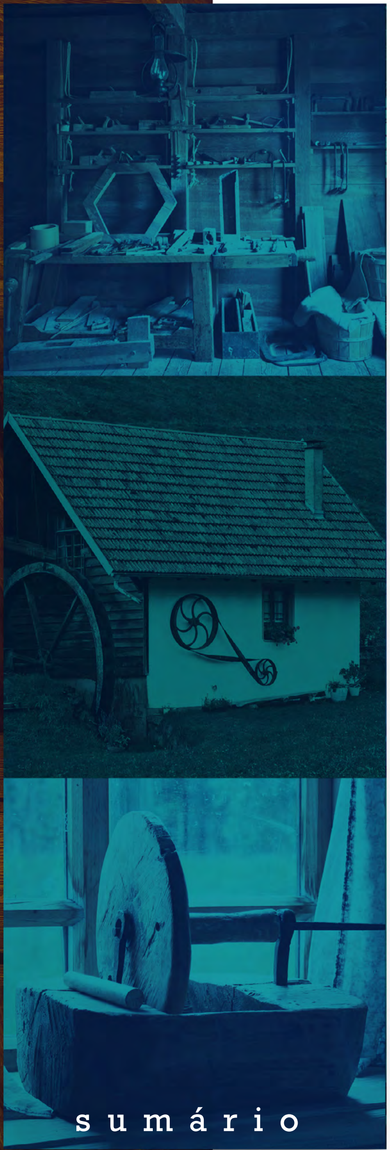


Figure 4.2 - German immigration to Brazil 1850/79 Brazil x Blumenau.



Sources: CARNEIRO, 1950 and MAHLE, 1950.

During the same period, the Italian migration to Brazil, as shown in Figure 4.3, was mostly concentrated in São Paulo. The number of immigrants that went to Santa Catarina was relatively insignificant and assessment. The available data does not allow any assessment.



According to the available data, during the colonization period, 1829 to 1930, forty settlements areas were established in Santa Catarina, mostly with German immigrants (see Map 4.1). Inter-settlement migrators flows have also been recorded in Southern Brazil with most of them going to the Santa Catarina settlements. Map 4.2 shows the main migrator flows over that same period.

The two case study areas, Orleans and Blumenau (Itajaí Valley), represent a very special example of those migration processes. The reasons are twofold. First, the two Colony Companies which organized both the migration to and settlements of Orleans and Blumenau had different origins and purposes, The Companhia Grão-Pará, which was responsible for the foundation and administration of the Colônia Grão-Pará in Orleans, was owned and financed by foreign companies, whose main concern was to extract the maximum profits out of the enterprise and send them back to their countries of origin. On the other hand, *Companhia* Blumenau, (founded and operated by its very first immigrant, Dr. Hermann Bruno Otto Blumenau), was established with the explicit Purpose of stimulating the development of local commercial activities in Santa Catarina. As argued in the next section, this difference would later be crucial for the development of the town of Blumenau, since it allowed the emergence of an endogenous process of capital accumulation.

Secondly, there is also another important difference between the two settlements concerning their technical base, whose historical development was possible to trace back thanks to very rich files available in both areas, particularly in Blumenau where the heritage foundation, *Fundação Casa Dr. Blumenau*, has kept all kinds of documents pertaining to the history of Blumenau. These two basic facts, namely an endogenous process of capital accumulation and the development of a local technical base, were absolutely essential for the success of Blumenau's industrialization.

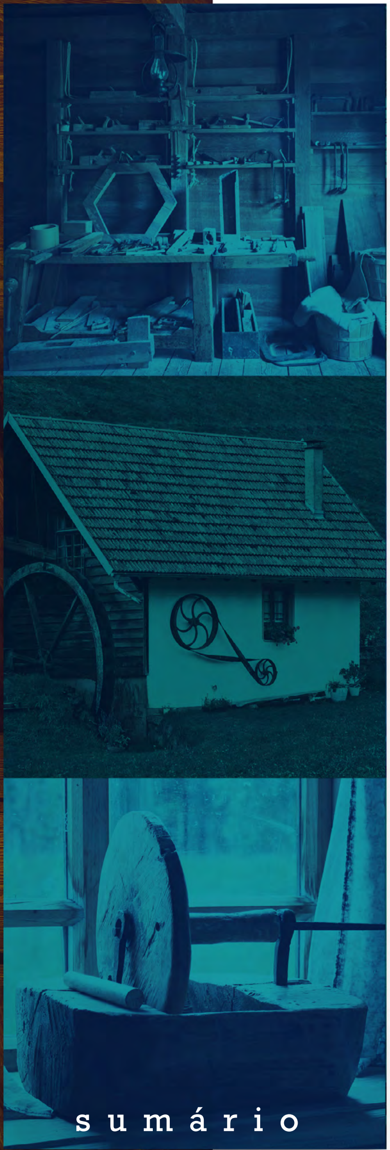
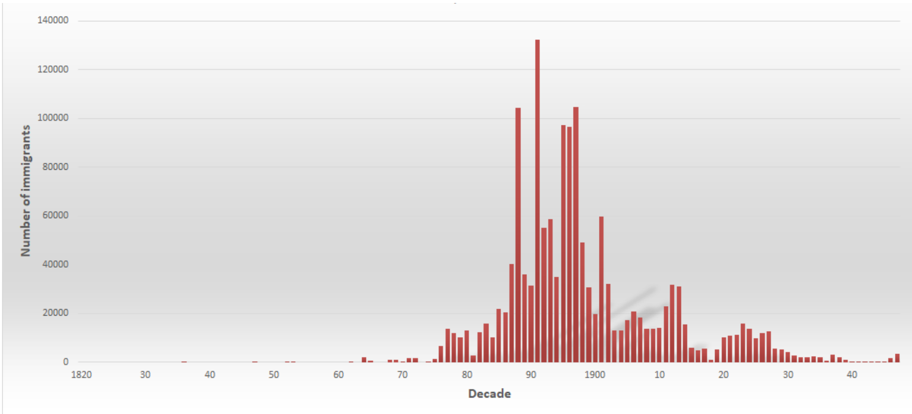


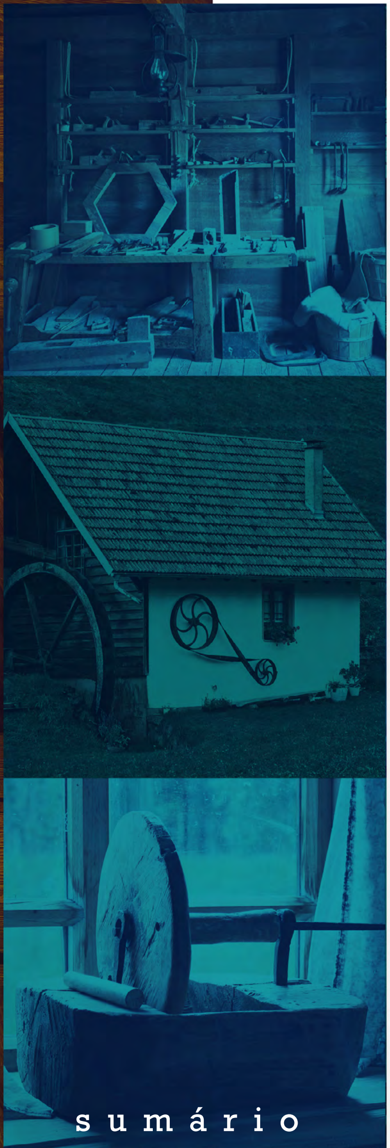
Figure 4.3 - Italian immigration to Brazil 1830/1947.



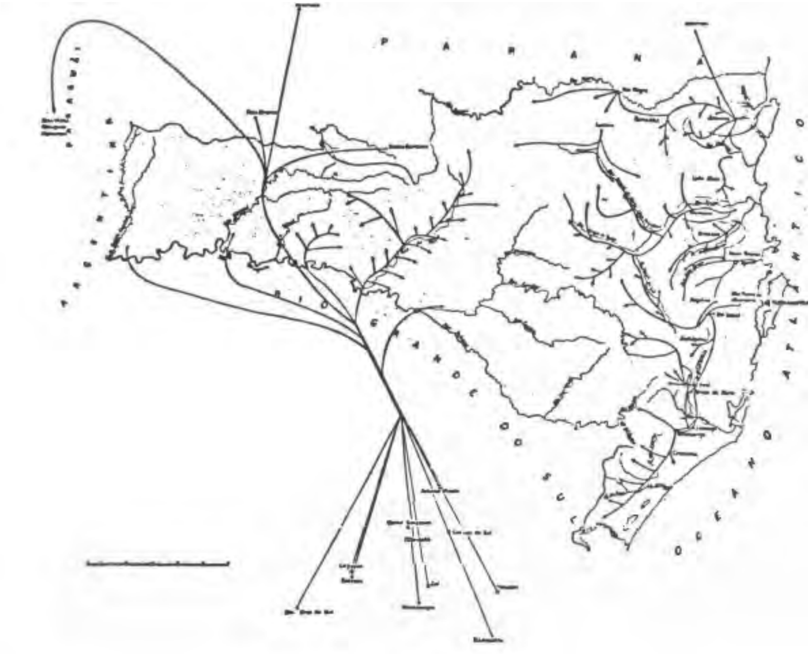
Source: CARNEIRO, 1950.

Map 4.1. - Distribution of colonial settlements in Santa Catarina.

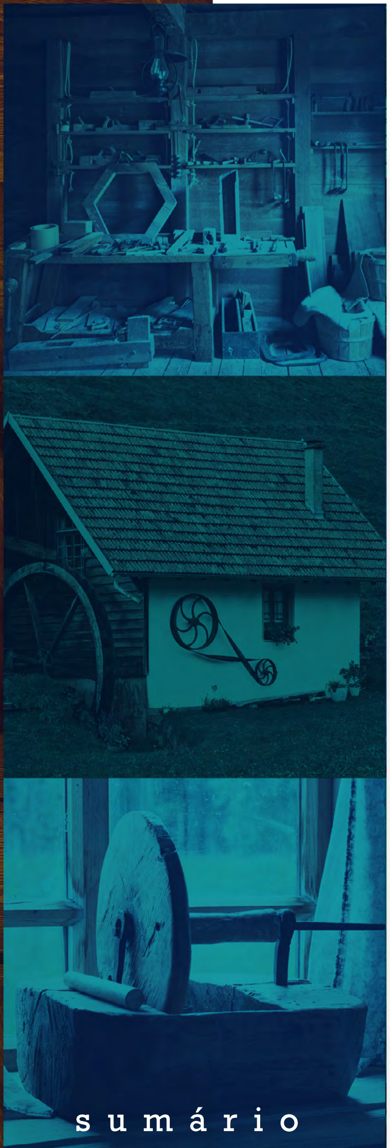
Source: CARNEIRO,1950.



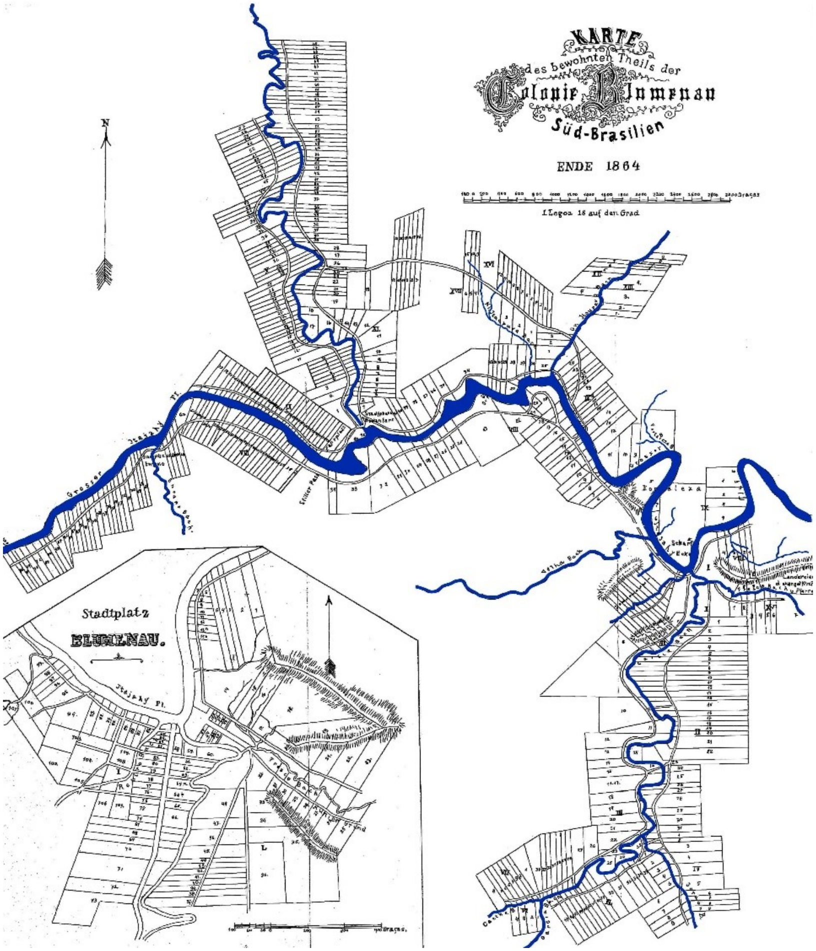
Map 4.2 - Internal migration by european immigrants (1850 -1930).

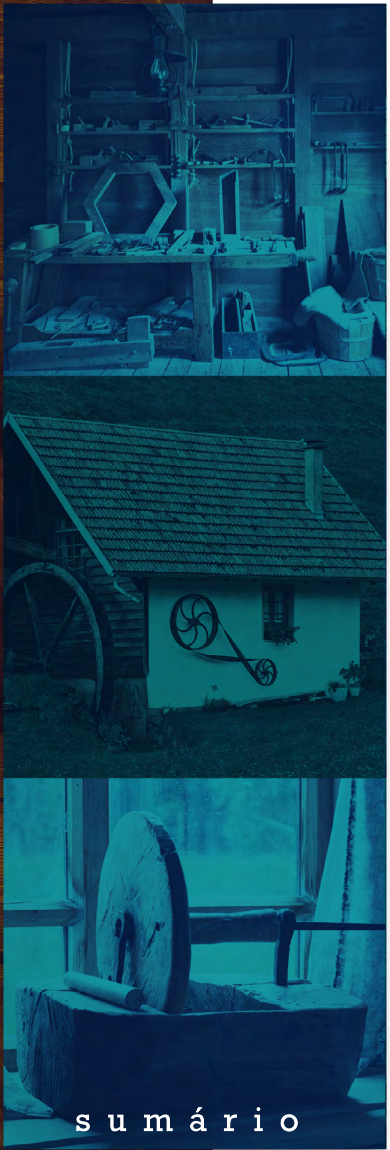


Source: CARNEIRO,1950.



Map 4.3 - Map showing Blumenau city map.





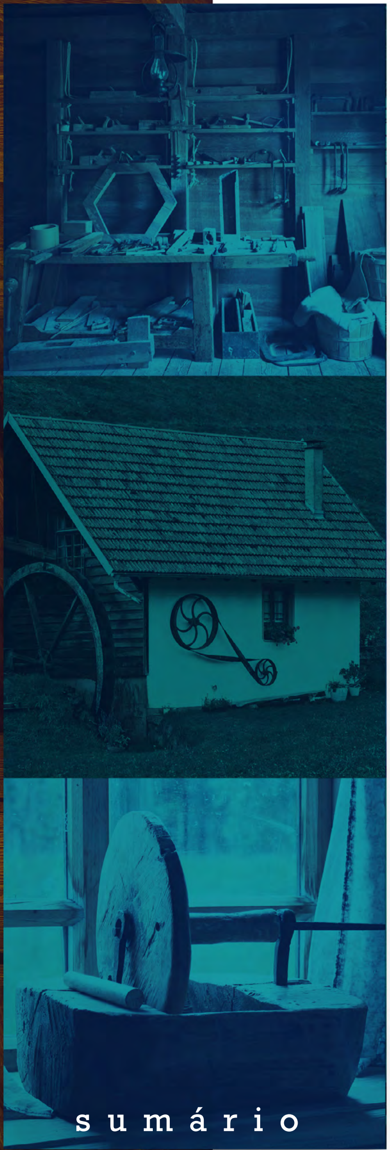
BLUMENAU: FROM PROTO-INDUSTRIALIZATION TO INDUSTRIALIZATION

Blumenau was founded on September 1850, by Dr. Hermann Blumenau, a young German scientist, and seventeen other German immigrants. The foundation of that first settlement in the area of the Colônia Blumenau had been the culmination of six years of preparations by the founder, involving diplomatic and financial arrangements, and extensive exploratory travel.

Born in Hasselfeld, in the dukedom of Brunswick, on 26 December 1819, Hermann Bruno Otto Blumenau was the seventh son of a traditional and wealthy family. After training as pharmaceutical chemist (1836-42), Hermann Blumenau worked for two years at a chemical company, in Erfurt. In 1844, he decided to stud chemistry at the Faculty of Philosophy of the University of Erlangen, where he got his doctor degree.

It was during his stay at Erfurt that Dr. Blumenau heard for the first time about the exotic Brazilian forests and lands through two famous German naturalists, Alexandre von Humboldt and Dr. Fritz Muller. In 1843, during a visit to London, he was introduced to the Consul-General of Brazil for Prussia, Johann Jakob Sturtz, who was in charge of attracting potential immigrants to Brazil. Apparently, after that meeting in London, Dr. Blumenau began thinking about the possibility of undertaking a settlement venture in Brazil (da SILVA, 1978; da SILVA, 1954).

Dr. Blumenau came for the first time to Brazil in 1846 to be professor of chemistry and mineralogy at a faculty in Rio de Janeiro at the invitation of Consul Sturtz. However, since the School had not set

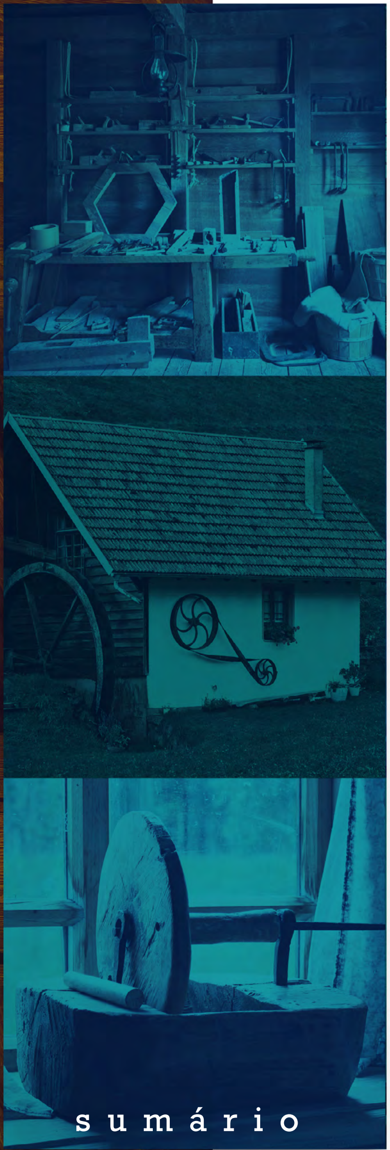


been founded, he decided to go South to visit some German colonies in the State of Rio Grande do Sul and in Desterro (later renamed Florianópolis) in the State of Santa Catarina. Towards the end of 1847, together with another German, Ferdinand Hackradt, whom he had met in Rio de Janeiro, Dr. Blumenau explored the region of Itajaí Valley searching for an area in which to establish a colony.

From 1848 until the foundation or the first immigrant settlement in 1850, both Dr. Blumenau and Hackradt had to face man obstacles to organize the settlement company including, at the end, the breaking down of their partnership. Although rich in fascinating stories, full of innumerable illustrative facts and deeds, the period will not be discussed in detail here. For the sake of the thesis' argument, it suffices to give a brief account or that history, highlighting the main points (for a general view or that period see: da SILVA, 1954; da SILVA, 1978 SEYFERTH, 1974; SINGER, 1977).

The first phase of Blumenau's development covers the years from 1850 to 1880[62] and can be divided into two distinct periods. The first, comprising the initial ten years of the settlement, was devoted to establishing the minimum infrastructure required for the subsistence of the newly arrived immigrants. By far, that was the most difficult time for the pioneers, considering that they were almost total isolated from other urban centers and that they had to face the forest, the hostility of the indians and hazardous weather.

As far as the Colônia Blumenau Company is concerned, its situation was not too different from that or the pioneers. To begin with, very few immigrants arrived during the first decade: approximately 1,000 immigrants (see Table 4.1 below). The Blumenau Company had to face strong competition from other companies which had at their disposal large capital resources to cover the high costs of such an investment.[63] Secondly, the initial investment turned out to be much higher than Dr Blumenau had previously thought and, consequently,



he had to pass the company's debt out of his own personal resources. After the first eight years or financing the settlement venture, Dr. Blumenau was running out of funds.

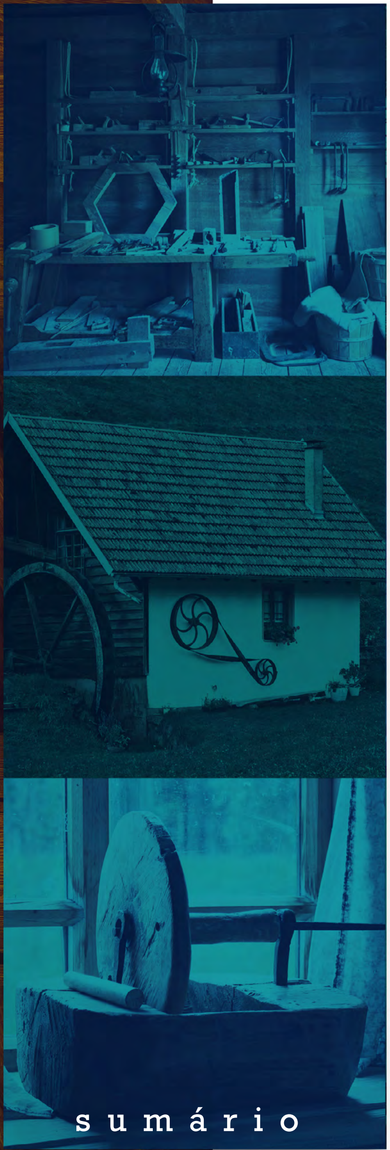
Table 4.1 - German migration to Blumenau: 1850/80.

German Immigration into Blumenau 1850 / 80											
Decades / Years	0	1	2	3	4	5	6	7	8	9	Total
1850 / 59	17	8	110	28	139	41	294	199	82	29	947
1860 / 69	91	548	607	168	127	199	162	223	1407	979	4511
1870 / 79	32	23	185	358	328	322	314	176	342	273	2353
Source: Dr. Blumenau's reports.											

Source: Dr. Blumenau's reports.

The reasons for such difficulties were due, on the one hand, to the small number of immigrants that had arrived at the colony during the initial period. Such a small population did not favor any noteworthily domestic market. On the other hand, those immigrants, who came from a society which was undergoing the transition from feudalism to capitalism, kept their consumption patterns and imported new instruments of production and other durable goods. Consequently, the colony's trade balance presented a negative result during those years, such debts were partially covered by the immigrants' own savings and by Dr. Blumenau resources, that were paid out to the immigrants as wages for building the settlement 's infrastructure.

In 1859, after having some contacts with the Brazilian Government to negotiate his company,[64] Dr. Blumenau was successful in selling *Companhia* Blumenau to the government.[65] In fact, the government always had a sympathetic attitude toward Dr. Blumenau's settlement



venture and, consequently, the responsibilities for the management of the newly created official settlement company was kept in the hands or Dr. Blumenau himself, who was invited to stay on as company director.

The second period of Blumenau's initial phase of development, from 1860 up to 1880, represented its consolidation as a successful settlement. During this period the number of immigrants arriving at the settlement was nine and a half times greater than the previous one (see Table 4.1) and the total Population in 1880 was approximately 17,000 inhabitants. Table 4.2 below summarizes Blumenau's populational growth per decade.

Table 4.2 - Population of Blumenau: 1850/80.

Population of Blumenau 1850 - 1879			
	1850 / 59	1860 / 69	1870 / 79
Inhabitants	943	6268	17200
Rate of growth (%)	-	665	1802

Tables 4.3 - Evolution of the exports & imports in Blumenau 1866 – 1879[2].

Evolution of the Exports & Imports in Blumenau (Index: 1866=100)			
Year	Exports	Imports	Exp/Imp
1866	100	100	0.76
1867	145	122	0.9
1868	207	196	0.8
1869	378	360	0.8
1873	445	460	0.73
1874	570	586	0.74
1879	1277	1004	0.79

Source: *Centenário de Blumenau*.

2 The numbers in the columns 'Exp/Imp 'represent the rate of the values of the Exports 4 Imports.

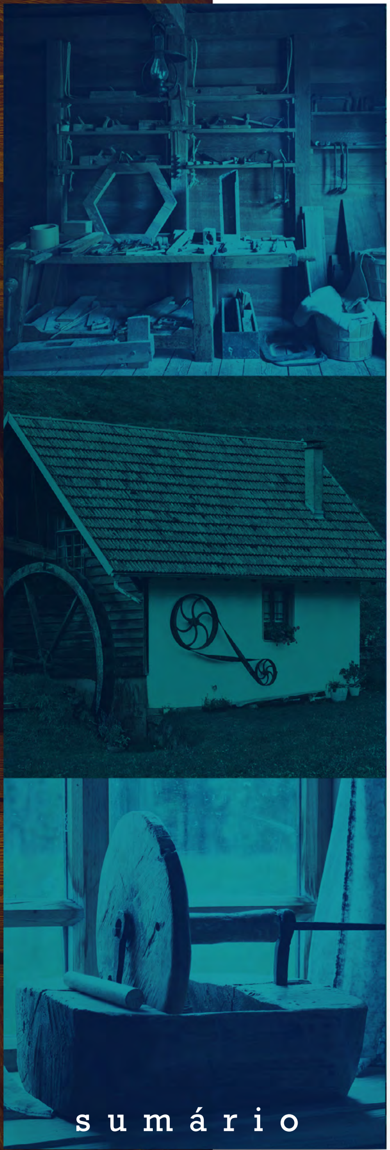


Table 4.4 - Evolution of the Exports & Imports in Blumenau[3].

Evolution of the Exports & Imports in Blumenau (Index: 1899=100)			
Period	Exports	Imports	Exp/Imp
1899 -1902	100	100	1.01
1903 – 1906	142	212	0.68
1907 – 1910	200	312	0.65
1911 – 1914	233	128	1.83
1915 – 1918	346	146	2.38
1918 – 1922	786	779	1.02
1923 - 1926	2292	1835	1.26
1927	2746	2279	1.21
1928	3039	2332	1.31

Source: *Centenário de Blumenau*.

Owing to the substantial investments made by the Brazilian Government, which, between 1860 and 1880, had expanded the colony's infrastructure and facilities by 2,900% above Dr. Blumenau's record during the previous period[66], the colony's economic activities substantially increased. The rates of growth of Blumenau's import and export trade during the two periods, i.e., from 1866 to 1879 and from 1899 to 1928, are a significant indicator of the level or the economic activity in Blumenau at the time. Moreover, the comparison in each period between the evolution of the rate of the values of the exports and imports shows that during the first period: (I) the colony trade balance had a constant debt of approximately 30% a year; (II) the export's rates of growth during this same period were slightly higher than of import's (with the exception of 1873 and 1874). The graph on Figure 4.4, below, shows the evolution of Blumenau's trade over that period.

Concerning the second period, the figures indicate that: (I) the economy of Blumenau experienced substantial growth during

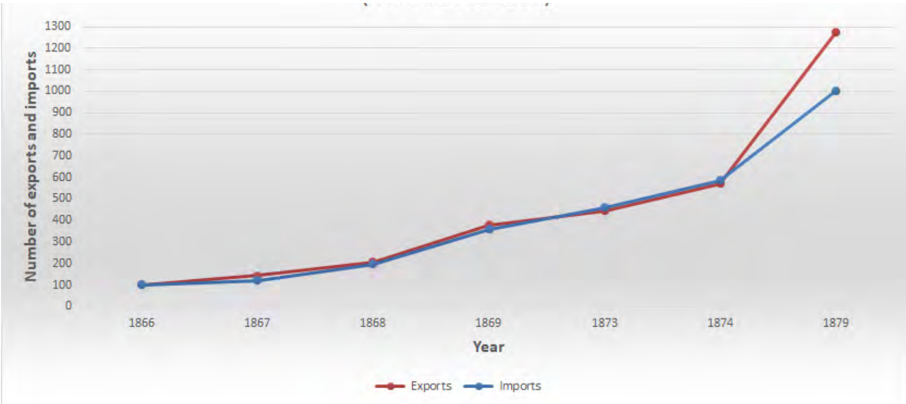
3 The numbers in the columns 'Exp/Imp 'represent the rate of the values of the Exports 4 Imports.

sumário

the second period, especially after 1922 when the exports sharply increased; (II) from 1899 to 1928, the trade balance presented a positive result almost over the whole period, except for the years of 1903/06 and 1907/10. The graph on Figure 4.5 shows Blumenau's rates of growth for exports and imports over the period.

The explanation for such steady economic growth can be found on three distinct and set interrelated processes. The first is concerned with the social and economic structures which were established in Blumenau. As it was already pointed out, the German immigrants reproduced in their new settlement, Blumenau,

Figure 4.4 - Blumenau: Exports x imports 1866/ 79 (Index: 1866=100).



Source: *Centenário de Blumenau*, 1950.

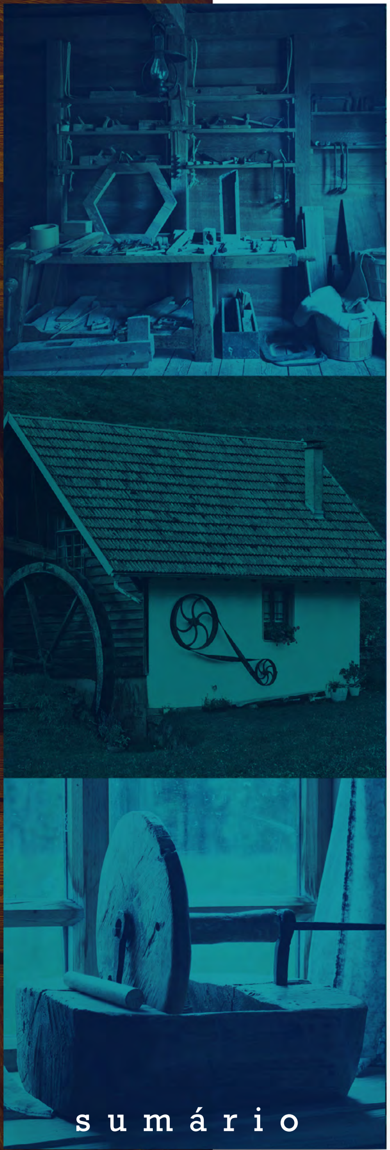
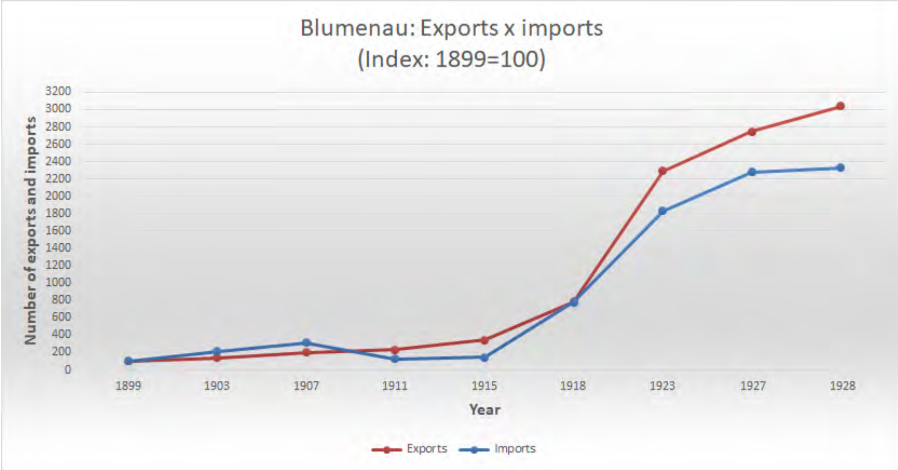


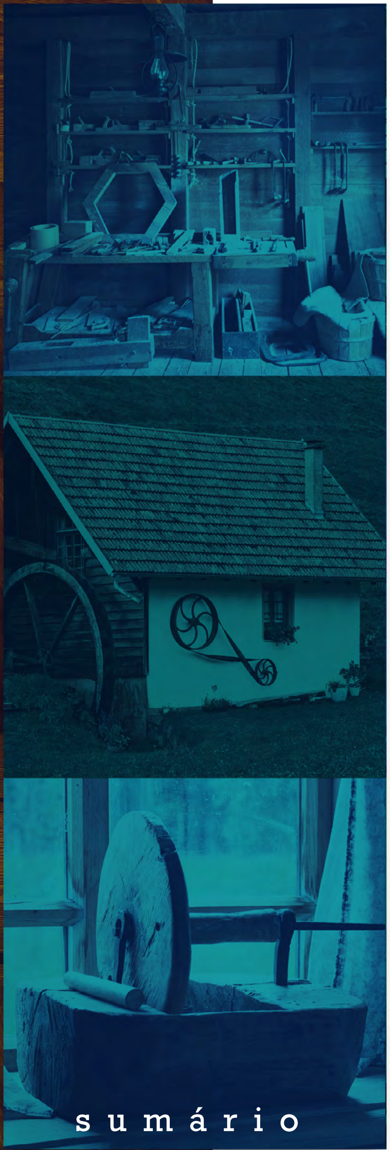
Figure 4.5 - Cassava Base Process (1850).



Source: *Centenário de Blumenau*, 1950.

Almost the same set of social and economic conditions of their places of origin. These conditions had emerged in some areas of Germany and of other countries as well, like France, during the process of transition from feudalism to capitalism. This process, called proto-industrialization by some authors (this term was first coined by the American historians Franklin F. Mendels and Charles & Richard Tilly) or industrialization before industrialization as Peter Kriedte, Hans Medick and Jürgen Schlumbohm (KRIEDTE, 1981) have named it, is related to what those authors regard as the second phase of the disintegration of the feudal system and the transition to capitalist society.

In other words, as long as the feudal ties were losing their strength, a large part or the rural population started to live almost entirely or to a considerable extent from industrial may production for inter-regional and international markets.

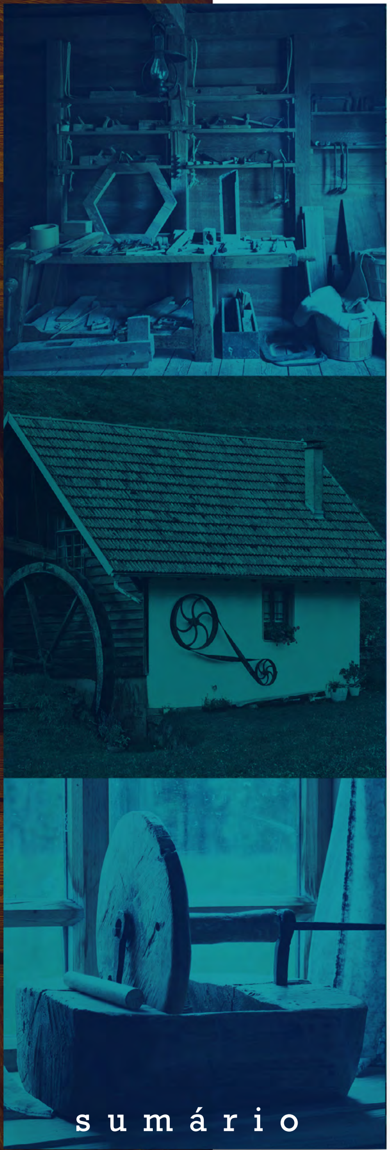


Clearly, that process did not spread all over Europe or not even throughout those countries in which it took place. It occurred only in regions that presented certain conditions, such as: availability or labour, and that were located near urban areas that were suffering from shortages in the supply of raw material and of labour for their growing industrial demand. This problem of inelastic supply of labour and materials had emerged in the flourishing urban areas mainly as a result of the rigid policies of the guild system, which was fighting for its surviving. The merchant capital solved the problem by moving industrial production from town to countryside.

The division of labour between town and countryside (which emerged during the first phase of transition) and the process of social differentiation and polarization within rural populations, are regarded by those authors (c. KRIEDTE, 1981) as having determined the origins of proto-industrialization in Europe. And this process of industrialization had, still according to the same authors, played a significant role in the development of capitalism.

As far as the development of Blumenau is concerned, affected by the process of proto-industrialization it was in to distinct ways. First, it forced man's craftsmen to give up their small business activities, therefore inducing them to try a new life elsewhere. Second, when the transition process was almost complete and the large scale industries were already emerging, the small proto-industries started to face strong competition and then had to closed down, The workers of those industries as well as a segment of petty-bourgeoisie affected by this later crisis were attracted by the possibilities offered by the New World. And those immigrants who came to Blumenau succeeded in reproducing some of the characteristics or the proto-industrialization process and seem to have learned some lessons from it and managed to avoid major economic crises.

The second process is related to establishment in Blumenau of a wide spectrum of skills and crafts. The development of a productive



infrastructure from the very beginning of the colony's economic life, thanks to growing technical capabilities, later made the industrialization process possible.

It must be emphasized here that that process did not happen by chance. Since Dr. Blumenau started his settlement venture in Brazil in 1850, he was very concerned with the availability of skills and technical knowledge in the colony. From the annual reports that Dr. Blumenau wrote to the Brazilian government it becomes clear how important he considered this matter, i.e., to develop a local technical capacity, and what sort of steps he took to achieve such capacity.

Throughout Dr. Blumenau's reports he explicitly mentions his concern with the colony's productive capacity and his deep interest in having more skilled immigrants. In this respect, Dr. Blumenau also made quite clear the sort of measures he took in order to select the potential immigrants to his colony; through his agent in Germany, Dr. Blumenau requested immigrants with special skills such as a millwright, a mechanic, etc. Table 4.5 shows the evolution of Blumenau's immigrant skills from 1850 to 1863.

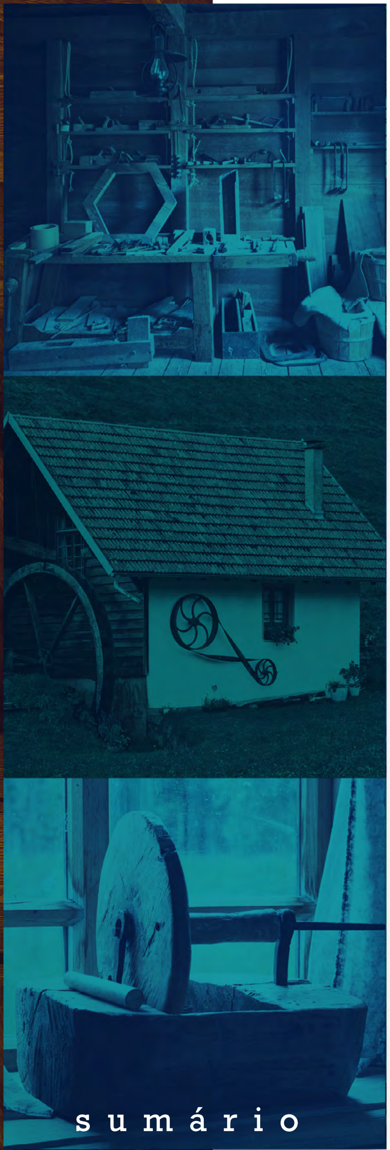
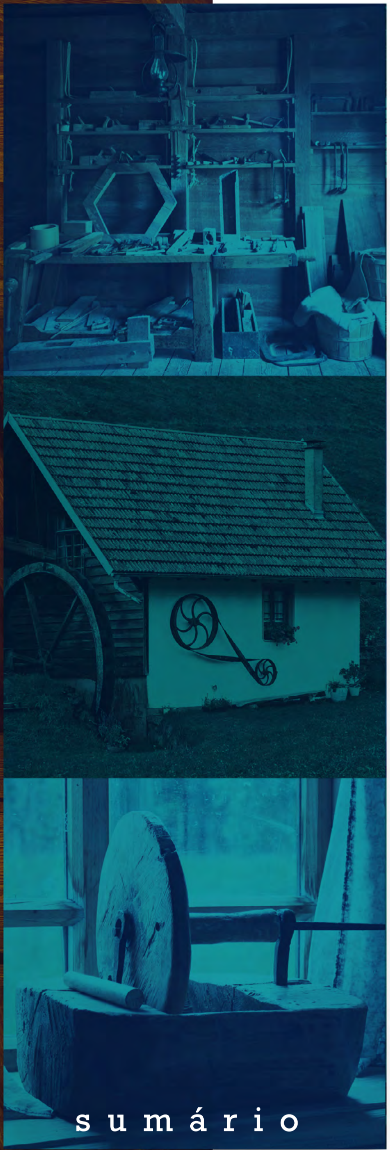


Table 4.5 - German immigration into Blumenau
1850/63 Skills of the immigrants.

German Immigration into Blumenau 1850 / 63 Skills of the Immigrants							
Skills / Years	1850	1853	1859	1860	1861	1862	1863
Shoemaker	-	2	-	4	-	6	-
Mason	-	2	-	3	-	12	-
Millwright	-	1	-	2	-	2	-
Miller	-	1	-	-	-	-	-
Barrelmaker	-	1	-	-	-	3	-
Mechanic	-	-	6	3	5	2	10
Clockmaker	-	-	-	-	-	1	-
Butcher	-	-	-	1	-	1	-
Saddler	-	-	-	2	-	5	-
Tinsmith	-	-	-	1	-	2	-
Clerk	-	-	10	2	2	2	1
Peasant	3	-	23	3	5	-	24
Surveyor	1	-	-	-	-	-	-
Carpenter	1	2	-	-	-	15	-
Joiner	1	3	-	6	-	13	-
Blacksmith	2	1	-	3	-	5	-
Tinker	1	-	-	1	-	-	-
Cigar Maker	1	-	-	-	-	-	-
Veterinarian	1	-	-	-	-	-	-
Phisician	-	1	-	-	-	-	-
Professor	-	1	-	-	-	-	-



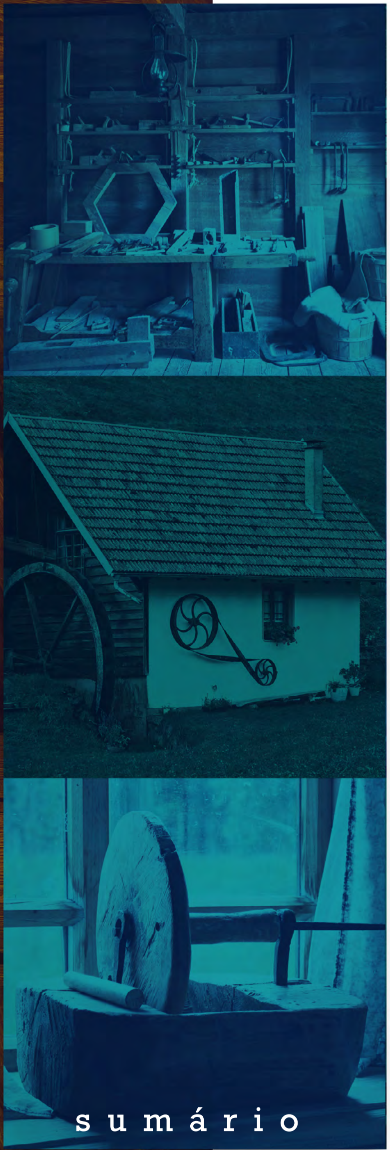
Professional Gardner	-	1	-	-	-	-	-
Tradesman	-	1	8	1	3	-	1
Gunsmith	-	1	-	-	-	2	-
Turner	-	1	-	2	-	-	-
Tailor	-	2	-	2	-	6	-

Source: *Relatórios do Dr. Blumenau*.

Such well-defined policy allowed the development of a wide technical base which, to some extent, was a small-scale reproduction of that of Germans at that time. As a result, a good number of small-business for repair services, crafts, mill construction, etc. Were setup in Blumenau. Some of those backyard-shops did quite good business and later turned to industrial production, as it was the case of *Metalúrgica Riosulence* and *Industrial Rex*, two medium-sized light capital goods firms for the cassava starch and wood industries, which started as simple repair service shops, Table 4.6, below, presents a comparison between the export of different classes of products from Blumenau, just after the end of its transition period from proto-industrialization to industrialization (1880 to 1914).

Table 4.6 - Comparison of the exportation values between classes of products: Blumenau 1919/23.

Comparison of the Exportation Values Between Classes of Products (Blumenau 1919 / 23)										
Products / Years	**1919**		**1920**		**1921**		**1922**		**1923**	
	Share	**Index**	**Share**	**Index**	**Share**	**Index**	**Share**	**Index**	**Share**	**Index**
Livestock	41%	100	39%	111.6	38%	120.2	36%	151.9	30%	201.2
Agricultural Products	34%	100	34%	117.6	22%	83.9	20%	96.8	22%	178



Wood	5%	100	3%	73.7	3%	71.8	11%	402.2	17%	929.4
Industrial Products	20%	100	23%	134.9	37%	291	33%	291.1	31%	419

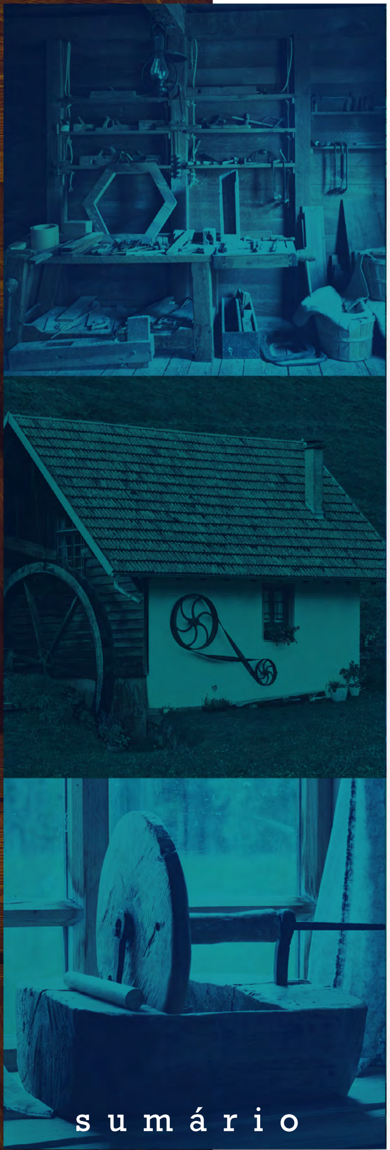
Source: *Relatórios Municipais.*

Despite the great difficulty in obtaining detailed information on Blumenau's economic performance at that time, especially of quantitative information, the Figures shown on Table 4.6 clearly indicate the growing importance of Blumenau's industrial products to its export trade balance.

A better evaluation of the growth of industrialization in that region may be obtained through a more detailed analysis of the development of the manufacture goods industries was mentioned before, the industrialization process was started in 1879 with the setting-up of a textile industry, which would later become the most economically relevant industry in the region and in the state. Actually, the Blumenau municipality was responsible in 1980 for close to 50% of the Santa Catarina State textile production (*BRASIL/IBGE*, *Censo* 1980).

The Hering brothers, who had immigrated from Germany (Saxon Region), were the pioneers in the textile industry. The started during the latter part of 1879, with a small knit cloth industry. This business, which initially was just a small backward enterprise, developed to its present status the Hering Textile Industry. Today, this Firm belongs to the Hering Group, which is active in the most varied fields, from agro-industry to the manufacturing of electronic equipment or telecommunications.

The second most important industrial branch is metallurgy. The pioneer in this Field was K. Ernst Averbach, who had emigrated from Germany in 1886 (also from Saxons) and founded a small smelting works in a place called *Itoupava-Seca*, Blumenau, The Foundry gradually became the '*Eletro-Aço Altona*', a medium to large steel industry (in



1985, for instance, its gross revenue was approximately US$13 million, with an average or 900 workers). It is interesting to mention that, during the early period of the Blumenau's industrialization, the small Averbach firm was also a school for the training of personnel for the different foundries in the region.

The evolution of the manufacturing industries in the Blumenau Municipality between 1883 and 1948 is summed up in Table 4.7, below. In this Table, the significant growth of the textile and metallurgic sectors can be readily seen.

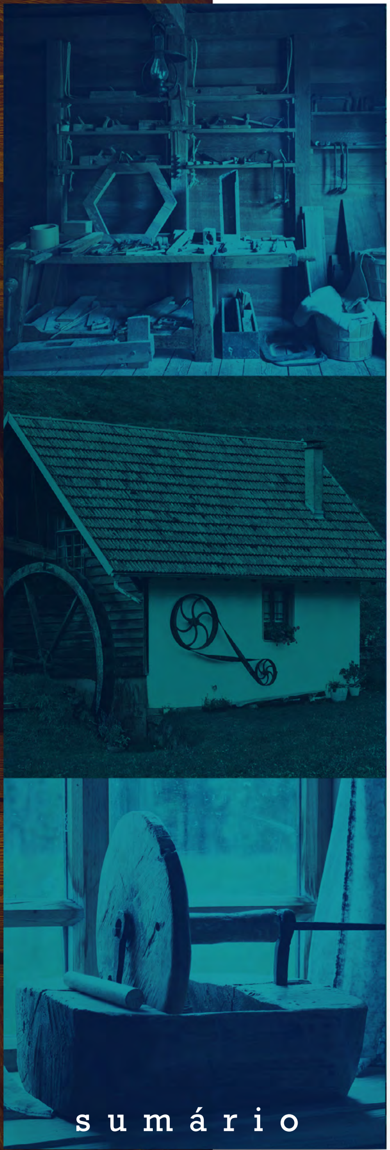
Table 4.7 - Blumenau: evolution of the industrial sector 1883/1948.

BLUMENAU: Evolution of the Industrial Sector - 1883 / 1948 - constant price (1948); (index 1883 = 100)

Manufacturing	1883		1915		1948	
	Index	**Rank**	**Index**	**Rank**	**Index**	**Rank**
Textile mill products	100	3	600	2	25.000	1
Fabricated metal products	n.a	n.a	100	4	1.950	4
Food and kindred products	100	1	615	1	496	2
Lumber and wood products	100	2	52	3	273	5
Miscellaneous industries	100	4	480	5	16.000	3
Total	100	-	451	-	1.532	-

Source: HERING, I. "O Desenvolvimento da Indústria Blumenauense" in *CENTENÁRIO DE BLUMENAU* - 1850 / 1950.

The industrial development was extremely facilitated by the introduction of electric power in the region. Electricity generation started around 1910, with the construction of a small hydro-electric plant at Gaspar Alto by pioneer F.G. Busch. Nevertheless, it was im-

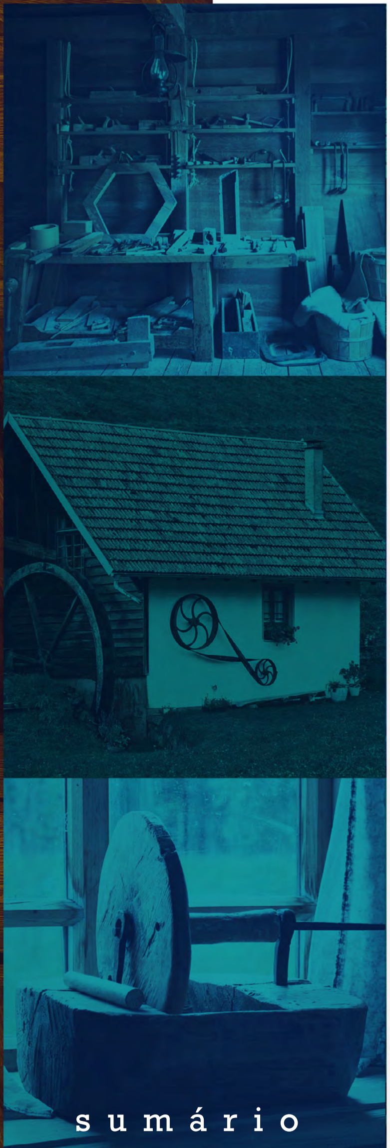


mediately seen that the amount of power generated by this plant was insufficient to meet local demand. Another group was formed under the leadership of P. Feddersen and this group finished the Salto Plant in 1915, which had an installed capacity of 4,000 HP.

The history of electric power generation in Blumenau provides an interesting example of the innovation capacity and aggressiveness of the region's businessmen. The building of the Salto Plant was a daring undertaking at the time and to implement it the proprietary firm, "Feddersen, Jensen & Zimmermann", had to take a loan from a group in São Paulo, which later became a partner in the undertaking (1920). With time, however, the São Paulo partner refused to increase its investment in order to generate more power. This attitude clearly went against the interests of the Blumenau businessmen for whom an increased power generation capacity was vital.

To solve the problem, a consortium was formed which was made up by the Hering group, already the largest industry in Blumenau; the Renoux group, also operating in the textile branch; the Hoepke organization, still one or the largest commercial firms in the state; the *Banco Agrícola* and the *Banco Alemão Transatlântico*; as well as other local businessmen, This consortium bought the São Paulo's group participation and continued to expand the power generation capacity that was so necessary to the industrialization and the economic growth of Blumenau. This fact illustrates another important characteristic of the industrialization process in the region, that has already been mentioned, namely that the process was mostly controlled locally (SINGER, 1977). A fundamental condition for a self-sustained process of capital accumulation (CARDOSO, 1979).

In the 1930s, the Blumenau industries increased their supply of goods to the national market, thus becoming part of the Brazilian industrialization process. According to Paul Singer, the success of the Blumenau industries was due to the fact that the started their activities



early, taking advantage or the market opportunities available at the time (SINGER, 1977). The expansion of the manufactured goods industry from 1958 to 1980 is shown on Table 4.8. As can be readily seen, the textile and garment manufacturing branches continue to be leaders in the manufacturing sector.

Table 4.8 - Blumenau: evolution of the industrial sector 1958/1980[4] [5] [6] [7].

BLUMENAU: Evolution of the Industrial Sector - 1958 / 1980 - Values in constant (1980) US Thousands of Dollars

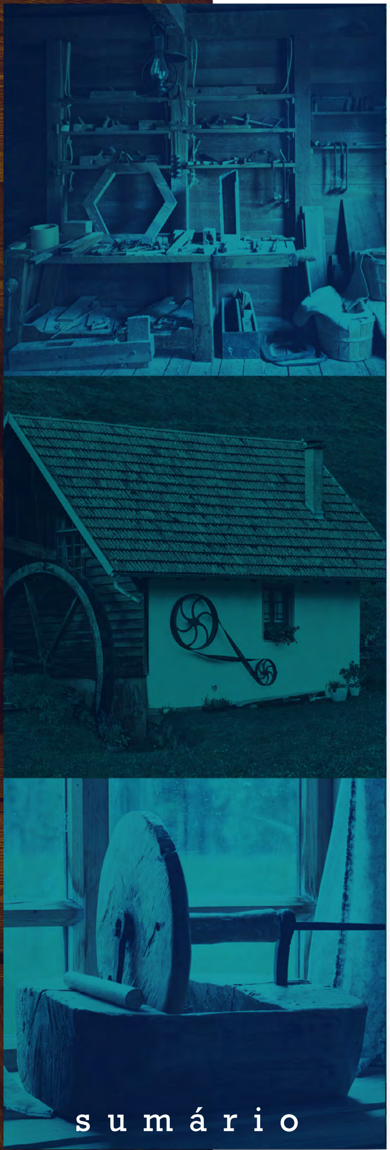
	1958				1970				1975				1980			
	Estab.	Employees (4)	Value add (5)	Rank (6)	Estab.	Employees (4)	Value add (5)	Rank (6)	Estab.	Employees (4)	Value add (5)	Rank (6)	Estab.	Employees (4)	Value add (5)	Rank (6)
Mining	x	x	x	-	5	28	16	-	7	39	124	18	7	54	344	17
Manufacturing durable goods	25	874	2372	B	155	2101	2668	B	158	3973	17971	B	236	5670	57051	B
Fabricated metal products	11	537	1949	2	40	971	1511	3	33	1676	9763	3	58	2349	29286	4
Machinery, except electrical	x	x	x	-	11	126	212	10	23	798	3151	8	44	1331	11576	8
Electrical, electronic equipment	x	x	x	-	5	35	58	18	10	151	1167	12	16	440	6353	9
Transportation equipment	x	x	x	-	10	151	203	11	10	414	1300	11	10	307	1996	14
Lumber and wood products	14	337	423	4	43	490	435	8	46	584	1476	10	64	862	5637	11
Furniture and fixtures (g)	-	-	-	-	46	328	248	9	36	350	1115	14	44	381	2203	13

4 Represents the monthly average of production workers plus all other employees.

5 Exchange rates used: 1958 US$1 = Cr$18.72; 1970 US$1 = Cr$4.56 (in 1966 there was a monetary reform); 1975 US$1 = Cr$8.07; 1980 US$1 = Cr$51.334 (the exchange rates used represent the July average of the corresponding year).

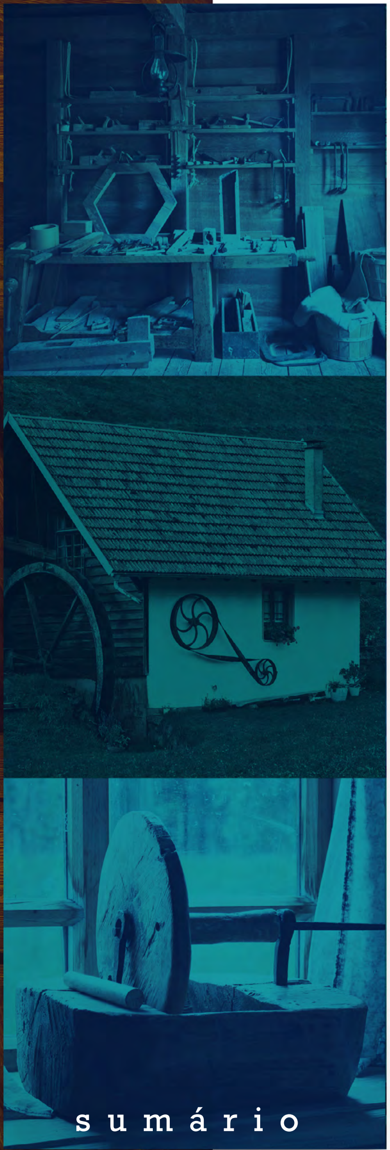
6 Value added ranked.

7 For 1958, the furniture's and fixtures' figures were included in the previous item.



Nondurable goods	64	6329	12325	A	239	13915	17872	A	248	20965	98166	A	312	27883	489721	A
Textile mill products	27	4413	10069	1	39	9446	12266	1	39	6773	31130	2	54	13477	180278	2
Apparel and other textile products	x	x	x	-	16	163	152	13	31	8104	43597	1	64	8373	220132	1
Food and kindred products	15	346	673	4	58	747	1262	4	46	910	4791	5	54	1265	12507	6
Paper and allied products	4	102	101	7	7	305	603	7	8	848	2091	9	11	907	11753	7
Rubber	x	x	x	-	3	25	21	19	5	44	167	16	4	42	474	16
Leather and leather products	5	75	282	6	5	75	83	16	3	48	166	17	3	16	135	18
Chemicals and allied products	2	9	12	10	7	97	97	15	2	n.a.	n.a.	-	3	105	1349	15
Misc. plastics products	x	x	x	-	3	87	66	17	6	210	1097	15	13	428	5874	10
Tobacco manufactures	2	529	34	9	3	693	692	5	3	1742	4249	6	2	n.a.	n.a.	n.a.
Printing and publishing	3	54	81	8	17	202	194	12	16	293	1164	13	16	354	3334	12
China and porcelain products	x	x	x	-	54	772	666	6	55	1199	3736	7	52	1522	12686	5
Miscellaneous industries	6	801	1073	3	27	1303	1772	2	34	786	5978	4	36	1394	41169	3
Total	89	7203	14697	-	399	16044	20555	-	413	24977	116262	-	555	33607	547116	-

Source: *BRASIL/IBGE – Censo Brasileiro* 1970 and 1980; *Censo Industrial* 1975 KAMIGONIAN A. (1966) – *"Estudos Geográficos das Indústrias de Blumenau"; Revista Brasileira de Geografia*, 3.



The growing industrialization process of the Blumenau economy can also be shown through the increase of the share of industrial production in the local gross domestic product. Table 4.9 shows a comparison between industrial and agricultural productions.

Table 4.9 - Blumenau: industrial and agricultural gross output value (%) - 1940/1980.[8].

BLUMENAU: Industrial and Agricultural Gross Output Value (%) - 1940/80					
	1940	1950	1960	1970	1980
Agriculture	25	n.a.	n.a.	3	0.5
Industry	75	n.a.	n.a.	97	99.5
Total	100	n.a.	n.a.	100	100

Source: *BRASIL/IBGE – Censo Brasileiro* 1940, 1950, 1960, 1970, and 1980.

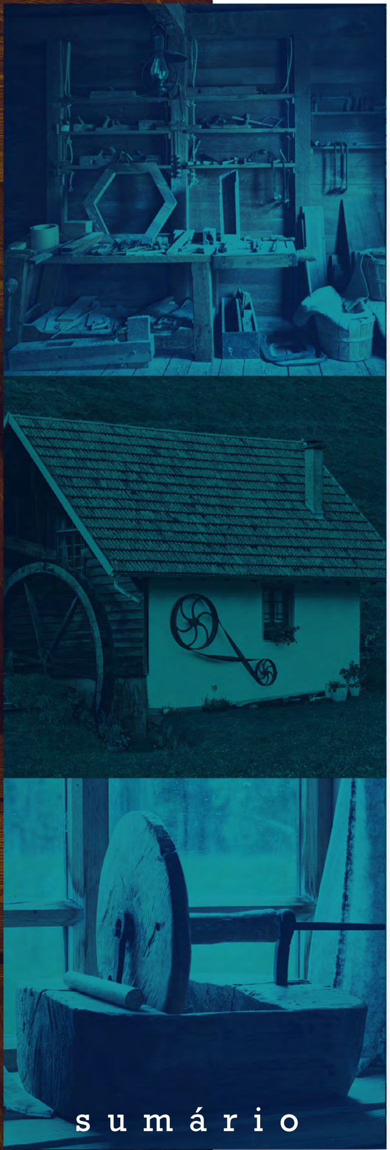
The urban expansion of Blumenau, which went hand in hand with the industrial process, received an added thrust during the 40s. Between 1940 and 1980, the share of the economically active population that worked in industry, as compared to the population that worked in agriculture, went from 20% in 1940 to 85% in 1980 (see Table 4.10, below).

Table 4.10 - Blumenau: comparison between the industrial and agricultural labour forces - 1940/1980.

BLUMENAU: Comparison between the industrial and agricultural labour forces- 1940/80					
	1940	1950	1960	1970	1980
Agriculture	74	47	n.a.	27	15
Industry	26	53	n.a.	73	85
Total	100	100	n.a.	100	100

Source: *BRASIL/IBGE – Censo Brasileiro* 1940, 1950, 1960, 1970, and 1980.

8 1940's figures represent estimated averages.



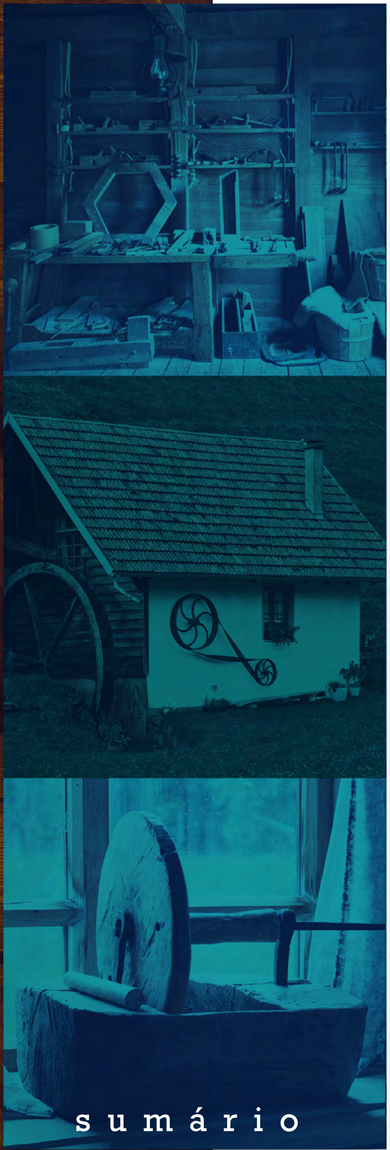
One hundred and thirty years after being founded, Blumenau had become a predominantly urban and industrial center.

Finally, mention should be made of a third process related to the economic development of Blumenau, during its proto-industrialization period, which concerns the role of the first entrepreneurs that settled in the region. According to the available information, particularly that provided by specific studies on the history of Blumenau's industrialization (HERING,1950; MAMIGONIM, 1965; *SC/CEAG*, 1980; SINGER, 1978), strongly emphasize the importance of those entrepreneurs for the success or Blumenau's industrial development. In the next chapter, this role is taken into account, specially concerning the firms' strategy towards innovation.

ORLEANS: FROM PROTO-INDUSTRIALIZATION TO AGRICULTURAL SPECIALIZATION

During the first half of the nineteenth century a large coal mine was discovered in the south of Santa Catarina. Early in 1880, the construction of a railway was started, the Thereza Christina Railroad, inking the coal mine areas and Imbituba, a small harbour situated on the Southern coast of Santa Catarina.

The area or the *Colônia Grão-Pará*, in Orleans, was located between the Imbituba harbour and the coal mines; the lands belonged to the Royal Family (at that time Brazil was still a monarchy). There were already three immigrant settlements nearby: the "*Colônia Espontânea*" de Braço do Norte, "*Colônia* Azambuja" and the "*Colônia* Urussanga".



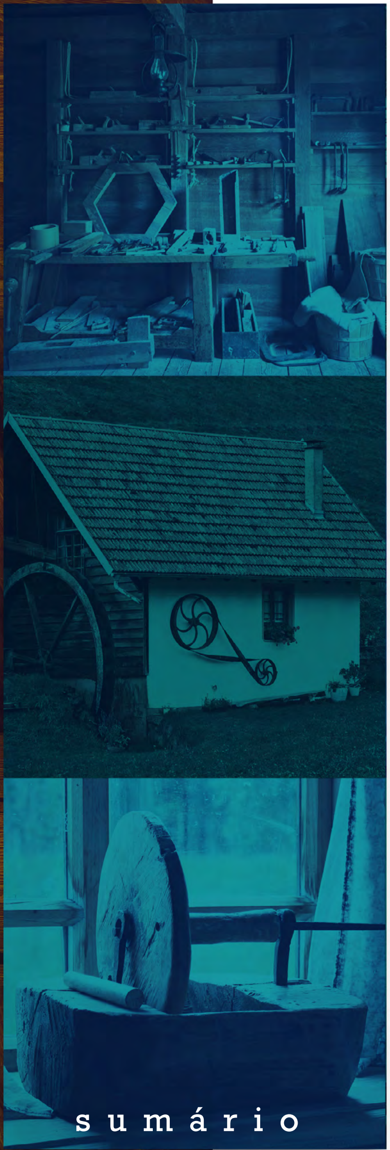
On 15 November 1881, a contract was signed in Paris between Princess Isabel, to whom the Orleans lands actually belonged, and the *Comendador* Joaquim Caetano Pinto Júnior, a well-established Portuguese merchant who lived in Paris and had a business in Rio de Janeiro for import & export trade. According to that contract, Princess Isabel would have twenty-five per cent of all net profits from the settlement enterprise in Orleans in addition to and here comes what seems to be the real reason or that contract the same share in the net profits from the exploitation of coal mines or other minerals, if they were found in the area (MARTINS, 1979; also files of the *Companhia Grão-Pará*).

The *Colônia Grão-Pará* was established on December 2, 1882. It had a completely different start from that of Blumenau. Not only because of its origin, which incidentally had also been financially covered by a French firm - *Fould Freres & Cia*[67], but also because of the infrastructure that was set up even before the first immigrant had arrived.

In 1884, two years after the foundation of the *Grão-Pará* settlement in Orleans, the company had twenty-nine employees, namely one executive director, one secretary, four clerks, six surveyors, one physician, four nurses, one drawer, and fourteen servants [68]!

The first immigrants that arrived in of Orleans were mostly Italians. In April 1884 there were approximately 1,000 people living in the *Colônia Grão-Pará* settlements, of which forty-two per cent were Italian, thirty-one per cent German, twenty per cent Portuguese, and a small percentage of French and Polish. However, a relatively high proportion, around one third, of the lands that were sold by the company were bought by immigrants that had already settled in the neighbouring colonies.

However, despite the large infrastructure that was set up and the large amount of capital invested in the enterprise - in five years the *Companhia Grão-Pará* had invested over seven times more than Dr. Blumenau had expended during the first ten years of his company.



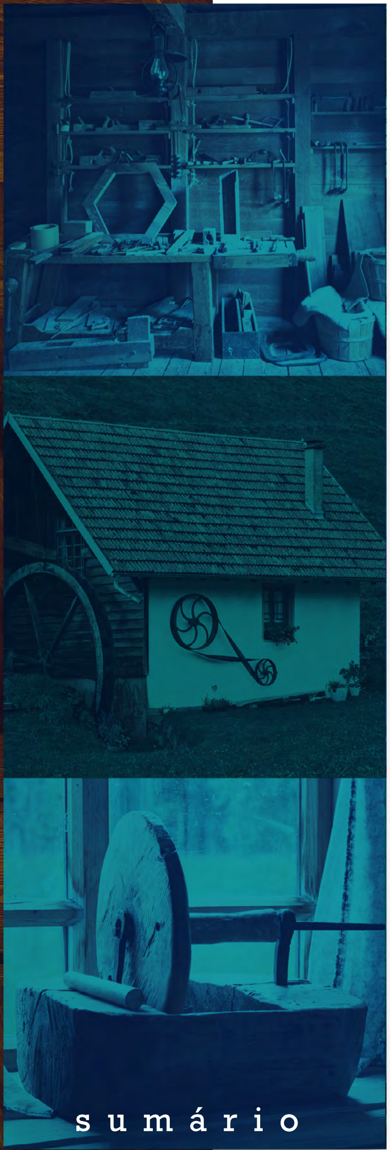
[69] moreover, in 1890, fearing the end of the monarch in Brazil and the prospect of more losses, the company was almost completely dismantled, keeping only two trade posts open, now run by the son of *Comendador* Joaquim Pinto.

The central question that emerges from this case is why did the Orleans settlements not develop as Blumenau's? Or putting it in another way? Why was it that the process of proto-industrialization did not succeed as it did in Blumenau?

The interesting thing about the Orleans case is that it helps to understand the success of Blumenau's development. In order to make this point clear, it is necessary to draw a simple comparison between the two cases. This comparison can be made by looking at the three main aspects which were suggested in the previous section as being the basis of Blumenau's successful industrial development.

The first aspect refers to the development of endogenous social and economic structures. As it was already stressed in the previous sections, the establishment of a flourishing trade, which was locally owned, had been crucial in both phases, i.e., during the proto-industrialization phase, by providing the economic conditions for its development; and through the transition phase, by the tradesmen themselves, who moved on into industrial activities.

In Orleans, the development of commercial activities had very different characteristics from those already identified for Blumenau. Initially, it is necessary to emphasize the socio-economic profile of the businessmen themselves. Among the businessmen who participated directly or indirectly in the business of the Colony, there were two main categories. The first was made up of small businessmen (shopkeepers) located in the colony. The second was made up of medium and large businessmen, among which the *Companhia Grão-Pará* itself and its associates with selling posts in the colony as well as those businessmen



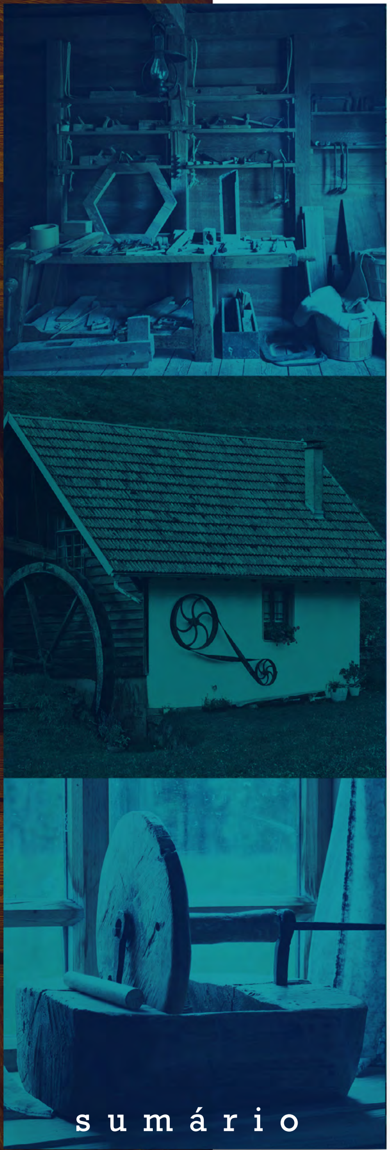
located in the ports of Laguna, Desterro and Tubarão (see Map 4.1) and in Rio de Janeiro.

According to the records available, until 1888 the *Companhia Grão-Pará* controlled all commercial operations between the colony and the outside as well as all local businesses, furnishing "chits" to the settlers who did not have any financial resources so that the be able to buy the necessary goods (MARTINS, 1979). Even the services rendered by the settlers to the company were paid with these "chits", thus, for a long time the local economy was practically "demonetarized".

Another problem faced by the settlers was the absence of transportation and road infrastructures which would permit the local economy to flourish. According to the *Companhia Grão-Pará's* 1881 report, there were only three routes of access to the colony, all of which by river (the Capivary, Braço do Norte and Oratório rivers). The construction or a branch or the Thereza Christina Railroad, around 1888, was not sufficient to overcome the transportation problem.

In fact, those problems were enhanced. Firstly, this railroad was built for the transport of charcoal extracted from neighbouring lands to the ports of Laguna and Tubarão. The initial plans of the railroad company had made no provisions for intermediate stat ions for loading and unloading people and goods. Secondly, the very large fares charged made the transport of small amounts of goods economically impossible.

Thus, the flow of production was only feasible in large amounts, be it through the small river freight boats, be it through the railroad. Both means of transportation were monopolized by the large businessmen and, mainly, by the *Companhia Grão-Pará* itself, which exported the colony's products to more advantageous markets.



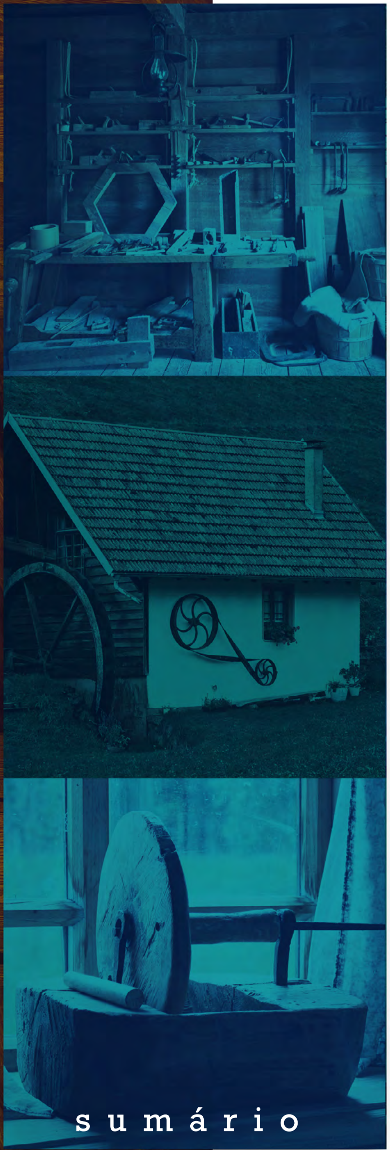
Since the company's major concern was to pay back its investment, no significant economic ties with or commitment to the development of the region were ever actuals established. This can be illustrated by the small number of agro-industrial units that were set up in the company area, between 1882 and 1892. It is shown on Table 4.1, below, there were only twenty-eight mills in operation in the Orleans area, while in Blumenau, after its first decade there were eighty-two mills (see Table 5.6, Chapter 5).

Table 4.11 - Orleans: family-based industries 1882/92.

Family Based Industries - 1882 / 92 (Orleans)	
Types	Number
Cassava flour* - Mills	17
Sugar - Mills	10
Hand - Mills	9
Carpentries	10
Bakeries	8
Smitheries	5
Breweries	4
Brick Factories	3
Charqueadas	2
Joineries	2
Tailor's Workshops	2
Wood - Mills	1

Source: Fieldwork. (Files of the *Companhia Grão-Pará*)

The weak performance of the local agro-industries during the proto-industrialization phase was in act a consequence of the process through which the economic and social structures were formed in



Orleans. This process, as was described above, did not permit the emergence of a more independent economy (particularly with regard to the decision-making process) and a sounder technical base. Consequently, there was no significative industrialization in the region, as may be seen in Table 4.12, below.

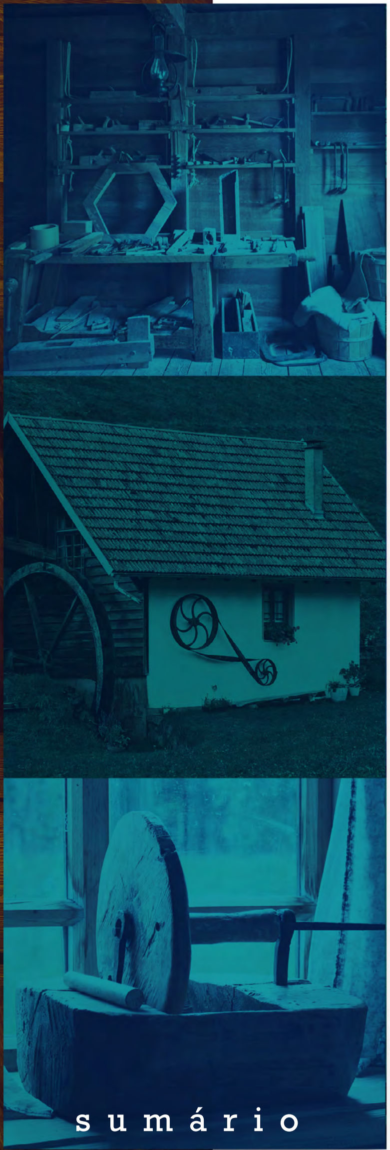
Table 4.12 - Orleans: evolution of the industrial sector 1958/1980[9] [10] [11].

ORLEANS: Evolution of the Industrial Sector - 1958 / 1980 - Values in constant (1980) US Thousands of Dollars	1958				1970				1975				1980			
	Estab.	Employees (9)	Value add (10)	Rank (11)	Estab.	Employees (9)	Value add (10)	Rank (11)	Estab.	Employees (9)	Value add (10)	Rank (11)	Estab.	Employees (9)	Value add (10)	Rank (11)
Mining	-	-	-	-	-	-	-	-	-	n.a.	n.a.	-	-	-	-	-
Manufacturing durable goods	-	-	-	-	31	134	56	-	45	201	422	-	48	414	1607	-
Fabricated metal products	-	-	-	-	4	18	10	3	2	n.a.	n.a.	-	3	23	110	5
Machinery, except electrical	-	-	-	-	1	n.a.	n.a.	-	1	n.a.	n.a.	-	1	n.a.	n.a.	-
Electrical products	-	-	-	-	1	n.a.	n.a.	-	x	x	x	x	1	n.a.	n.a.	-
Transportation equipment	-	-	-	-	x	x	x	x	2	n.a.	310	1	5	24	49	6
Lumber and wood products	-	-	-	-	21	59	22	2	34	121	112	3	28	213	1030	1
Furniture and fixtures	-	-	-	-	4	57	24	1	6	80	n.a.	-	10	154	418	4
Nondurable goods	-	-	-	-	18	23	7	-	22	46	235	-	30	207	1573	-

9 Represents the monthly average of production workers plus all other employees.

10 Exchange rates used: 1958 US$1 = Cr$10.72; 1970 US$1 = Cr$ 4.56 (in 1966 there was a monetary reform); 1975 US$1 = Cr$8.07; 1980 US$1 = Cr$51.334 (the exchange rates used represent the July average of the corresponding year).

11 Value added ranked.



Textile mill products	-	-	-	-	1	n.a.	n.a.	-	x	x	x	x	1	n.a.	n.a.	-
Apparel and other textile products	-	-	-	-	1	n.a.	n.a.	-	1	n.a.	n.a.	-	3	122	498	3
Food and kindred products	-	-	-	-	9	23	7	4	12	46	212	2	15	85	995	2
Leather and leather products	-	-	-	-	1	n.a.	n.a.	-	1	n.a.	n.a.	-	1	n.a.	n.a.	-
Printing and publishing	-	-	-	-	1	n.a.	n.a.	-	1	n.a.	n.a.	-	2	n.a.	n.a.	-
Miscellaneous industries	-	-	-	-	5	n.a.	n.a.	-	7	n.a.	23	4	8	n.a.	80	7
Total	-	-	-	-	49	157	63	-	67	247	657	-	78	621	3180	-

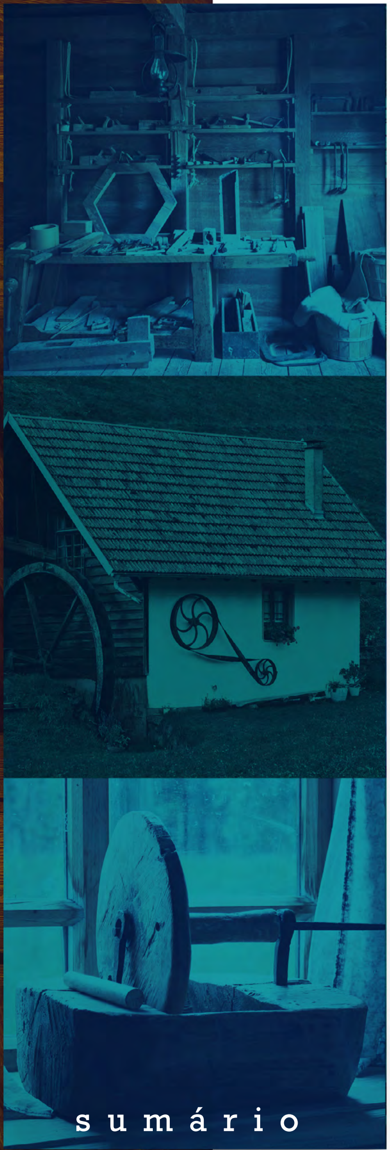
Source: *BRASIL/IBGE – Censo Brasileiro* 1950, 1970, 1975, and 1980.

In fact, the subsequent phases of the Orleans socio-economic development process produced an essentially agricultural economy, based on small and medium size production farms. The stability of this agricultural economy may also be assessed by comparing the distribution of the labour force between the primary and secondary sectors, as shown in Table 4.13.

Table 4.13 - Orleans: comparison between the industrial and agricultural labour forces - 1940 / 1980.

ORLEANS: Comparison between the industrial and agricultural labour forces- 1940/80					
	1940	1950	1960	1970	1980
Agriculture	89	78	n.a.	96	88
Industry	11	22	n.a.	4	12
Total	100	100	n.a.	100	100

Source: *BRASIL/IBGE – Censo Brasileiro* 1940, 1950, 1960, 1970, and 1980.



The second aspect is related to the development of an endogenous technical base which, as it was illustrated in the case of Blumenau, it is also extremely important for a process of self-sustained industrialization. In order to provide the colony with the widest possible range of skills and technical knowledge, Dr. Blumenau took a great deal of care, supervising himself the selection of immigrants.

In Orleans, the *Companhia Grão-Pará* seems not have had that kind of policy, since no special request was ever made to the company's agent concerning this matter. At least none was found neither in the company's files during the fieldwork nor in the bibliography surveyed at that time (1981).

The fact was that Orleans did not have the same kind of skilled immigrants as Blumenau did[70]. Tables 4.14 and 4.15 illustrate this point quite well.

Table 4.14 - Orleans: Colônia Grão-Pará 1882/92 Skills of the immigrants.[12].

ORLEANS: Colônia Grão-Pará 1882 / 1892 - Skills of the Immigrants	
Skills	No.
Shoemaker	7
Hospital Orderly	2
Surveyor	3
Falqueador (I)	1
Stone-Cutter	3
Mason	3
Machinist	2
Total	21

Source: Fieldwork/1981.

12 Person who roughews or squares timber

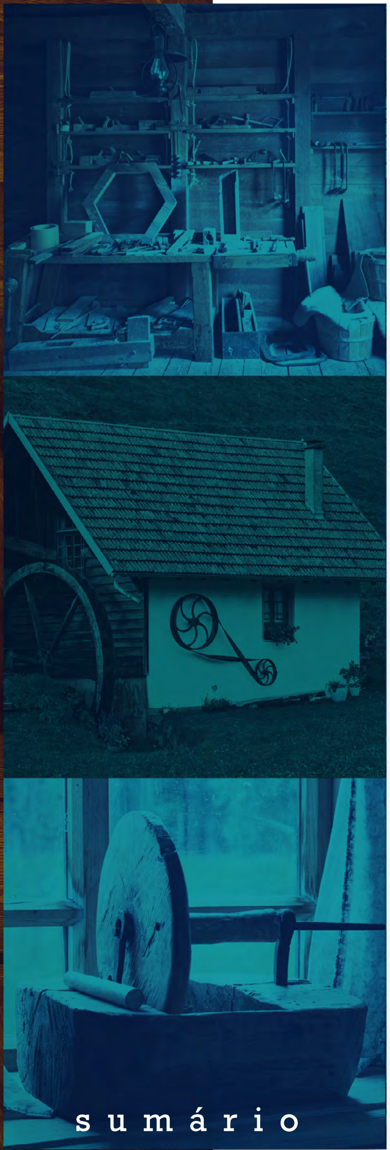


Table 4.15 - Orleans: Colônia Grão-Pará (include Rio Belo) skills of the Immigrants.

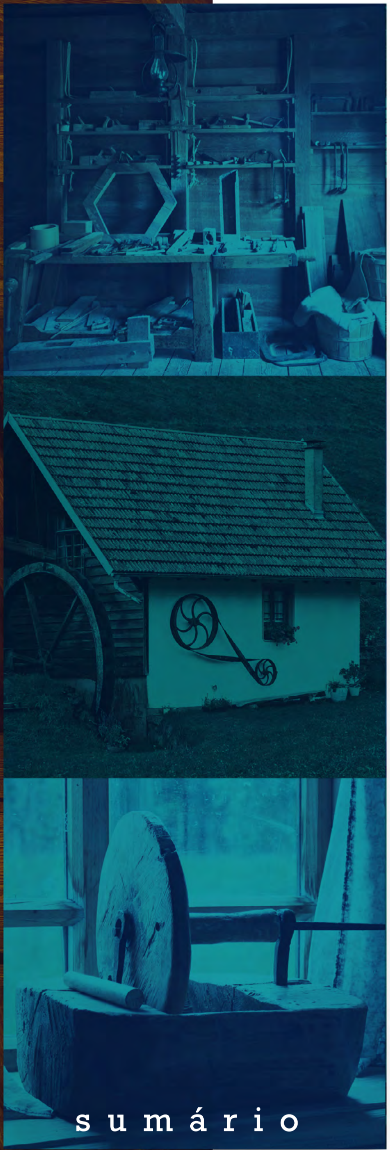
Distribution of Immigrants According to Skills 1882 / 1892 (Orleans & Rio Bello)		
Skills	Totals	(%)
Woodcrastsman	1	
Tanner	1	
Blacksmith	1	
Joiner	1	
Baker	1	
Shoemaker	2	
Saddler	2	
Total Craftsmen	9	14.00
Total Craftsmen	3	
Total Craftsmen	29	
Total Craftsmen	19	
Total Craftsmen	4	
Total	64	100.00

Source: Fieldwork/1981. (Files of the *Companhia Grão-Pará*).

NOTES TO CHAPTER 4

INTRODUCTION

[60] Note that the term 'colonial' is used here as referring exclusively to the economic system set up by the immigrants. Therefore, it should not be confused with the Brazilian Colony,



established by the Portuguese and whose economy was mostly characterized by export-oriented plantations, based on slave labour force.

THE SETTLEMENTS IN SOUTHERN BRAZIL: 1850 – 1900

[61] Desterro was founded on an island of the same name, which later became the capital of the State or Santa Catarina, renamed Florianópolis.

BLUMENAU: FROM PROTO-INDUSTRIALIZATION TO INDUSTRIALIZATION

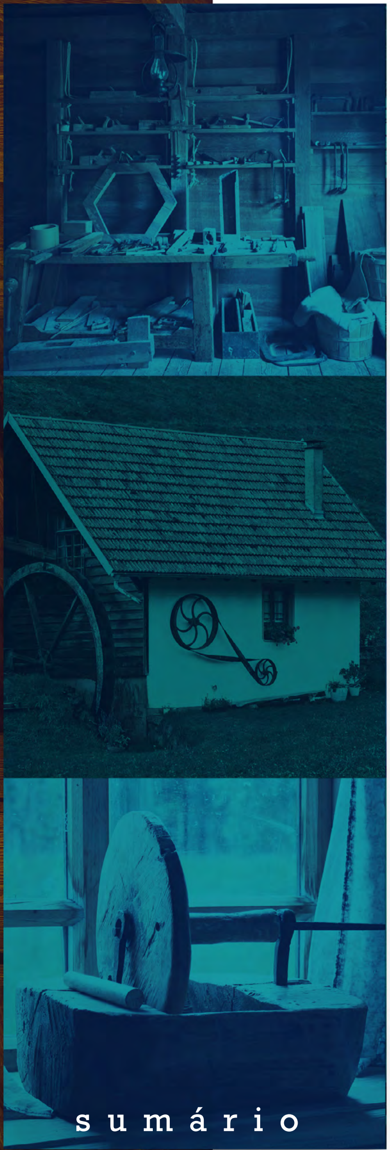
[62] Singer refers to 1883 as the end of that first phase (SINGER, 1977), but other studies suggest 1880 because it was in that year that the first industry was founded in Blumenau. This industry, Hering S/A, is currently one of the biggest textile companies in Brazil.

[63] From the beginning, Dr. Blumenau financed the enterprise with his own personal resources. Even the substantial amount of money he inherited after his father's death, in 1850, was almost entirely invested into his colonial company.

[64] After Brazil's independence from Portugal in 1822, its political regime continued to be monarchical until 1889, when the Republic was established.

[65] A reproduction of the contract between the Brazilian government and Dr. Blumenau, concerning the selling of the *Colônia* Blumenau, can be found in "*Centenário de Blumenau* – 1850/1950".

[66] During that period the Brazilian Government invested 2,468 Contos, which gives an average or 112 Contos/year (1 Sterling Pound = 23 Contos - average exchange rate between 1860/1880). During the first ten years of the colony, the total investment made by Dr. Blumenau was 85 Contos (also, the 45,000 Thalers he inherited from his father should be included. However, it is likely that such money had been mostly expended abroad, with the immigrants travelling expenses).



ORLEANS:
FROM PROTO-INDUSTRIALIZATION
TO AGRICULTURAL SPECIALIZATION

[67] A French company, the *Fould Freres & Cia*, and another import & export trader from Rio de Janeiro, Le Cocq Oliveira, were also banking the *Comendador* Joaquim Pinto. During the first five years or the *Companhia Grão-Pará*, the *Fould Freres* participated with approximately seventy per cent of the whole investment.

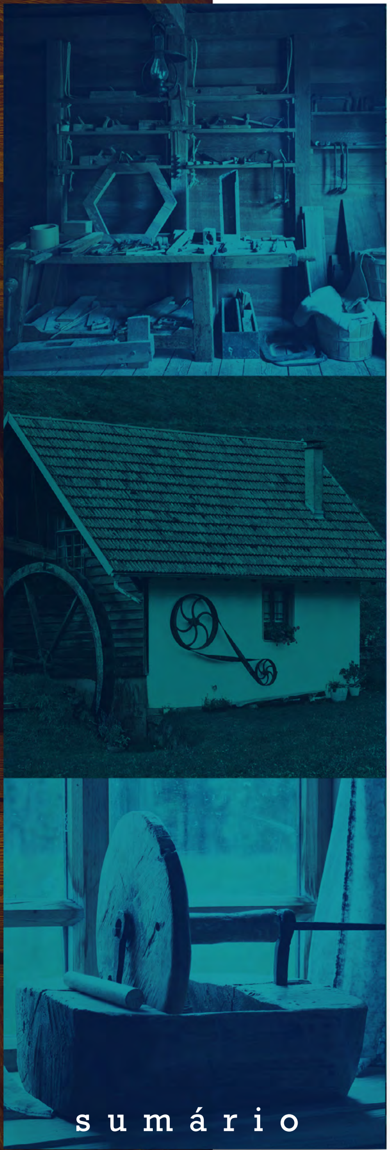
[68] The establishment of such a complex very beginning, strongly suggests that the enterprise was the exploitation of anything else. infrastructure from the actual objective of minerals rather than anything else.

[69] This calculation already includes the possible effects of the inflation at that time. This was done by taking into account the fluctuations of the Brazilian currency vis-a-vis the Sterling, over that period.

[70] Another possible explanation for that situation could be the fact that at that time São Paulo was already attracting many immigrants, especially for the coffee plantations.

5

DEVELOPMENT OF THE CASSAVA STARCH AGRO-INDUSTRY IN SANTA CATARINA

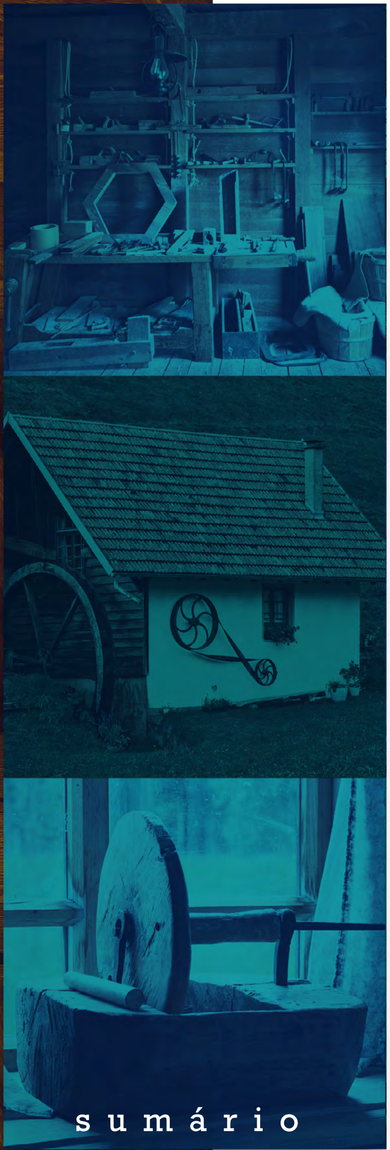


INTRODUCTION

In this chapter, the technological development of the cassava starch agro-industry in Santa Catarina between 1850 and 1980 is discussed. The analysis is focused on the history of the cassava starch industry in Blumenau, which had its beginning in 1916 when the first cassava starch industrial plant was founded by two brothers, Hans and Fritz Lorenz. Incidentally, the *Companhia* Lorenz was also the first starch industry in Brazil and is currently the largest Brazilian cassava starch industry.

In Section 5.2 an overall view or the economic and social history of the cassava agro-industry in Brazil is presented. It stresses the marginal position and the main constraints which the production of cassava has faced throughout Brazilian history, ever since colonial times. Comparison between the pattern of cassava production in Brazil and Santa Catarina, with regard to its cultivation and processing, is also presented in this section.

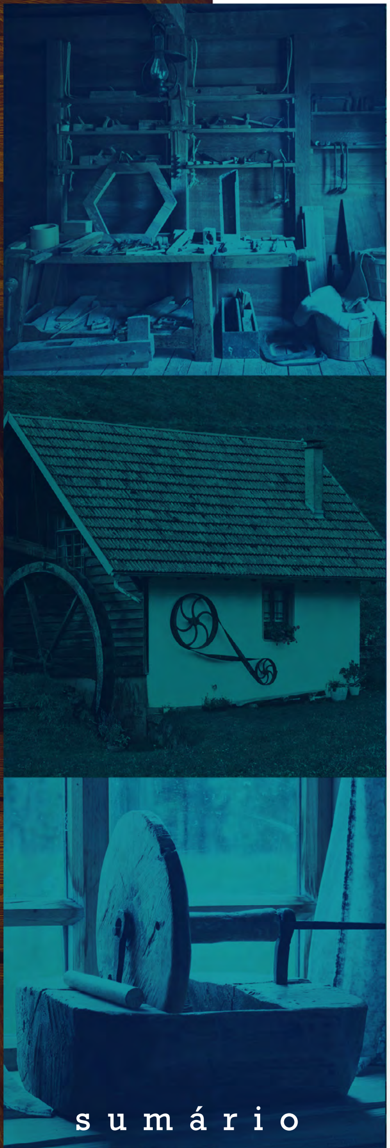
Section 5.3 deals with the technological development of cassava processing (proto) industry in Santa Catarina, particular is in the region of Itajaí Valley where Blumenau is located. Here, the analysis is concerned with the technological change brought about to the cassava processing units by the immigrants, during the proto-industrialization period in Blumenau's development process. It is then argued that those changes were secondary technological innovations, in the sense that the represented only minor shifts from the technological trajectory in the existing technological paradigm. Yet, such changes had not occurred so far in any other Brazilian region, despite three and a half centuries of colonial history. In this respect, the social and economic structures set up by the immigrants in Southern Brazil, particular is in the case study area, were extremely important, since the created the necessary conditions for the development of a cassava agro-industry on a basis other than



that defined by the colonial economic system. Equally important was the establishment of a solid technical base in the Blumenau colony from the very beginning, sharply contrasting with the history of the *Colônia Grão-Pará* in Orleans.

In Section 5.4 the process of technological progress during the industrialization period is discussed. The patterns of technological change are analyzed against the background of the industrialization process that took place in the region of Itajaí Valley. This analysis is made taking into account the different development phases, discussed in the previous chapter, with their distinct patterns of capital accumulation. Here, the emergence of a light capital goods industry, increasing the local technological capability, was a significant achievement in the development of the region's technical base. In this context, the technological strategies followed, in general, by the firms of the region are also taken into account.

Finally, the impact of the introduction of a new technological process to produce chemically modified starch is presented This new process, which represented a primary innovation not only in terms of the local cassava starch industry but also in terms of the local technical base, led the Lorenz Company, the only Brazilian starch Company that had the necessary conditions to make such a move, to change its technological strategy. In 1973, the Lorenz Company set up a new Company, a joint-venture with the National Starch and Chemical Corporation, which was at the time one of the transnational companies that had the control of the patents to produce the chemicals modified starches.



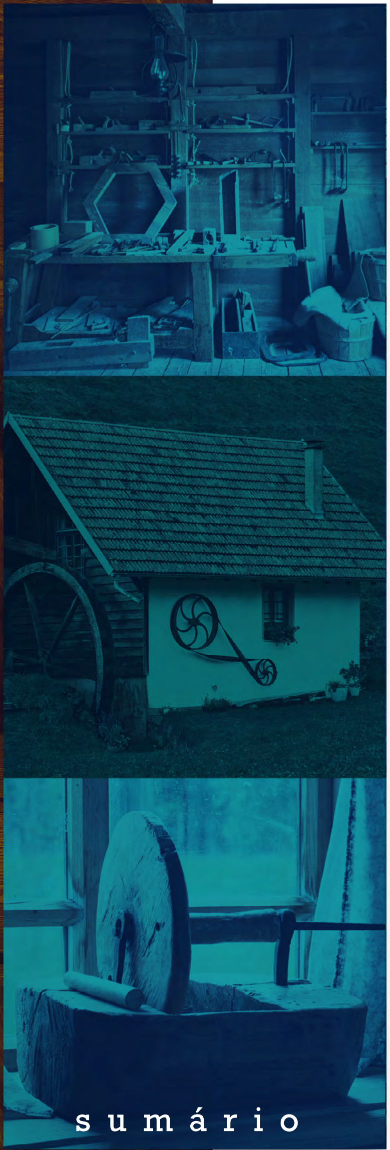
THE SUBSISTENCE PRODUCTION SYSTEM

In Brazil, cassava cultivation and cassava processing have historically presented four distinct characteristics. The first refers to the scale in which cassava cultivation is presently carried out. typical area of cassava production ranges, according to the 1980 Brazilian Census, from two to five hectares. Such small plots represented twenty-three per cent of the total areas of production and accounted for about sixteen per cent of both the total amount and the total value of the cassava produced in that year. In other words, cassava cultivation is presently and presumably will continue to be predominant is undertaken on a small scale. About fifty-four per cent of the cassava growing farmers are land owners. Such pattern is in sharp contrast with the general patterns of land ownership in Brazil, as can be seen in the Table 5.1, below.

Table 5.1 - Distribution of landownership & area groups in Brazil.

Distribution of Land Ownership & Area Groups (Brazil)								
Area (ha/ Farms)	Owners		Tenants		Share-Croppers		Others	
	No. Of Farms	Total Area (ha)	No. Of Farms	Total Area (ha)	No. Of Farms	Total Area (ha)	No. Of Farms	Total Area (ha)
Less than 10	1241209	5245720	475057	1113826	247288	908337	634465	1736375
10 to 100	1682147	55136011	86816	2497056	67650	1430729	180161	5430544
100 to 1000	422478	111412370	22392	5980685	3253	776073	40398	8630059
1000 to 10000	41726	96591954	1090	2296089	199	465597	2481	5195207
More than 10000	2211	56247278	38	949180	14	250158	82	2561164

Source: *Censo Brasileiro* - 80.



The small-scale cultivation that characterizes cassava cultivation in Brazil is deeply rooted in Brazilian colonial history. As it has already been pointed out, the chief concern of the colony's economic activities was centered on export-oriented commodities based on large one-crop plantations. The growing of crops for local needs, particularly foodstuff, constituted a marginal, although necessary, activity in the colony's economic life. Usually such activities were carried out under an apparent is benevolent plantation owner, who allowed the slaves to take care of their small allotted plots once a week (generally on Sundays...). Cultivation of subsistence crops were also carried out by tenant farmers, quite often attached to large plantations. [71] Thus, the food requirements or the people engaged in the production of those export-oriented crops were reasonably provided for. [72]

The second characteristic is related to the organization of the labour process, the cultivation of subsistence crops was frequently organized on a family basis, i.e., the labour force engaged in those small-scale productive activities was mainly constituted by the non-waged labour of the farmer's family members. This form of production is still predominant nowadays. In the case of cassava, according to the 1980 census, about ninety-two per cent of the labour force working in cassava cultivation was constituted by the farmers' family members. this situation is in sharp contrast with, for instance, the labour process in sugarcane plantations, where the production requires a high level of capital investment (see Figure 5.1). As it can be seen in Table 5.2, the non-waged workers predominate in the Brazilian agricultural labour force.

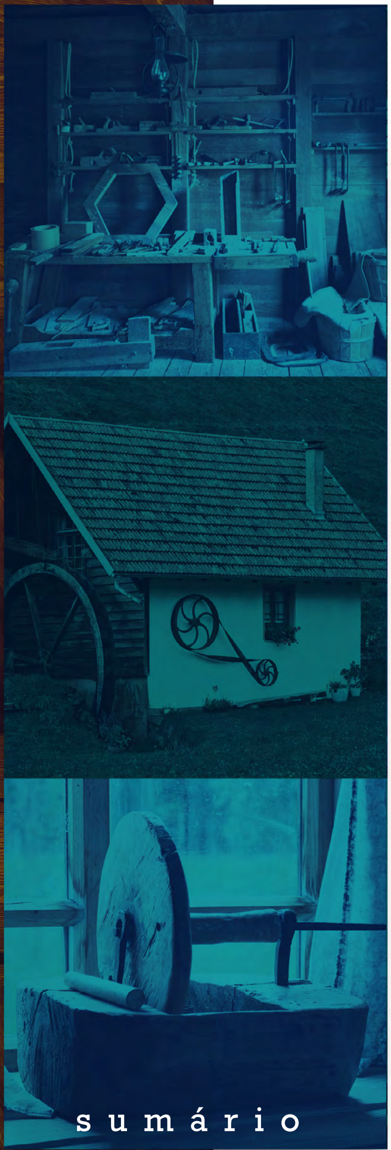
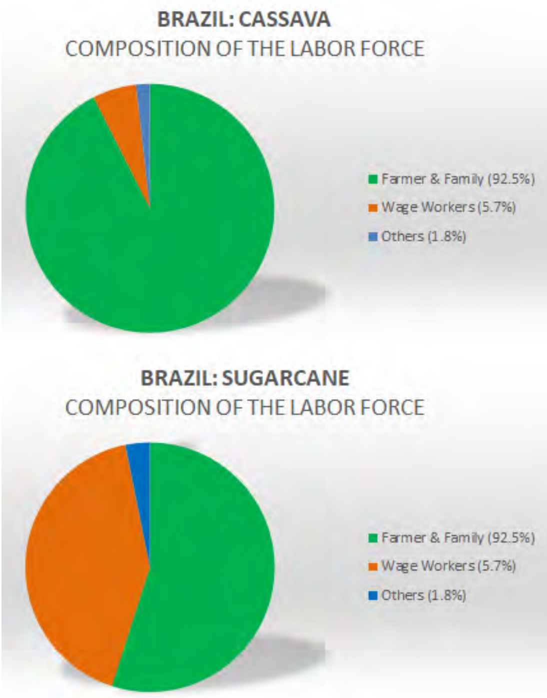


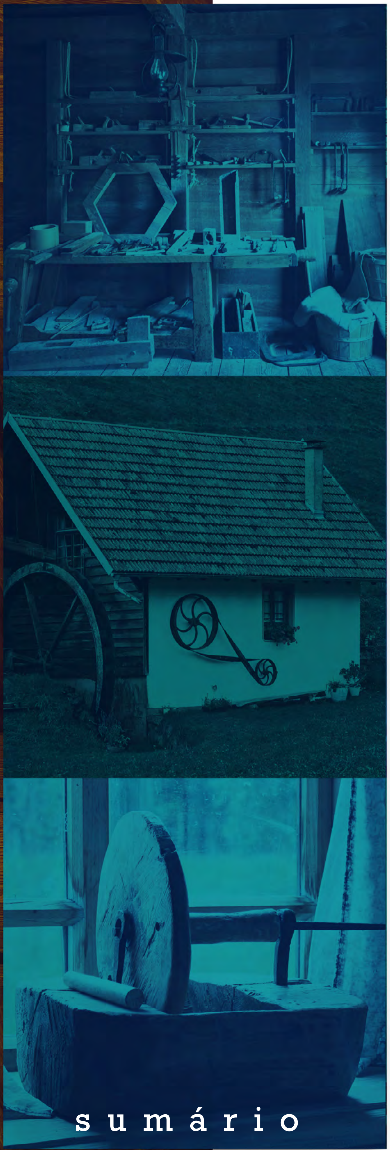
Table 5.2 - Labour force distribution according to area groups (Agricultural sector) in Brazil.

Labour Force Distribution According to Area Groups (Brazil)					
Area (ha/Labourers)	Members of the Farmer's Family	Permanent Employees	Temporary Employees	Share-Croppers	Others
Less than 10	7309179	111141	453482	30106	17813
10 to 100	6737771	578905	1121034	243207	37757
100 to 1000	1459653	1009995	917008	192172	25715
1000 to 10000	114917	380501	242911	26602	6699
More than 10000	2256	85950	29797	378	993

Source: *Censo Agropecuário Brasil* - 80.

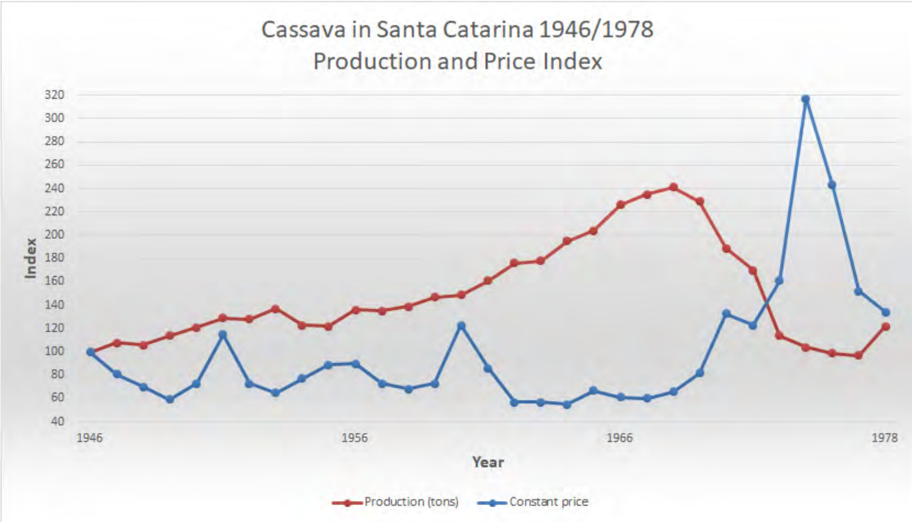
Figure 5.1 - Comparison between the compositor of the labour force in cassava and sugarcane.





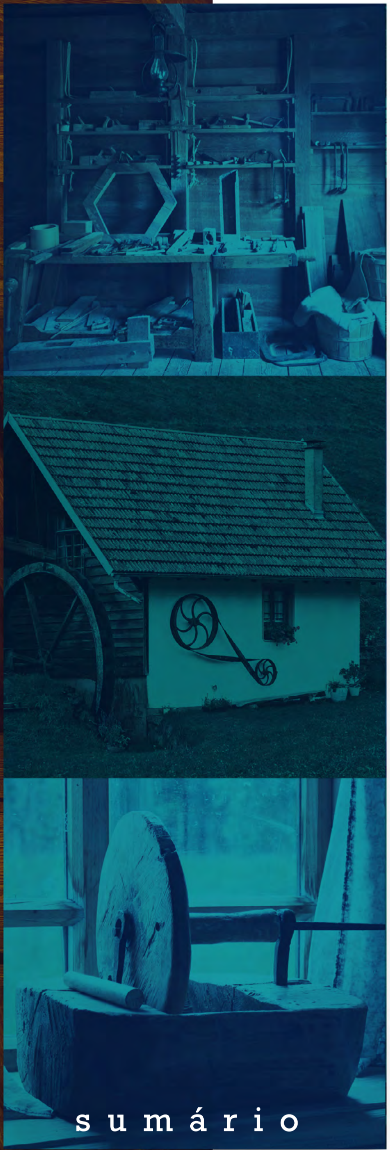
A third important characteristic of cassava production concerns its commercialization, which has constantly suffered from the problem of price fluctuation associated with an oscillating output performance (see Figure 5.2). This vicious circle has been one of the major constraints in the development of the cassava agro-industry (AGUIAR, 1977; PHILLIPS, 1973 and 1979; SILVA, 1979)[73].

Figure 5.2 - Cassava in Santa Catarina production and price index 1946-1978.



The reasons for such an irregular market behaviour can be found in the very economic and social history of that crop. As it was pointed out, the cultivation of cassava and the processing of its main foodstuff products (mainly cassava flour and cassava meal) had been incorporated into the colony's economy for the sole purpose of providing part of the food requirements of the plantation's labour force, which was actually engaged in the production of commercial crops.

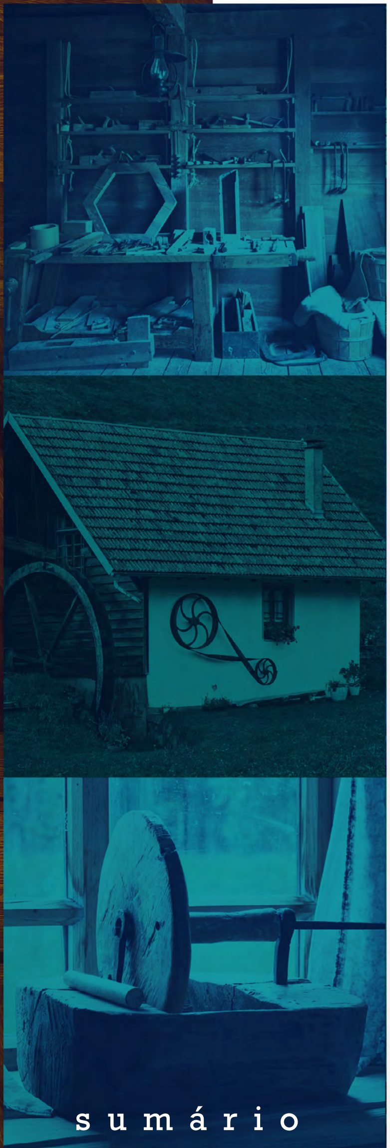
The abolition of slavery in Brazil in last quarter of the nineteenth century brought about new forms of economic ties between landlords and small farmers, including cassava producers, in the traditional



plantation areas, such as in the Northeastern Region (FORMAN, 1975). During the colonial period, the subsistence crop production was almost entirely consumed locally, i.e., by the plantation's labour force itself. Currently, the small surplus of each individual farmer or foodstuff productor is commercialized in the nearest urban marketplace, which quite often also has a small consumption market. Consequently, any increase in the cassava suppls (either as fresh cassava or as cassava flour) tends to induce a price reduction. When this happens, the farmer also decreases the cassava crop area for the following year. Two years later (the average maturation time for harvesting is between one and a half and two years) it is quite likely to occur a shortage in the cassava supply and, consequently, prices go up again.

Finally, the fourth relevant characteristic of cassava cultivation and processing is related to the technologies employed in the production processes which, in general terms, present a very low level of development (PHILLIPS, 1973; SILVA, 1979 SAINT, W. & L. G. MENDES, 1976). The cultivation is predominant if made on the same primitive technological level used during colonial times. The field clearing is still made using slash and burn techniques and the soil does not receive any kind of preparation with chemical fertilizers. There is no mechanization. Planting and harvesting are both done manually (incidentally, the intro duction of machines into the cassava cultivation process, particular is in its harvesting, will require a substantial selection and breeding effort because cassava tubers have a wide range of sizes, shapes and weights). Therefore, it is not surprising that cassava cultivation in Brazil has a low yield per hectare on the average (11 ton/ha), compared with an estimated potential production of 30 ton/ha (*BRASIL-CNPq*, 1978).

To sum up, the cassava production and processing in Brazil can present is be characterized by four main features: (I) cultivation based on small-scale farming and frequently intercropped with beans and corn; (II) labour force basically constituted by the farmers family members; (III) irregular market structure associated with an unstable



price pattern; and, Finally, (IV) low technological level in both the cultivation and processing stages.

Table 5.3 - Status of the cassava producers according to land ownership (Brazil).

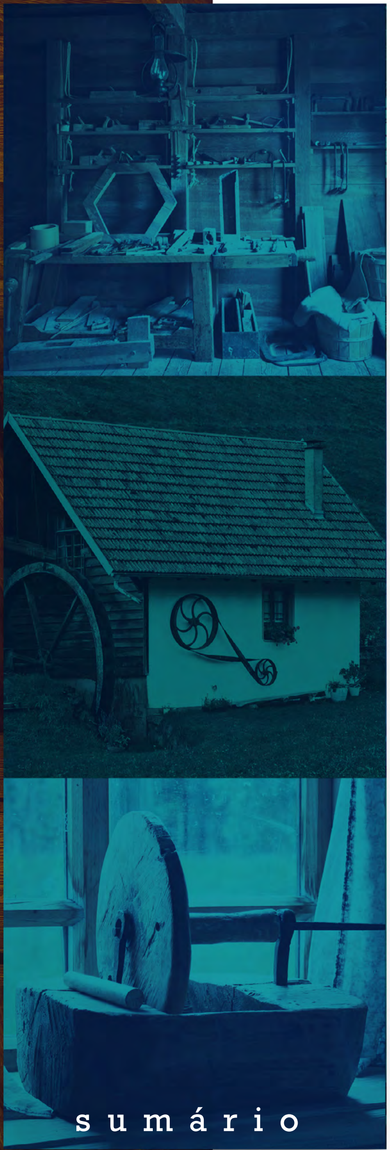
Status of the Cassava Producers According to Land Ownership (Brazil)				
	Owners	Tenants	Share-Croppers	Others
No. of Farms	282636	65402	14142	162591
Area (ha)	636706	400845	78829	1853677

Source: *Censo Brasil* – 80.

In Santa Catarina State, as far the cultivation of cassava is concerned, the picture is slightly different from the one just described. There, the typical area for cassava cultivation ranges between 10 to 2 hectares, which is about four times larger than the Brazilian average (2 to 5 ha). According to the 1980 census, there were 3,942 farms within this category representing 24 of the total number of arms in which cassava cultivation is carried out, these farms were responsible for 29% of the total cassava production in the State. The composition of the rural labour force, shown in Table 5.4, below, indicates that the great majority is constituted by the farmers family members, for almost all classes of area group (the only exception being the class of 10,000 ha and over, which is not significant in the State).

Table 5.4 - Labour force distribution according to area groups (agricultural sector) S. Catarina.

Labour Force Distribution According to Area Groups (Santa Catarina)					
Area (ha/ Labourers)	Members of the Farmer's Family	Permanent Employees	Temporary Employees	Share-Croppers	Others
Less than 10	215659	3183	8917	582	594
10 to 100	497670	15324	31762	2929	945
100 to 1000	26475	11893	10690	488	585



1000 to 10000	1208	5127	1966	5	54
More than 10000	16	299	7	-	-

Source: *Censo Agropecuário SC* – 80.

The major difference is related to the structure of land ownership which, as it is shown in Table 5.5, presents a high concentration on small farms in the State of Santa Catarina, also corresponding to a large proportion of the rural area of the State (50). For cassava cultivated areas, this pattern is quite similar, as Table 5.6 shows.

Table 5.5 - Distribution of land ownership per area groups Santa Catarina.

Distribution of Land Ownership & Area Groups (Santa Catarina)								
Area (ha/Farms)	Owners		Tenants		Share-Croppers		Others	
	No. of Farms	Total Area (ha)	No. of Farms	Total Area (ha)	No. of Farms	Total Area (ha)	No. of Farms	Total Area (ha)
Less than 10	46456	240924	8027	39284	8990	43737	12251	52846
10 to 100	116286	3176827	4441	101174	4175	85622	5886	134762
100 to 1000	8147	2068166	329	86193	111	27348	269	64384
1000 to 10000	584	1102996	17	30010	4	8966	9	17878
More than 10000	9	182654	-	-	-	-	1	10000

Source: *Censo SC* - 80.

Table 5.6 - Status of cassava producers according to land ownership (Santa Catarina).

Status of the Cassava Producers According to Land Ownership (Santa Catarina)				
	Owners	Tenants	Share-Croppers	Others
No. of Farms	13580	735	768	1528
Area (ha)	241131	5427	7143	13452

Source: *Censo SC* - 80.

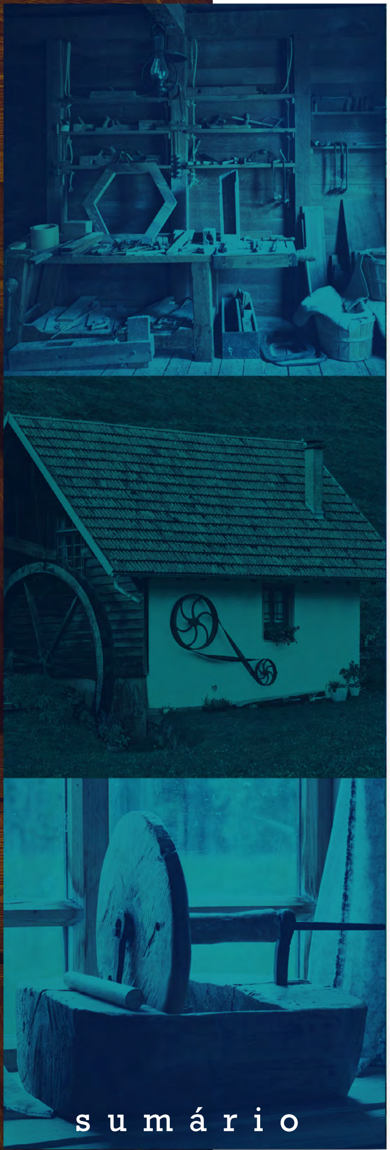
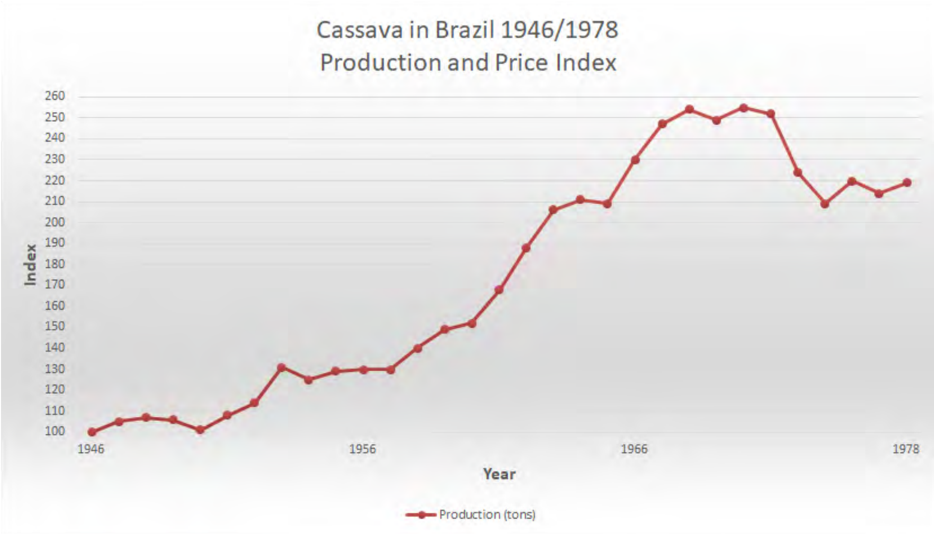


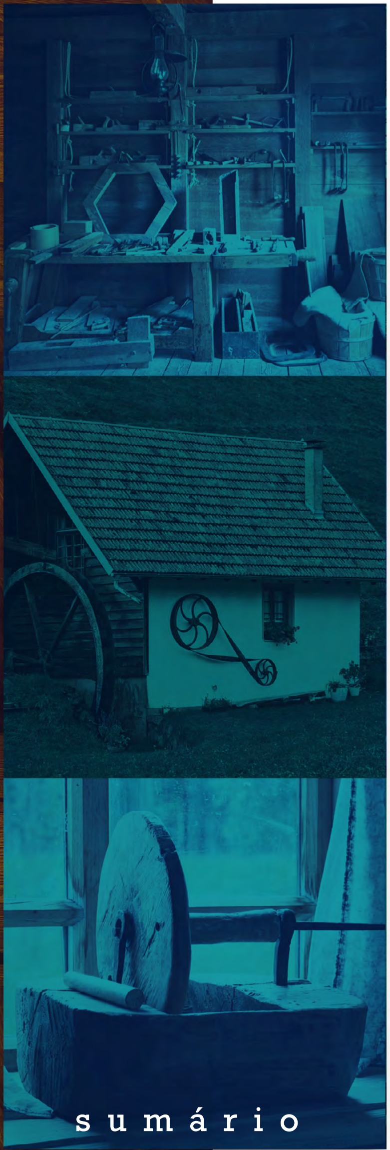
Figure 5.3 - Cassava cultivation in Brazil: production index.



TECHNOLOGICAL PROGRESS WITHIN THE PROTO-INDUSTRIALIZATION PHASE

Around the middle of last century, cassava flour was the most important export commodity or Santa Catarina. In 1854/55, for instance, the exportation of cassava flour represented 48.40 % of the total value exported (HUBENER, 1981). According to the available data, between 1854 and 1872 cassava flour was by far the main export product of Santa Catarina. Table 5.7, below, shows the share of cassava flour (in terms of weight) in the total export products.

Yet, despite its relative importance for the economy of Santa Catarina, the technological level of the cassava agro-industry was very low. Actually that industry simply consisted of small processing units to produce cassava flour and *goma*, a kind of starch-paste extracted at the



end of flour production process, which was produced in large amounts until 1833, when the commercialization of cassava flour without starch was forbidden because it reduced the nutritive value of cassava flour.

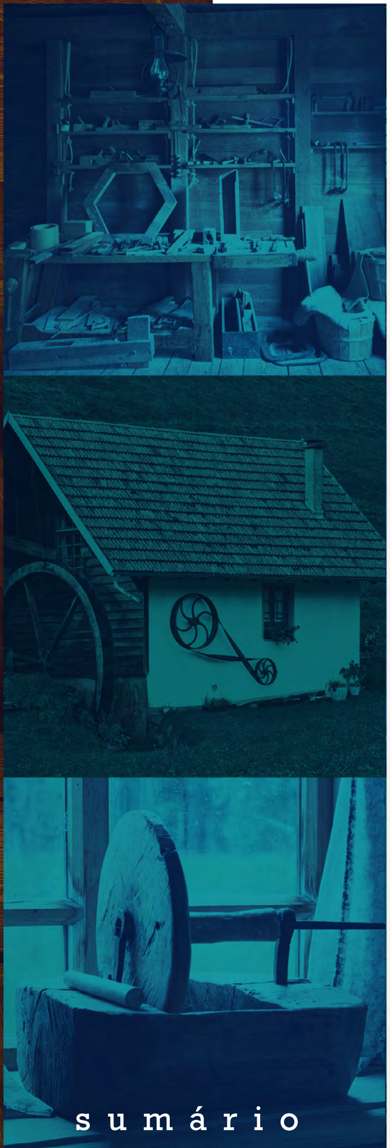
Table 5.7 - Main export products of Santa Catarina.

Triennial	Cassava Flour	Goma	Beans	Broad Beans	Corn
1854 - 57	85.6%	1.61%	4.9%	2.31%	5.68%
1857 - 60	81.7%	1.81%	3.2%	3.11%	10.1%
1860 - 63	76.9%	1.1%	5.1%	2.68%	14.4%
1863 - 66	78.6%	0.7%	3.2%	2.4%	15.2%
1866 - 69	77.5%	1%	1.7%	2.2%	17.6%
1869 - 72	78%	0.7%	0.7%	2.1%	18.49%

Source: Hubener - 1981.

The techniques employed either in the cultivation fields or in the processing units were extremely rudimentary. According to the historical records, *mandioca-prata* (silver-cassava) was the most common cultivated variety in the region, because it was easily adapted to its soil conditions. The same indigenous slash and burn practices were applied in preparing the fields, usually done between the months or May and July. During the month of August, the cassava was planted, using stalk cuttings from the previous harvest, which generals occurred in April.

Historically, the technology to produce cassava flour was known in Brazil long before the Portuguese colonization began. Very briefly, it can be described as follows: firstly, the cassava roots were washed in water and peeled; the peelings were screened or and coarsely ground. Originally, this work was done with shell scrapers and later, around 1850, with knives. Secondly, the peeled roots were grated on a



specially designed device; the indigenous device was a curved board with projecting points of wood or stone. Thirdly, the grated pulp had to be crumbled in order to make the flour. At this point there is a major difference between the indigenous process and the one introduced by colonists; Originally, the grated pulp was placed in a long narrow cylindrical basket with a loop handle at each end. One loop was then hooked over a branch of a tree and by using a log lever in the lower loop, the pulp was squeezed, extracting the poisonous juice (prussic acid). This process was modified by decanting the grated wet-pulp in a tank, where it was dried before crumbling. Depending on the time that cassava remains in the tank fermentation will occur, giving the characteristic smell of butyric acid which identified such cassava processing units (HUBENER, 1981; PINTO, 1938; BNB, 1969).

The technology employed in Santa Catarina around the middle of the last century was very rudimentary, despite the fact that at the time there was already some newly designed machinery for cassava processing. In 1848, for instance, a device was invented to improve cassava flour production, replacing the work of four men. Yet, in 1853 only two machines had been sold in the region. Such lack of interest in innovation, at least in that particular case, cannot be attributed to economic reasons, since that machine cost approximately 45% less than a slave (HUBENER, 1981; PIAZZA, 1956).

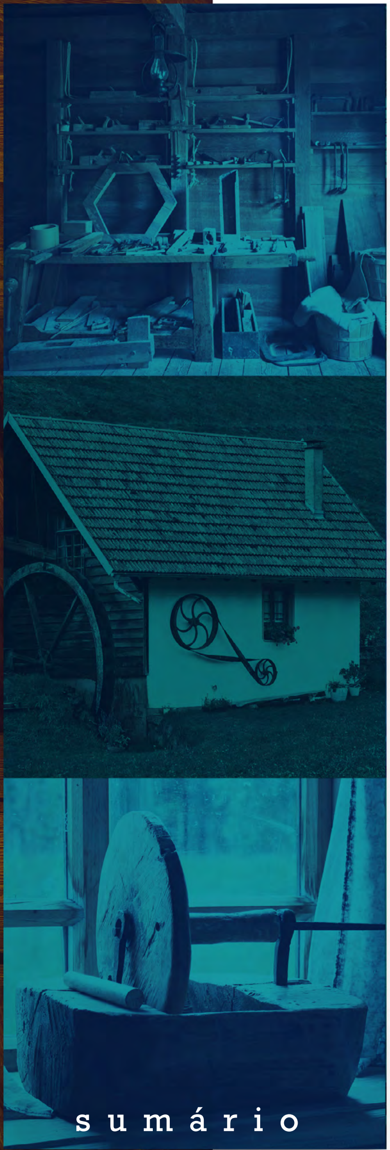
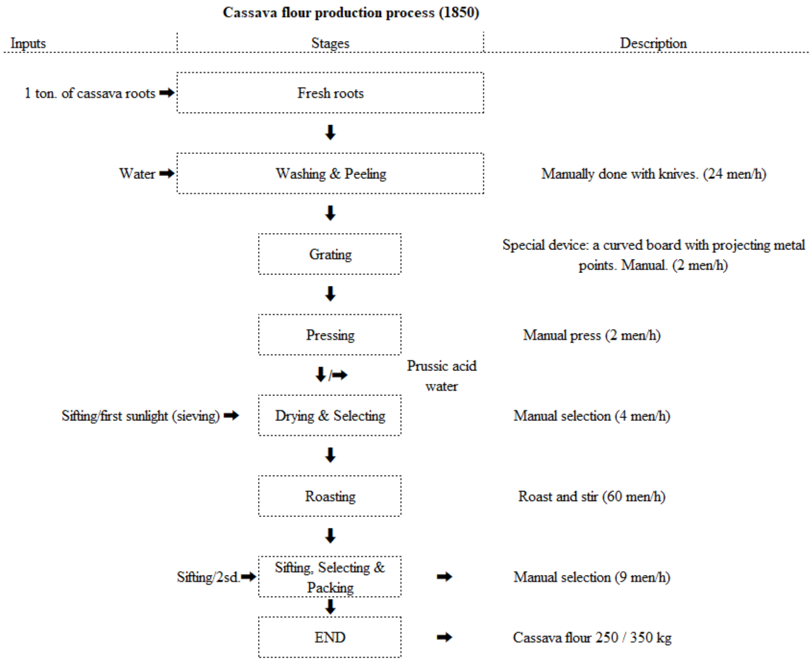


Figure 5.4 - Cassava flour production process.

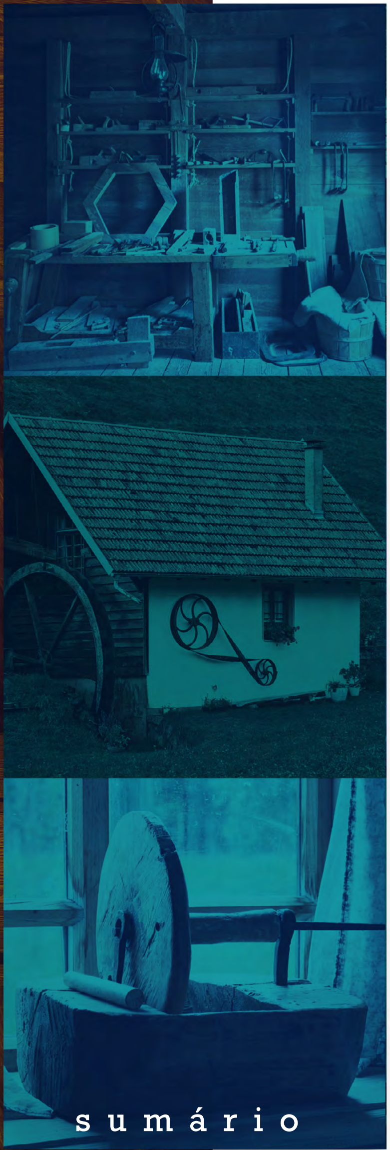


Source: Piazza, 1965; Vitti, 1975; Saint, W. & L. Mendes, 1976.

The daily average production of cassava flour, using that technique, was between 75 Kg (1.5 sacks of 50 Kg each) and 150Kg.

That was the situation found in 1850 by the first immigrants to Blumenau. However, this would soon be changed, thanks to a significant improvement of the local technical base brought about by the colonial development.

As it was discussed in detail in Section 4.3, from the very beginning of his colonial enterprise, Dr. Blumenau took great care with the development of the colony's infrastructure. Consequently, the requirements for a sound technical base was certainly among his major concerns. In the third report (1853) on the progress of his colony, Dr. Blumenau mentioned the construc-

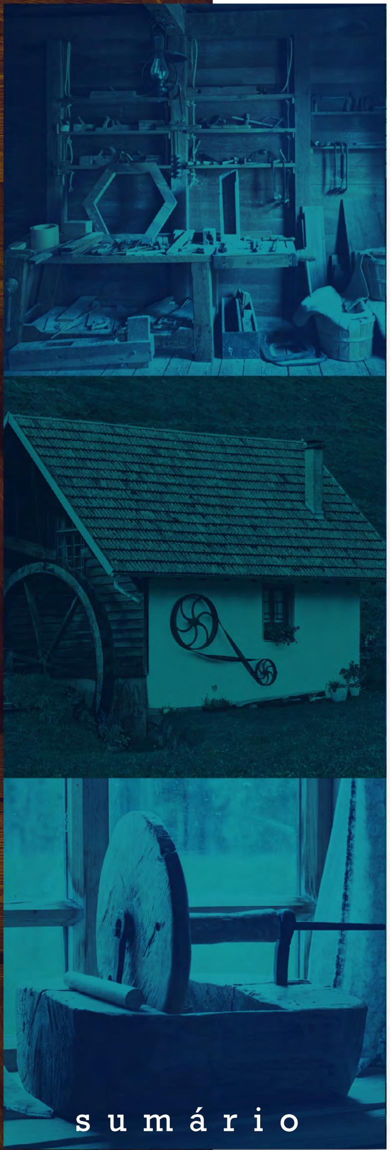


tion of mills to produce corn flour, rice and sawed wood in order to improve the conditions of the colony. The existence of millwrights, carpenters and other craftsmen in the colon made such improvement possible. The availability of a large spectrum of skills had been, as mentioned above, a strong characteristic of Dr. Blumenau's colony. In 1863, for instance, there were 31 craftsmen in a variety or mechanical skills, 41 woodcraft artisans and 5 millwrights (see Table 4.5, in Section 4.3).

As far as the cassava agro-industry is concerned, it's technological development, during the period of proto-industrialization, was achieved with the introduction of cassava mills. Most of the mills were waterpowered, thanks to the great number of small waterfalls in the area. It is interesting to note, here, the high demand for plots with either running water or waterfalls on which watermills could be built. Dr. Blumenau, for instance, mentioned in his fourth report (1854) that 40 people, while still in Germany, had asked him to reserve such plots precisely to build watermills. In 1883 there were, in the Blumenau area, a total or 346 mills in operation, 152 of which produced cassava flour. Table 5.8, below, summarizes the evolution of proto-industries during that period.

Table 5.8 - Blumenau: Proto-Industrialization phase 1850/80.

BLUMENAU: Proto-Industrialization Phase 1850 / 80										
Types of industry	1853	1856	1857	1858	1860	1861	1862	1869	1879	1883
Breweries	-	1	1	1	-	-	-	1	4	8
Brick Factories	-	1	1	1	-	-	-	8	12	12
Rice - Mills	-	-	-	-	-	-	-	3	4	6
Sugar - Mills	1	5	8	18	47	51	58	76	88	150
Cassava Flour - Mills	1	5	8	11	33	47	52	65	78	152
Sawmills	-	2	2	1	2	3	3	18	35	38



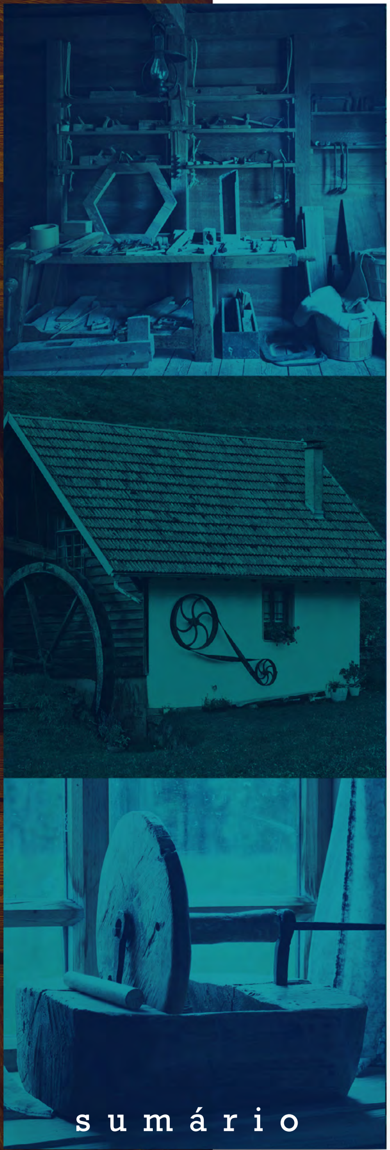
Potteries	-	-	-	1	-	-	-	-	-	-
Bakeries	-	1	1	2	-	-	-	-	-	-
Sugarcane Distilleries	-	3	3	14	-	-	-	-	-	-

Source: *Relatórios do Dr. Blumenau*.

The introduction of watermill technology for cassava flour processing substantially improved the production and reduced both the required time and labour. The production capacity of such mills ranged from 5/10 to 10/20 50 kg bags per day, which represented approximately 300% to 700% more than the average capacity of the previous process presented above.

The process used in those mills to produce cassava flour can be quite briefly described as follows. As soon as the cassava arrived in the mill, it went through a peeling process in order to remove a thin skin that surrounds the root. This operation was done in a rotative trellis work cylinder, by combining the action of the shaped edges of the trellis and of the water poured from above the apparatus. After the peeling, the roots were washed and ground to produce a type of moist pulp, the pulp was then taken to the press where most of the water was removed by compression. In many mills a very fine cassava flour (*polvilho*), for domestic use, was extracted from this water.

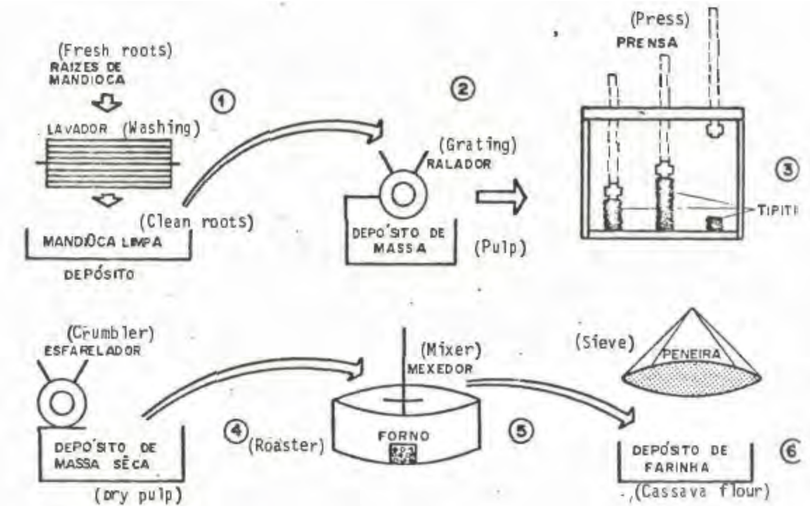
Nearly all these presses were made of wood and had three screws (see Figure 5.5). In order to go through this drying process, the cassava pulp was put in tipitins made of *taquaras* (*taquari* variety). Fan mills used burlap sack instead or tiptins. Nowadays, some mills are replacing the burlap sacks with a fine plastic mesh with very good results. There are many mills, specially in the Southern region of the State, that use barrel-presses. The pulp is put inside the open burlap sacks or plastic mesh, and then put inside the barrel.



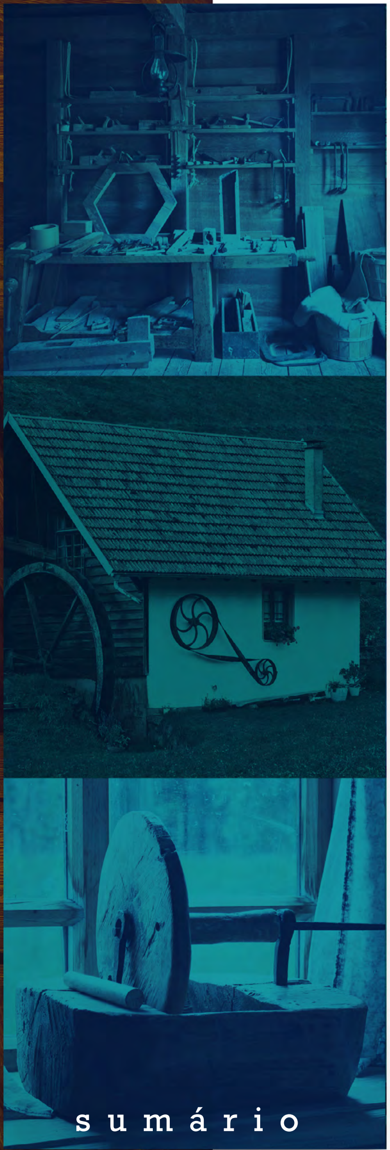
After the pressing process, the cassava pulp was taken out of the tipitins (or other devices) and put through a crumbler. From the crumbler, it was taken to a circular oven made of copper and provided with a stirrer, that was heated by a coal or wood fire. The pulp took one hour and a half to dry. Each full oven after the drying contained more or less 30 kg of dry cassava flour. Figure 5.5, on the next page, presents a schema of this process.

Currently, the cassava flour mills, using a production technique quite similar to the one just described, are mainly located in the Southern region of the State of Santa Catarina. In Itajaí Valley area, although there are still a good number of such units, they have become less important or the cassava roots market than they used to be. The cassava starch industry dominates the market, using approximately seventy per cent of the available roots[74].

Figure 5.5 - Production of cassava flour (plant design - 1968).



Source: "A Mandioca em Santa Catarina" - *CODESUL* - 1968.



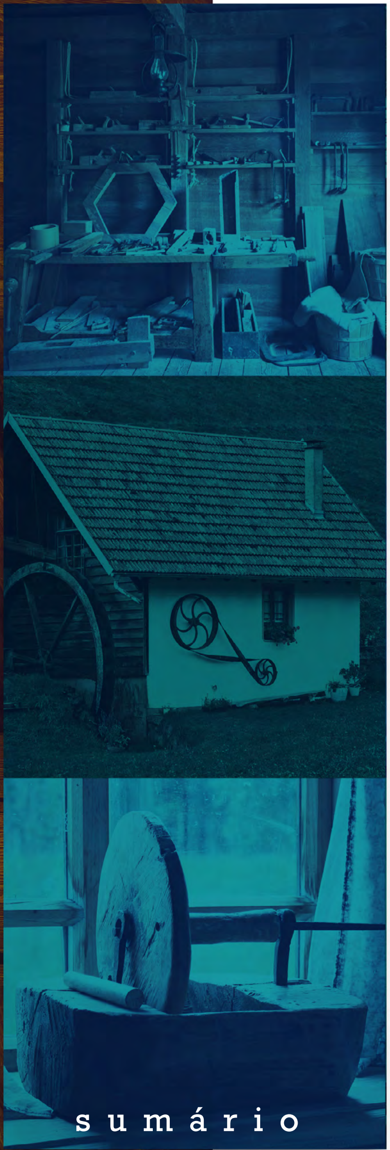
TECHNOLOGICAL PROGRESS WITHIN THE INDUSTRIAL PHASE

In May of 1916, the brothers Hanyand Fritz Lorenz, two well established tradesmen of the municipality of Blumenau, decided to move on to industrial activities. They followed a pattern that, according to the analysis made on Section 4.2, had been quite common in Blumenau's development history.

Before the establishment of the cassava starch industry in Blumenau, the export of cassava processed products had already lost its importance for the region's economy. The available statistics show that the export of cassava flour, in the previous years, had accounted for less than one per cent of the total value of exported agricultural products (*PREFEITURA DE BLUMENAU*, 1917). The production of cassava starch, a more elaborated product, or a more diversified market such as the textile industry, let the Lorenz brothers to have an optimistic expectation for their new enterprise.

However, according to the Blumenau's mayor report of 1919, the Lorenz Company underwent financial crises since the very beginning. According to the report, these difficulties had been caused by the European economic crises, which were reflected on the main Brazilian domestic markets at the time, and also by the lack or an adequate transportation system to export from Blumenau to those markets, particularly to Rio de Janeiro (*PREFEITURA DE BLUMENAU*, 1919). Consequently, only one third of the total production of that year had been sold, remaining a stock of approximately 500 ton. of *goma* (starch-paste) and *sagu*.

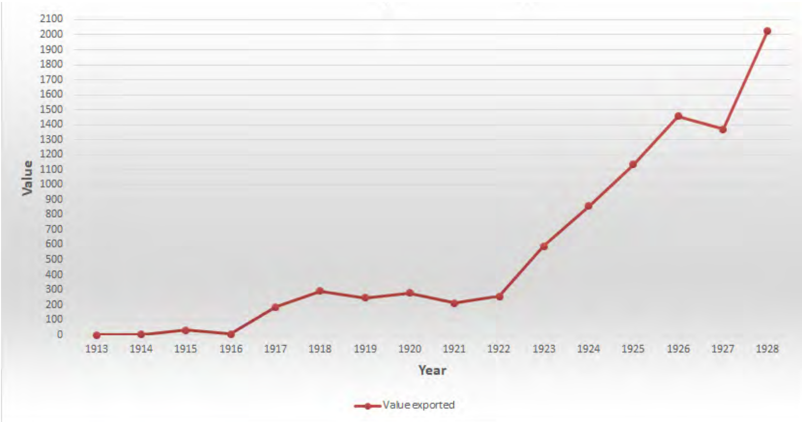
Despite the great economic difficulties faced by the Lorenz Company during those initial years, which lasted until 1921, they set up another starch plant in 1918 through this same company. This second



plant also produced starch-paste (*goma*), *sagu*, and *dextrina*, which is a kind of modified starch, more suitable for industrial applications than the other products.

In 1920, increase the export of cassava products experienced a 12.2% (*PREFEITURA DE BLUMENAU*, 1920). But in 1921 cassava products again suffered a setback on its exports, dropping 23.7% (*ibid*., 1921). It was only after 1922 that the market for cassava starch products experienced steady growth, as it is shown on Figure 5.6 below.

Figure 5.6 - Cassava starch exportation 1913/1928.



Source: *Relatórios Municipais*.

The cassava starch industry followed the same pattern of slow rate of growth during the implementation period, from 1916 to 1940, that was observed in Blumenau's industrialization. During this period, only seven starch plants were set up, three of which by the Lorenz Company. Table 5.9 below summarizes this development.

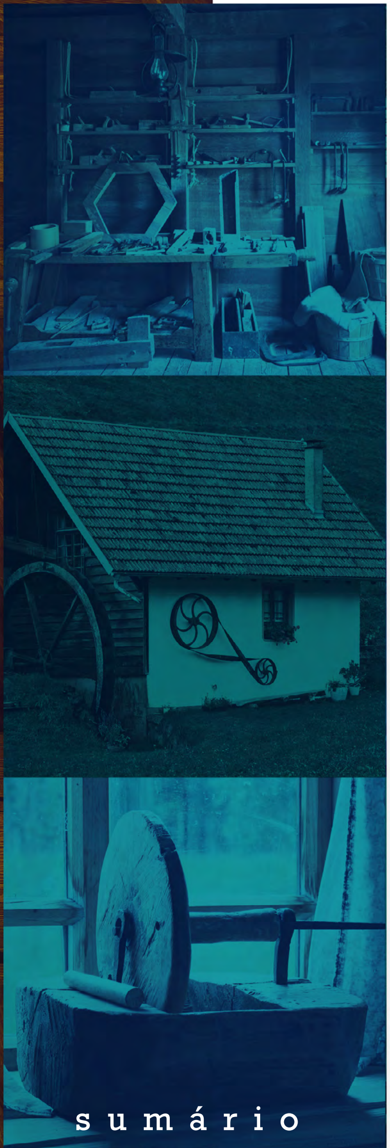


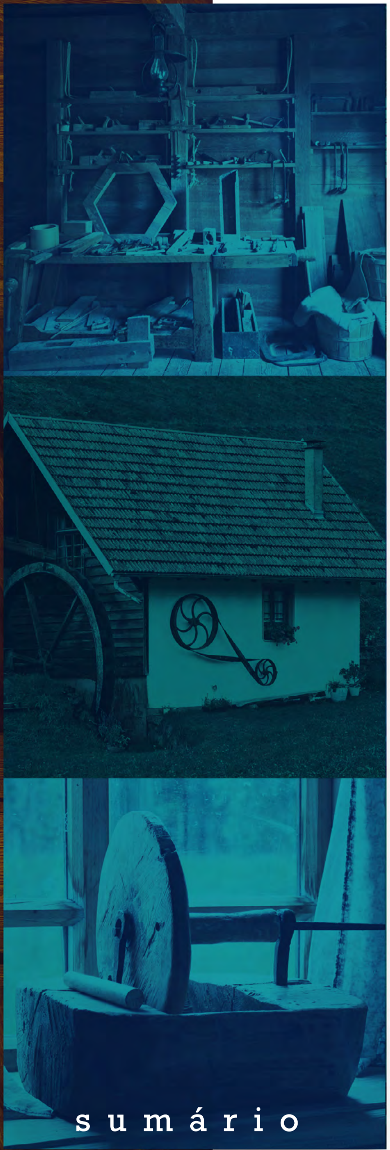
Table 5.9 - Cassava starch industry of Santa Catarina The first starch plants of Itajaí Valley 1916 - 1936.

Cassava Starch Industry of Santa Catarina - The First Starch Plants of Itajaí Valley (1916 - 1936)			
Year	No. of New Plants	Total No. of Plants	Firm
1916	1	1	Lorentz
1918	1	2	Lorentz
1919	1	3	Struw
1923	1	4	Proenhow
1925	1	5	Lorentz
1933	1	6	Agro-Comercial Cassava
1936	1	7	Tridapalli

Source: Fieldwork/1981.

The first starch plant of the Lorenz Company could process, at full capacity, 10/tons. per day. The machinery employed had been designed and constructed entirely by the local mechanics and craftsmen, and was mostly made of wood. The power was supplied by a small river called Encano (name by which that plant became known). Although it was set up in 1916, the plant started production only in the following year. In its first year, the Encano Plant processed 473 ton. of roots, out of which 434 ton were cassava roots, 5 ton sweet potatoes and 34 ton *araruta* (a variety of cassava).

Towards the end or 1917, another starch plant was set up in a place that is now located in the municipality of Indaial. This new *feculária* (starch plant), owned by the firm Struw & Co., was constructed, according to the news published at that time in the local newspaper (Der Urwaldsbote - 5/10/1917), with the "most up to date equipment, with similar only in Rio de Janeiro". The equipment consisted basically of a system to extract humidity using hot air.



The first starch plants produced two sets of products for distinct market consumption. One, aiming at the industrial market, produced *dextrina* (sweet starch) and *goma* (starch paste), The other set of products, more appropriated for direct human consumption, produced *amidon agrio* (sour starch), *sagu* and *tapioca*.

During the Second Great War, the traditional suppliers of cassava starch - Thailand, West Malaysia and Philippines - were unable to meet the demand from both the United States and Europe. This situation offered an excellent opportunity to the Brazilian cassava starch industries, which since that time have mostly been located in Santa Catarina. Representatives or the American Food Company were sent to Brazil to buy the whole cassava starch production and to stimulate the establishment of new starch plants to increase the supply of cassava starch.

As a result of the American Food's policies, and thanks to the new market opportunity induced by them, twenty-four new cassava starch plants were set up in the region of Itajaí Valley[75]. It is interesting to note that, despite the growth in cassava starch production and, therefore, an increase in the demand for cassava roots, the price of fresh cassava roots declined in real terms during the same period (see Figure 5.2 on page 162).

After that period of economic boom, the development of the cassava starch industry in Santa Catarina had a smoother rate of growth, as shown in Table 5.10 below.

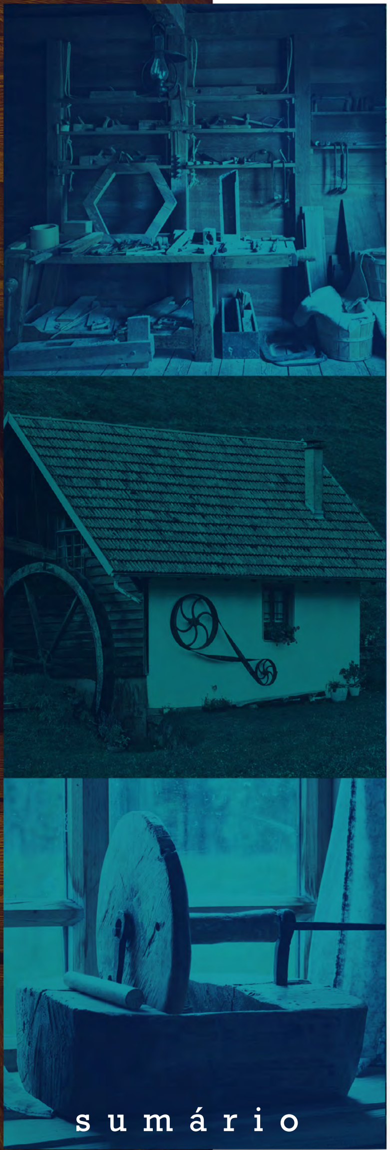


Table 5.10 - Cassava starch industry of Santa Catarina starch plants of Itajaí Valley: 1940/79.

Cassava Starch Industry of Santa Catarina - The First Starch Plants of Itajaí Valley (1940 - 1979)		
Period	No. of New Plants	Total No. of Plants
Previous Period (1916 - 1936)	-	7
1940 - 1949	24	31
1950 - 1959	5	36
1960 - 1969	5	41
1970 - 1979	6	47

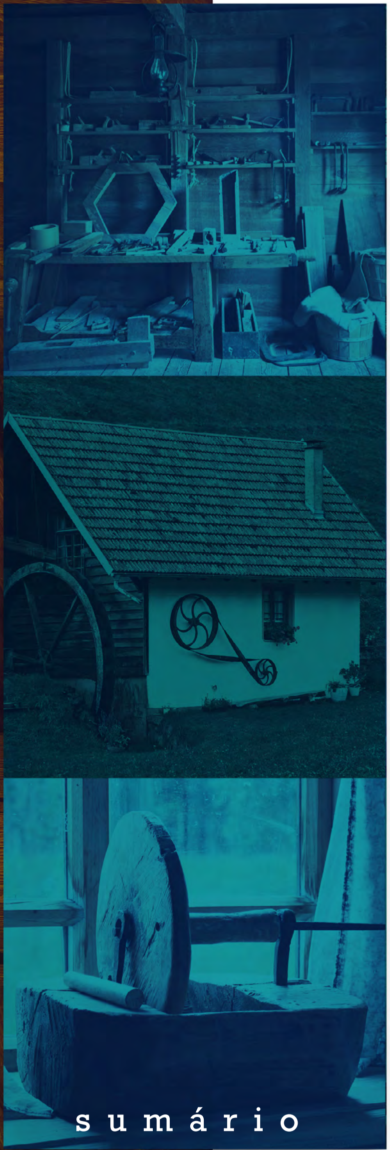
Source: Fieldwork/1981.

The industrial use of cassava starch is very wide, having about seventy distinct product applications, such as in foodstuff, adhesives, textiles, paper, gelling, fillers, munitions, just to mention the main industrial markets.

At the time that the production of starch started in Santa Catarina, the products' main applications were in textiles and foodstuff (particularly to produce biscuits).

As far as technological development is concerned, the necessary technical knowledge to set up the first starch plants was obtained either from specialized literature (mostly from Germany) or from the local craftsmen who used to work or had some experience in the potato starch industry. According to the information gathered from the interviews carried out during the fieldwork, the first starch plants that were built in Blumenau did not use any imported machinery, being entirely built locally[76].

The technological progress of the cassava starch industry in Blumenau can be divided into five distinct levels, each corresponding to a specific technical change in the product ion process of starch from cassa-



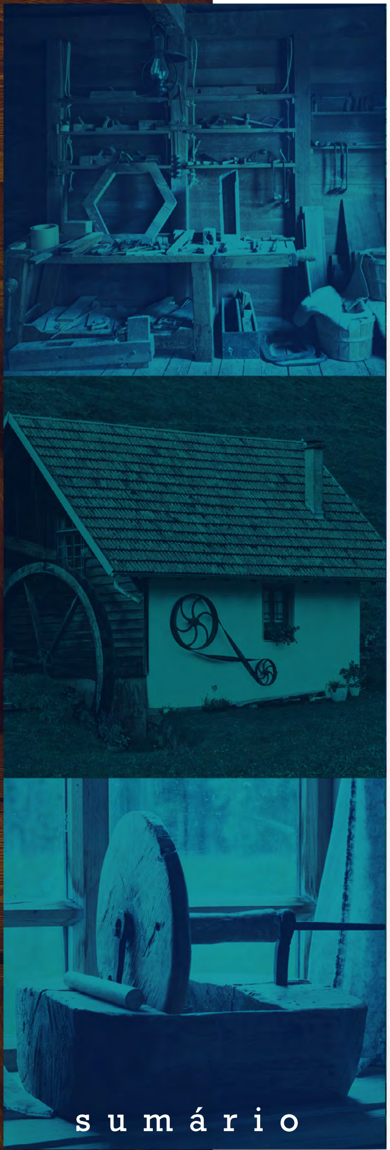
va. The first two levels were actuals minor technical improvements, made during the initial period of the industry, i.e., from 1916 to 1940, while the last three represented a significant shift towards increased starch productivity.

In order to further clarify how such technical changes affected the process of production of starch from cassava, it is desirable to give, first, a brief account of the process of starch production from cassava. That process can be broken down into four distinct stages: the first, comprising the four pre-processing functions of feeding, washing & peeling, grinding, and sieving. This stage leads to the preparation of the moist pulp. The second stage is to decant the starch in the liquid moist. The third stage is to dry and select the starch. Finally, the fourth stage involves the storage or packaging of the dry starch.

The first importation of machinery occurred around 1922, when the Lorenz Company bought the first mechanized centrifugal machines from Germany. These two machines were then completely dismantled and the required adjustments for cassava roots were made, since they had been originally designed to operate with potatoes as raw material. Later, after they had learned how to improve the performance of those two machines, the production of centrifugal machines was started by the Lorenz Company itself, which thus became the machinery supplier for the other cassava starch firms in the region.

The introduction of centrifugal machines in the cassava starch production process, just before the decanting stage, reduced the processing time by four hours, which at the time ranged between forty-eight and sixty hours.

The second major technical change, leading to the fourth level of technological development, came with the introduction of the so-called flash-drier system, which was also imported, in 1968, by the Lorenz Company from Germany. Here again the process of technological learning followed the same pattern. The system was carefully analyzed



and with the help of a local small mechanics firm the production of the flash-drier system began also in the region. This mechanics firm, which was in fact a kind of backyard mechanic service shop, later became a medium sized light capital goods firm, the "*Metalúrgica Riosulence Ltda*.", specialized in the production of machinery for the wood industry. For the cassava starch industry, this firm not only produces the flash-drier system but also delivers a complete starch plant on a turn-key contract, jointly with the Lorenz Company.

The flash-drier system, that is used in the last stage or the starch production line, allowed a reduction of the average processing time by six hours, the minimum number of workers per shift was also reduced from five to four.

Finally, the last level of technological development was reached by the introduction of a combined system of purifier centrifugal and vacuum filter machines which replaced the decanting canal system. This represented a real achievement and allowed the average processing time to drop drastically from eighteen/thirty hours to five/ten minutes and to reduce the number of workers per turn from 4 to 3 (for plants which could have a full processing capacity ranging from 40 up to 400 ton. / 24 h.). Table 5.11 summarizes those five technological levels.

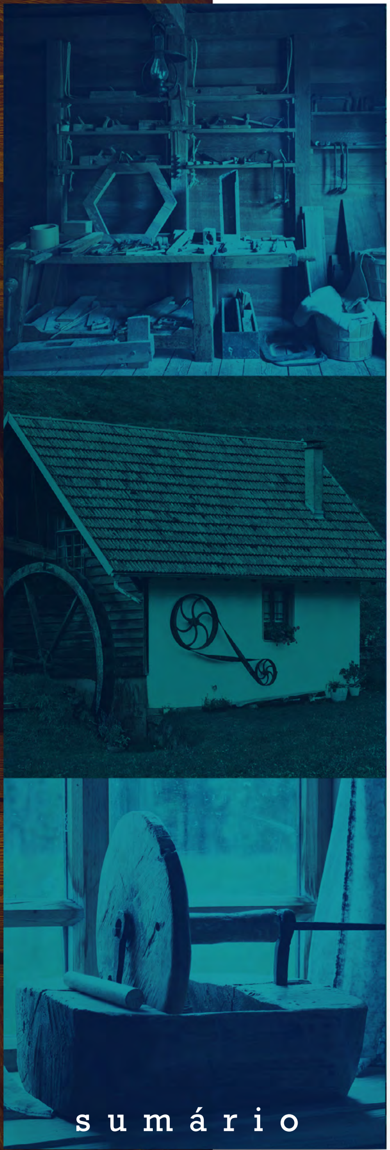


Table 5.11 - Cassava starch industry of Santa Catarina level of technological development[13].

Cassava Starch Industry of Santa Catarina - Level of Technological Development									
Level of Development	First Stage				Second Stage	Third Stage		Average Processing Time	Minimun No. of Workers per Shift
	Weighing & Feeding	Washing Up & Peeling	Grinding	Sieving	Decanting	Drying	Packaging		
L1 (1916)	Manual	Manual	Mechanized	Mechanized vibrating Sieve	Decanting Canal	Sunlight	Manual	48 - 60 hs	8
L2 (1920)	Manual	Mechanized	Mechanized --> (m)	Same	Same	Stove	Manual	24 - 40 hs	6
L3 (1922)	Manual	Mechanized -->	Mechanized -->	Same -->	Decanting Tank / Centrifugal Machine / Decanting Canal	Stove	Manual	18 - 36 hs	5
L4 (1968)	Mechanized -->	Mechanized -->	Mechanized -->	Same -->	Same --->	Flash-Drier System --->	Semi-Mechanized	18 - 30 hs	4
L5 (1973)	Mechanized -->	Mechanized -->	Mechanized -->	Extractor -->	Purifier Centrifugal Machine/Vacuum Filter --->	Flash-Drier System --->	Semi-Mechanized	5 - 10 min	3

Source: Fieldwork/1981.

13 "→" = Continuous process.

The productivity of each technological level is presented in Table 5.12 below. From the figures it is possible to assess how significant such technological changes were for the cassava starch industry in Santa Catarina. The output per worker for instance, soared from 2.6 to 285.7 sacks/worker/day, representing an enormous increase of 11,000%!

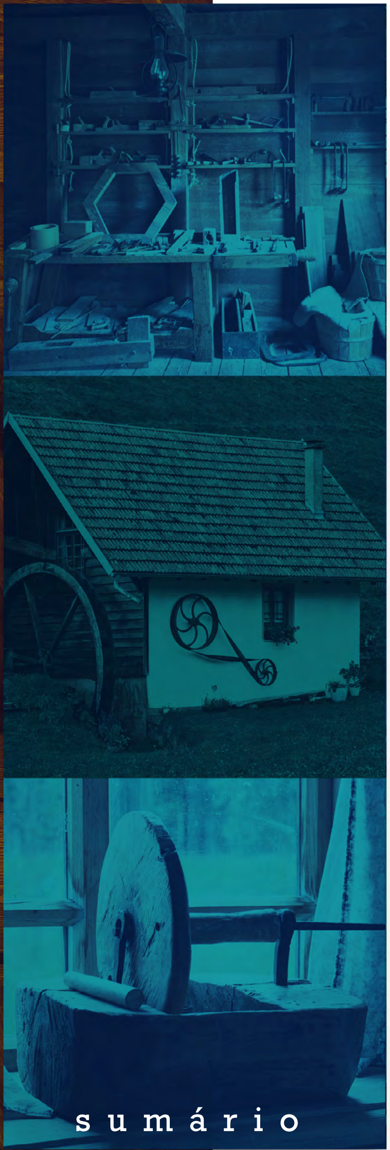


Table 5.12 - Cassava starch industry of Santa Catarina starch output according to the Technological level.

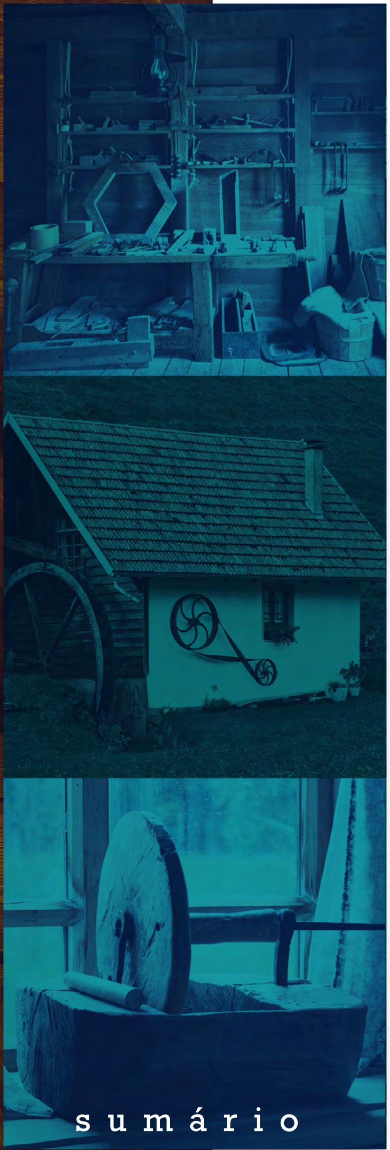
Cassava Starch Industry of Santa Catarina - Starch Output According to Techonological Level					
Level	Year	Processing Capacity (Tons / 24h)	Processing Time	No. of Workers (3 shifts)	Output Sacks / Worker / 24h
L1	1916	10	48 - 60 hs	38	2.6
L2	1932	50	20 - 36 hs	28	17.9
L3	1960	50	12 - 24 hs	24	20.83
L4	1968	150	5 - 7 min	10	150
L5	1973	400	5 - 7 min	14	285.7

Source: Fieldwork/1981.

Table 5.13 - Cassava starch industry of Santa Catarina output recording firm size.[14] [15] [16].

Cassava Starch Industry of Santa Catarina - Output Recording Firm Size																				
FIRM SIZE	OUTPUT - TONS / 24h (Full Capacity)																			
	0 - 10				11 - 20				21 - 40				41 - 80				81+			
	A (n)	B (o)	C (p)	D (p)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
0 - 10	5	5	2	14	1	2	1	4	-	-	-	-	-	-	-	-	-	-	-	-
11 - 50	2	2	-	-	8	16	2	29	3	12	-	-	2	12	1	43	-	-	-	-
51 - 100	-	-	-	-	-	-	-	-	2	8	-	-	-	-	-	-	-	-	-	-

14 "A" – Number of firms (Itajaí Valley) in the group.
15 "B" – Total output of the firms in the group/Total output in the region.
16 "C" & "D" – Same as "A" & "B" for Laguna.



101 - 200	-	-	-	-	-	-	-	-	-	-	-	-	2	12	-	-	-	-	-	-
201 - 500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
500+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	31	-	-

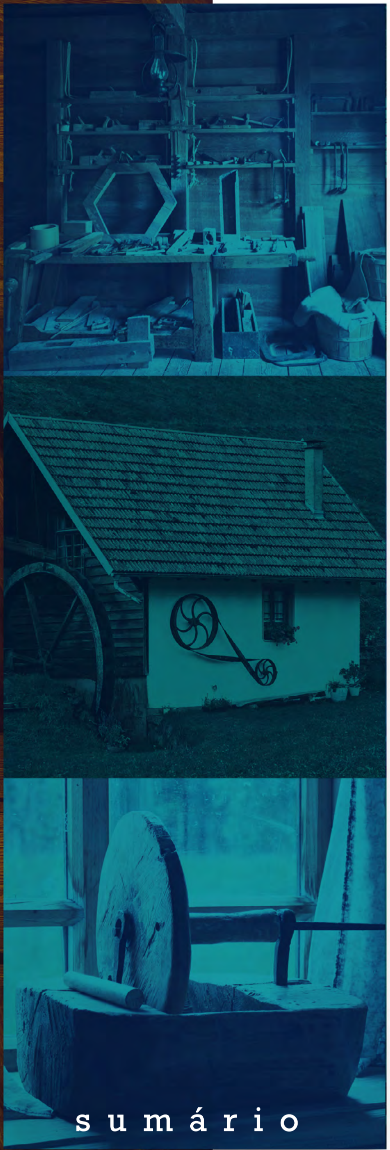
Source: Fieldwork/1981.

Table 5.14 - Cassava starch industry of Santa Catarina level of technological development by plant's output. [17 18 19 20].

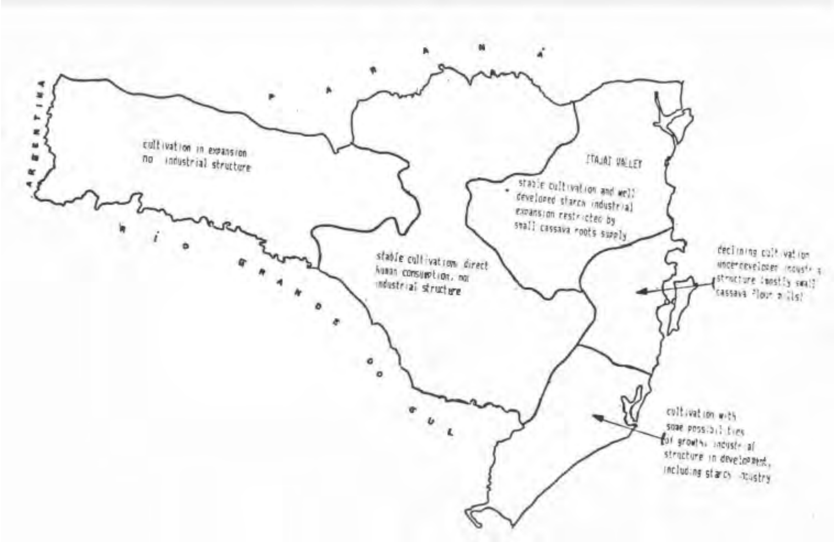
Cassava Starch Industry of Santa Catarina - Level of Technological Development by Plant's Output (Itajaí Valley)																
FIRM SIZE	OUTPUT - TONS / 24h (Full Capacity)															
	0 - 10				I I - 20				21 - 40				41 - 80			
	A (17)	B (18)	C (19)	D (20)	A	B	C	D	A	B	C	D	A	B	C	D
L1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L4	3	15	7	8	7	35	21	18	3	15	7	8	-	-	-	-
L5	-	-	-	-	2	10	6	5	3	15	7	8	2	10	6	5

Source: Fieldwork/1981.

17 "A" – No. of plants with that level in the sample.
18 "B" – A/No. of plants in the sample (%).
19 "C" – A/Total No. of plants in the Valley with that O/P (%).
20 "D" – A/Total No. of plants in the State with that O/P (%).



Map 5.1 - Santa Catarina state map.



At the time that the research fieldwork was carried out, there were forty-seven starch plants in operation in Itajaí Valleys, of all sizes and levels of technological development. Comparison between the starch plants of Itajaí Valleys and of the Laguna region, which is locate in the Southern region of the State, was made to compare the importance of that industry in the former region. Tables 5.12 to 5.14 show the distribution of a sample of starch plants according to the level of technological development, output per plant and firm size. Table 5.15 clearly indicates a significant diffusion of the process of technical change in both regions. The emergence of the cassava starch industry in the region of Laguna is a relatively new fact that began in the mid'60s. Map 5.1 shows the geographic distribution or the cassava agro-industry in the State of Santa Catarina.

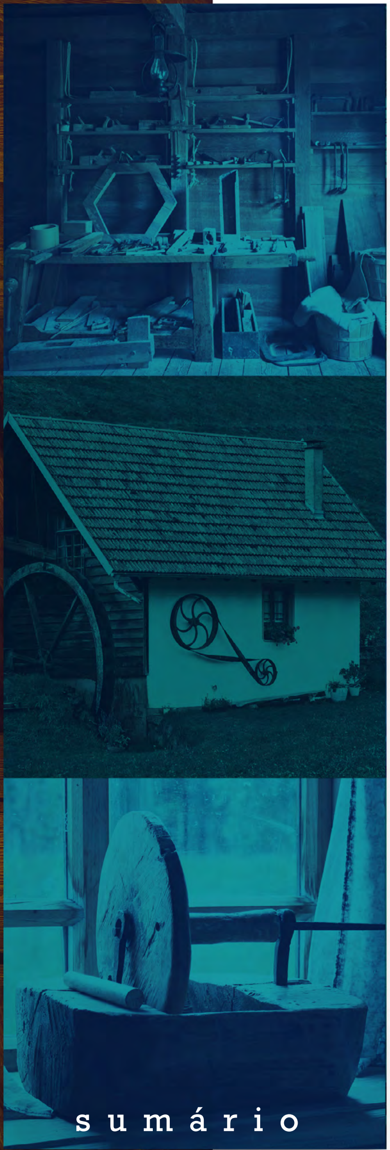
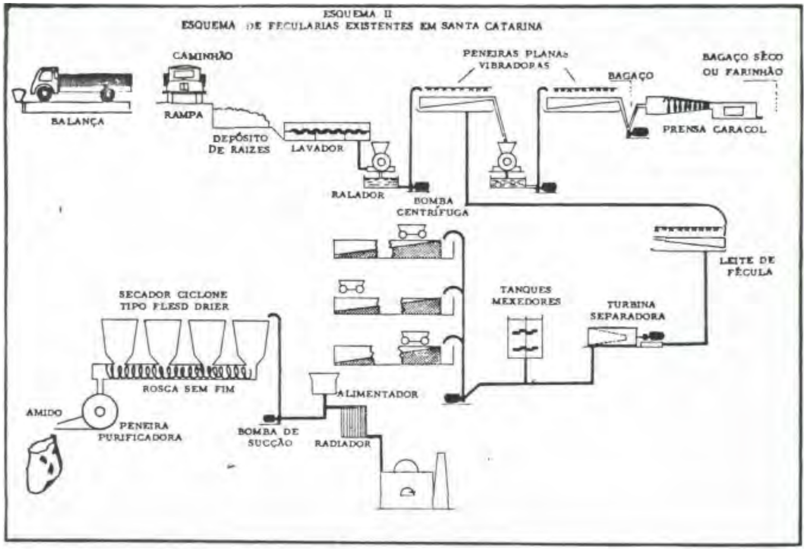


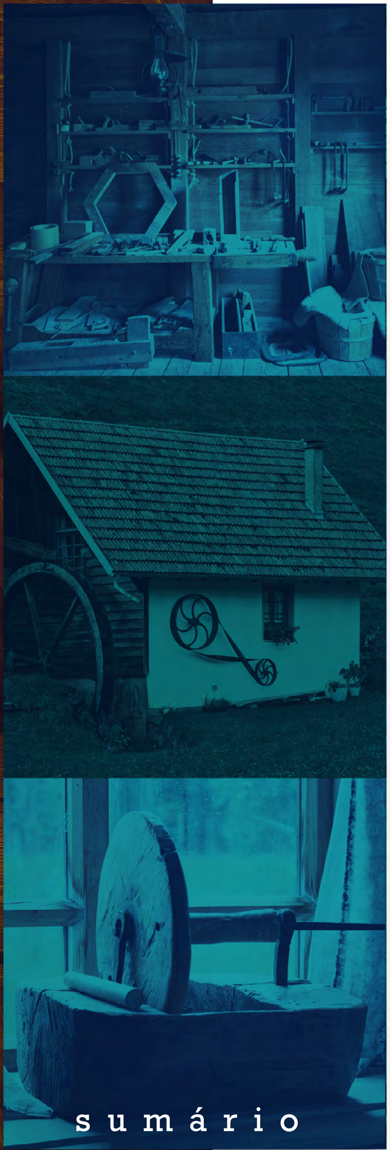
Table 5.15 - Cassava starch industry of Santa Catarina number of firms by output.

Cassava Starch Industry of Santa Catarina - Number of Firms by Output							
OUTPUT Ton / 24h (Full Capacity)	Number of Firms			Numbers of Firms in Group / Number of Firms in the Region		Numbers of Firms in Group / Number of Firms in the State	
	Itajaí Valley	Laguna	Total	Itajaí Valley (%)	Laguna (%)	Itajaí Valley (%)	Laguna (%)
0 - 10	7	2	9	27	33	22	6
11 - 20	9	3	12	35	50	28	9
21 - 40	5	-	5	19	-	16	-
41 - 80	4	1	5	15	17	13	3
81+	1	-	1	4	-	3	-
Total	26	6	32	100	100	82	18

Source: Fieldwork/1981.

Figure 5.7 - Production of cassava starch (plant design) - 1968.





TECHNOLOGICAL DISCONTINUITY: THE PRODUCTION OF THE CHEMICALLY MODIFIED STARCHES

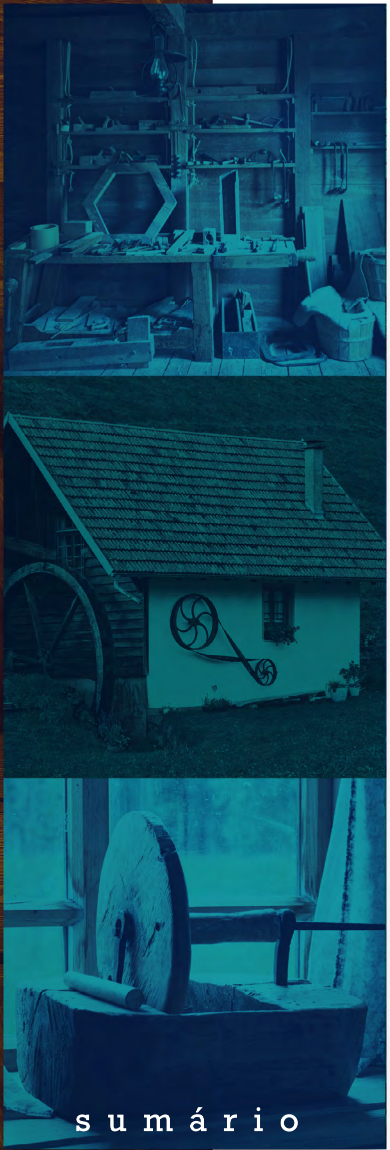
The utilization of starches is highly dependent on its colloidal characteristics; however, these properties may be altered either by physical or chemical means. The more common modified starches are the pre-gelatinized starches and those obtained by chemical modifications starch derivatives, acid-treated starches, oxidized starches, and dextrines.

Modified starches, as other modified polysaccharides, seldom constitute a finished product, but are mainly used as additives to improve or adjust the properties of a commodity. Through proper control of the modification, a great variety of products is possible, with the development or low-cost modification process offering span for research.

Starch products are merchandised in the dry state in several physical forms: pearl, which is roughly ground starch as received directly from the dryers; powder, which is made by grinding and passing the starch through fine sieves; lump, which is flash-dried starch made up of aggregates or 25-100 granules; and pregelatinized products, which are pre-cooked and dried by the manufacturer.

The most important products are starch dextrines, thin-boiling starches, oxidized starches, starch derivatives, and crosslinked starches. those products, A brier technical description, of each of is presented below, in order to give a better idea of the scientific and technological level of complexity as well as their main industrial applications,

Starch Dextrines - The term dextrine is sometimes used to cover the degradation products of starch regardless of the way they are produced. The exceptions are the monosaccharides and the



oligosaccharides. In this way dextrines are classified, by the general procedure used in their preparation, into four major groups:

1. Dextrines obtained by enzymic action, particularly by the action of the amylases on starch.

2. Dextrines produced by acid hydrolysis, in aqueous media.

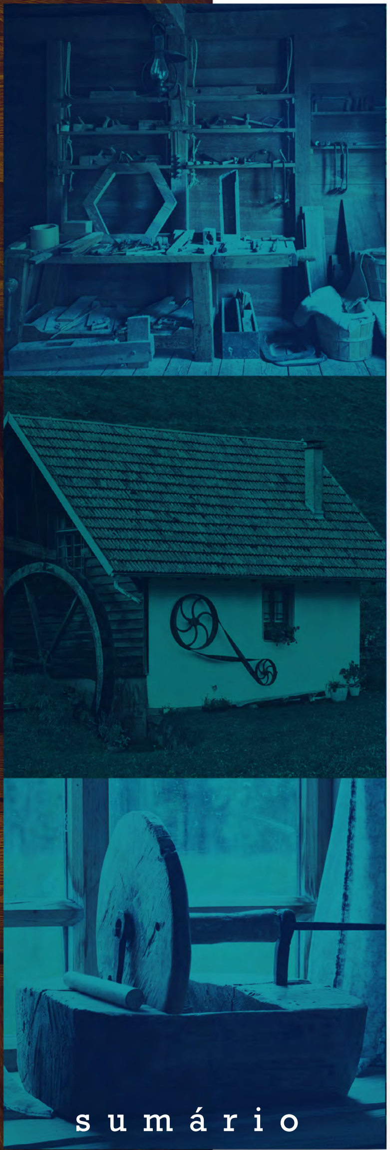
3. Cyclic dextrines obtained by the action of an enzyme produced by bacillus macerans.

4. Dextrines prepared by the act ion of heat, or both heat and acid, on starch.

However, the term generally refers to products obtained by the heating or roasting of unmodified starches, with or without the addition of an acid catalyst. Many dextrines grades and types can be manufactured by controlling the starch sources, moisture, catalyst, and duration of roasting. The resulting pyrodextrines or torrefaction dextrines are classified into three primary categories, depending on the amount of modification: White Dextrines, Yellow or Canary Dextrines and British Gums. Other minor subdivisions have also been introduced.

White Dextrines are produced by mildly heating powdered starch with dilute hydrochloric acid or acetic acid. The conversion, that can be made in the presence of relatively large amounts of acid, is rapid even at low temperatures. The water solubility varies from low (short conversion time and/or low temperature) to high (longer cooking times at higher temperatures). Sparingly soluble White Dextrines retain the retro gradatory characteristics of the original starch.

Yellow or Canary Dextrines are prepared by heating starch with acid at higher temperatures that are used for white conversions. The conditions favor more extensive structural changes. Hydrolysis predominates at first, but as temperature increases, the mixture becomes drier, and conditions become more favorable or transglucosylation and



polymerization. As a rule, these dextrines are over 95% soluble and can be used at concentrations of about 60%.

British Gums are prepared by heating starch without adding acid; The conversion is catalyzed by the traces or acids naturally present in starch (or that formed during pyrolysis) or by alkaline materials, such as sodium carbonate, sodium bicarbonate, and ammonia, in general, the products have dark colors, a wide range of cold-water solubilities, viscosities, and high viscosities.

Dextrines are used primarily as adhesives. However, they are very versatile and adaptable products with many binding and sizing applications, as Table 5.16, on next page, shows.

Thin-Boiling Starches - This type of modified starches is obtained by acid-treatment of starches at temperatures below the gelatinization points. the products differ from the parent starches in hot paste viscosities, but the gel strengths are not altered in the same proportion.

Thin-Boiling starches are used primarily by the textile industry; They are also employed in food industries in the production of gumdrops, fruit slices and jellybeans.

Oxidized Starches - Oxidized starches are manufactured by treating starches with sodium hypochlorite at temperatures below the gelatinization points. Starches thus modified have lower viscosities when gelatinized than the parent starches. They are noted for giving clear stable pastes which resist gelling. They are used primarily by the paper industry, although they also have some applications in food and textile industries.

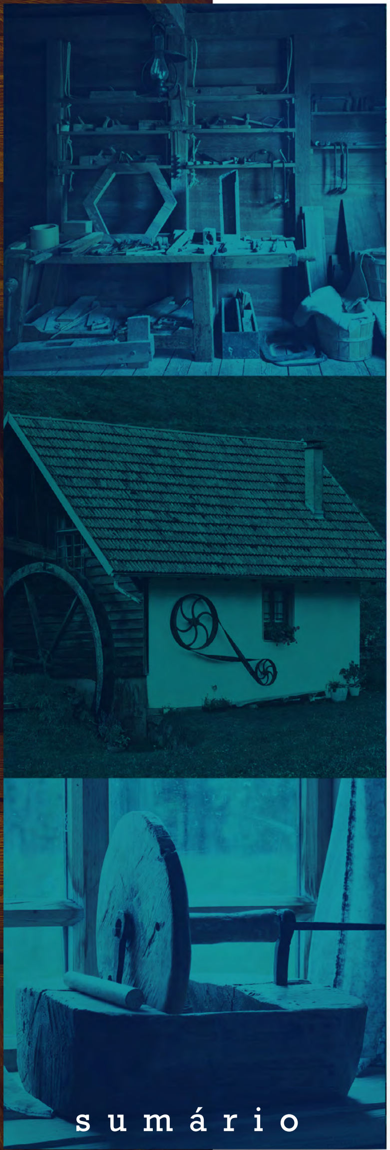
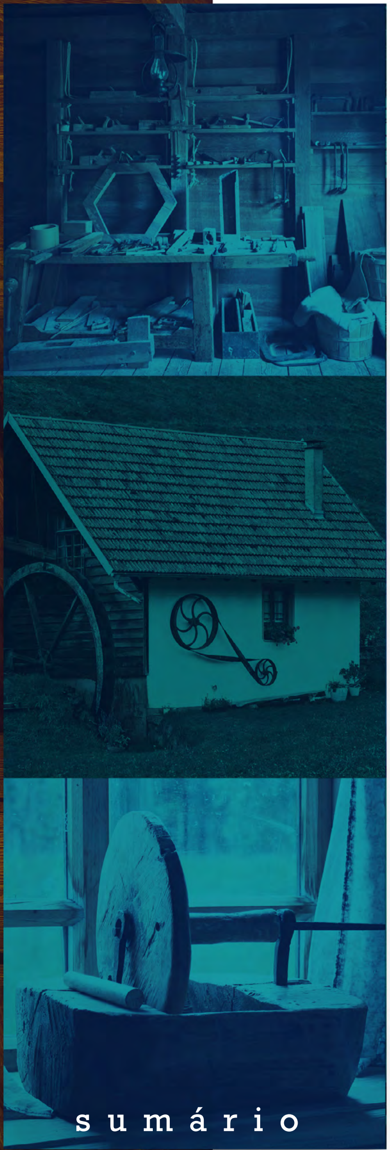
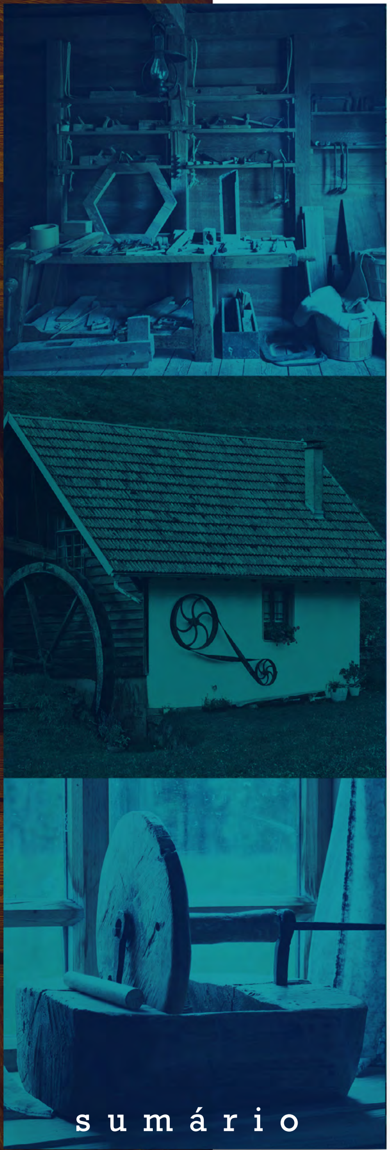


Table 5.16 - Dextrin's industrial applications.

Dextrin Industrial Applications			
Application	Suitable Dextrin		
	White	Canary	British Gum
Adhesives			
Bag bottom	X		X
Bag seam	X		
Bill posting	X		
Carton sealing	X	X	X
Cigarette seam	X		
Container sealing	X	X	
Envelope gum	X	X	
Envelope seal		X	
Gummed tape		X	
Laminating paste	X	X	X
Library paste	X		
Lining paste	X		
Linoleum cement		X	
Paper tube and cone winding	X	X	
Postage stamp		X	
Ceramics			
Pottery and tile glazes	X		
Cord polishing	X		
Crayons	X	X	



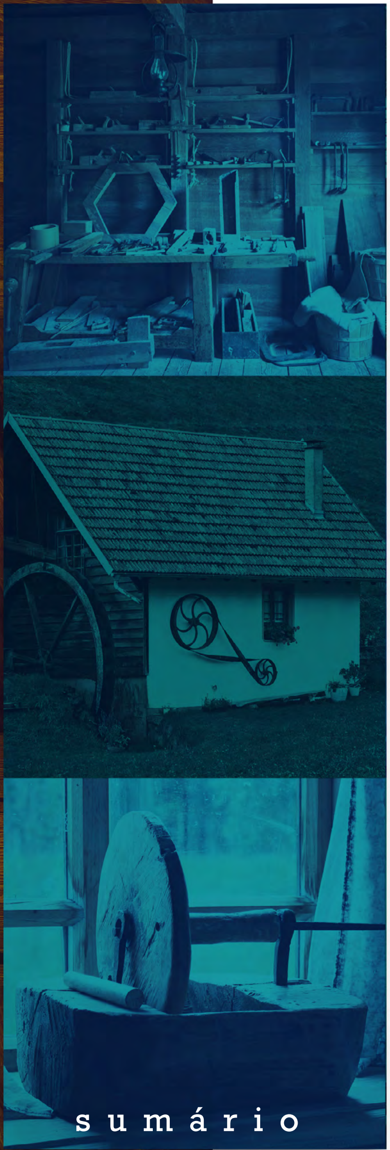
Detergents	X	
Dyes	X	X
Feed blocks		X
Flares and fireworks		X
Food uses	X	X
Foundries		
Sand binder		X
Core paste		X
Core wash		X
Fuel briquettes		X
Insecticides	X	
Leather		
Adhesives	X	
Shoe counter pastes	X	
Shoe polishes	X	
Linoleum		X
Paints		
Cold-water	X	
Poster	X	
Paper		
Calendar sizing	X	
Coatings	X	
Tub sizing	X	
Wallpaper	X	
Patching plaster	X	



Plaster board	X		
Printing			
Ink vehicle			X
Textile	X		X
Protective colloids	X	X	
Textiles			
Cloth printing	X		X
Dyeing	X		X
Glass fiber sizing	X		
Felt sizing	X		
Finishing	X		X
Rug sizing			X
Stiffening	X		
Warp sizing (spun rayon)	X		X
Welding rods		X	
Window shades	X		

Starch Derivatives - Derivatives, mainly ethers and esters, are formed by reaction at in most commercially available starch derivatives, only a small number of hydroxyl groups are substituted. The introduction of relatively small number of substituents, may profoundly alter the colloidal properties of the starch when it is dispersed in water. Among these properties, the increasing of clarity of the aqueous solution, the decreasing in the tendency to form a gel, and the improvement of the film-forming ability are of the greatest commercial importance.

Hydroxethyl starches (starch ethers) are chiefly used in the Paper and textile industries. Low-substituted carboxymethylstarch is also used in the paper industry as an additive to increase strength and



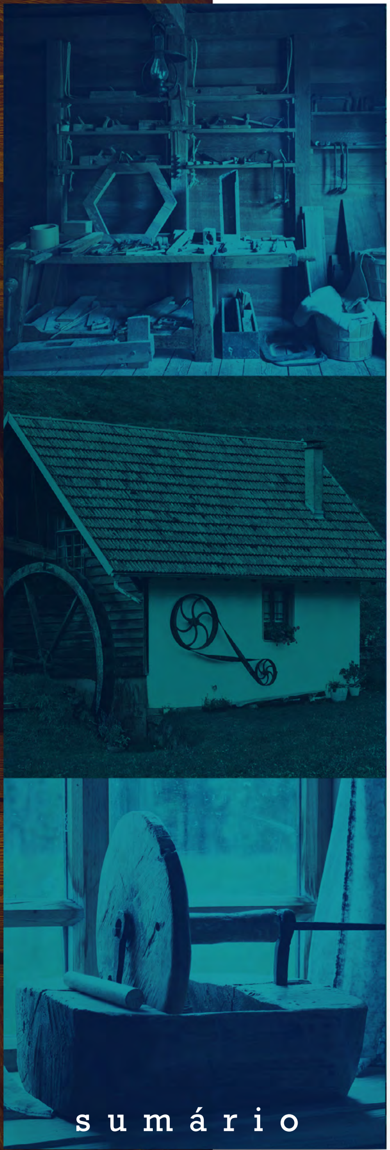
other properties of paper. Tertiary aminoalkyl ethers and quaternary ammonium alkyl ethers are cationic starches derivatives which have commercial importance. They are used principally as internal binders in the manufacture of paper. They are also employed as emulsifying agents for water-repellent sizing substances and as coating binders, both in the paper industry.

Starch Acetate (starch esters) is one of the first commercial derivatives of starch to be marketed. Starch acetates are being used by the food, paper and textile industries. Among the inorganic esters, the starch nitrates have risen to industrial importance because of their use in explosives. Potato starch is a naturally occurring phosphate derivative. Phosphoric esters of starches are used in food industry.

Cross-Linked Starches - The use of cross-linking reactions to vary the molecular parameters of starches has found applications of importance in paper, textile, dyes, ceramics, and other industries. Homogeneous cross-linked starches are obtained by having the polysaccharide react such as sodium trimetaphosphate, with a polyfunctional reagent, phosphorus oxychloride or epichlorohydrin, Cross-linked derivatives are used where stability to shear is important.

In Brazil, as we have already seen, the raw materials for starch production are mainly cassava and corn. The starches obtained have been used not only in the food industry, but also in paper, textile, pharmaceutical, and mining industries.

The utilization of modified starch in this country may, be considered restricted, considering the information usually available. In this way, the principal modified products are said to be the pre-gelatinized starches and the acid - treated ones, products whose patent protection does not hold anymore, as is the case with most chemicals produced in Brazil.



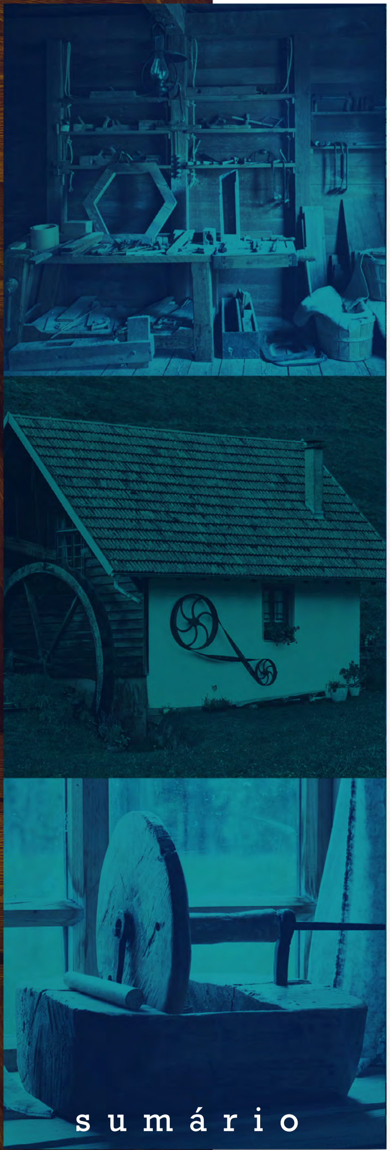
Employed mainly as additives, most of the modified starches used in the world are products from the fine chemicals industry. Because that sector is not well developed in the country, this would explain (partially, at least) the restricted use of modified starches.

The same reason can be used to explain some of the difficulties to produce starch derivatives, because the necessary chemical intermediates are not always available in Brazil. Patent regulations and the restrictions of transnational corporations to transfer technology also represent an important constraint to the endogenous development of this sector.[77]

Yet, despite all those obstacles, in the early seventies the Lorenz Company was seeking yet to produce both the chemically and the derivative cassava starches.

The great interest of the *Companhia Lorenz* in beginning modified starch production was, above all, the direct result of the good prices of these products in international markets, and, in some cases, modified starches were 300% more expensive than the non-modified product (LIMA, 1979). Also, as was described above, modified starches are the basis of a larger number of products and have more markets available to them.

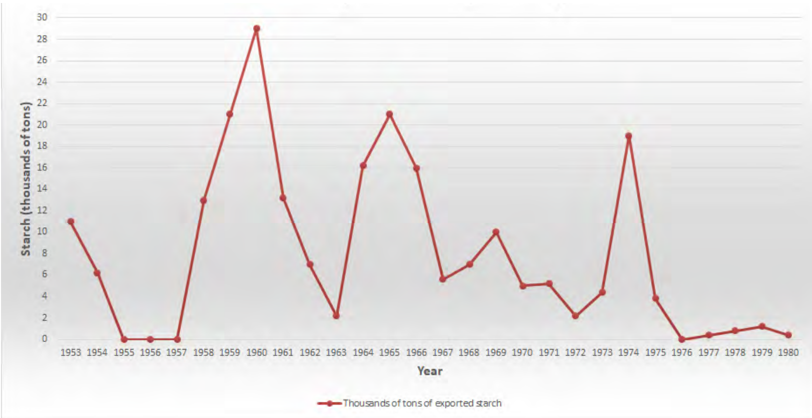
There was, however, another equally important factor which led Lorenz to invest in the area of modified starches, namely the sharp drop in the exports of ordinary starch (non-modified cassava starch) to the United States, which at the time was the main importing market. According to the information gathered at the Lorenz Company itself, the sudden American decision to substantially cut imports, beginning in 1974 (see Table 5.17), was mainly due to the introduction of a new variety of corn whose starch had characteristics like those of cassava starch.

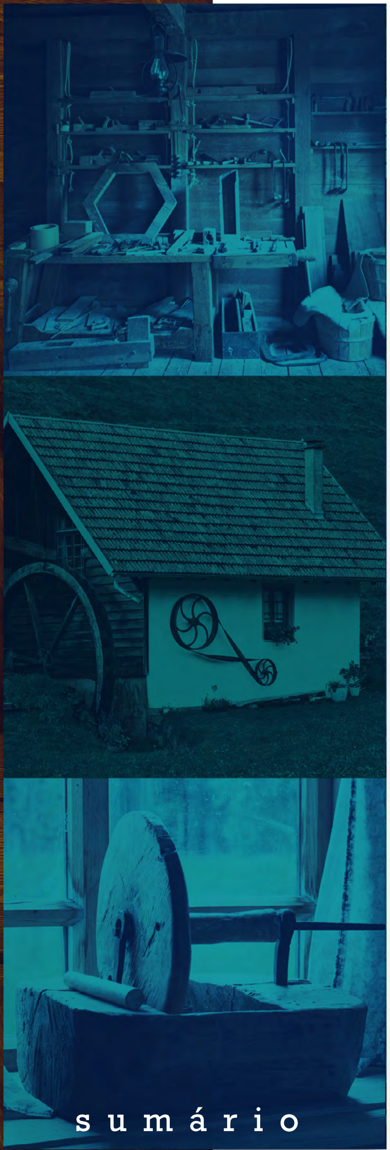


The financial impact caused by the significant drop in exports was only a part of the whole story. Encouraged by the Brazilian government export support program, at that time, Lorenz had committed 70% of the production to foreign markets. Thus, the Company lost the buyer or 7,000 tons of the starch which had been produced in that year (1974) for the United States market. It was, therefore, imperative that a radical change in the market strategy of the company be implemented. Furthermore, it was essential that the company go through a technological leap, so that it be able to manufacture and sell a whole range of new products derived from chemically modified starch.

Nevertheless, the reversed engineering strategy that had been successfully adopted by the Lorenz Company until then, as a mean of acquiring and implementing its own technological development, could not be applied in this case. The reason was that the new technological paradigm had considerably different characteristics not only regarding the nature of the technical-scientific knowledge involved, but also regarding its institutionalization in international markets.

Figure 5.8 - Cassava starch exportation 1963/1980 - Itajaí Port.

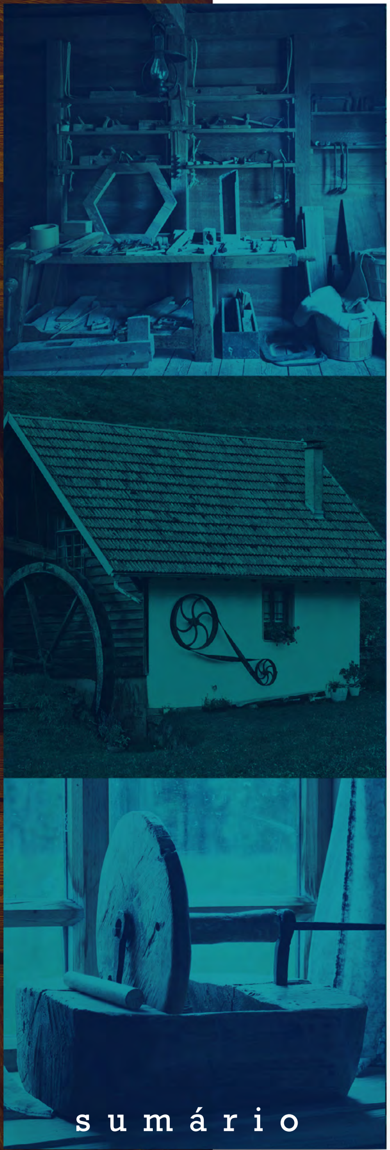




Initially, emphasis must be given to the nature and structure of the international chemically modified starch markets, whose production and marketing are controlled by large multinational companies. These companies, among which CPC International (USA), National Starch and Chemical Corporation (UK, Cargill (USA), A.E. Stale Mfg. Co. (US), and Gevaert Photo-Production N.V. (RDA) - have established an oligopolistic market that is very difficult to enter. Products and processes are strictly controlled by these companies, which generally do not accept licensing or sale of patents. Quite often, the way to obtain authorization to use or produce any of the processes owned and/or controlled by them is through an association, by which the suppling company pays in full for its shares with the technology. In the Brazilian case, the restrictive mechanisms to the registration of patents, which was previously described above, made this type of association practically the only possible was open for negotiation.

An alternative to the production of chemically modified starch products, without association with an of these multinational corporations, would be through domestic research and development. In the event that such an undertaking was successful, there would still remain the problem of selling the products.

However, for the Lorenz Company, the solution of such technological challenge would require overcoming several obstacles, both domestically and internationally. For this purpose, the Lorenz Company would have to meet two basic prerequisites. Firstly, it would be necessary to set up and equip a research and development department that, among other tasks, would have to make possible the application of basic chemical research results to industrial scale technological processes. Secondly, it would be necessary that there be well equipped and competent is manned research centers to provide the required scientific support. Such support, as was suggested in the

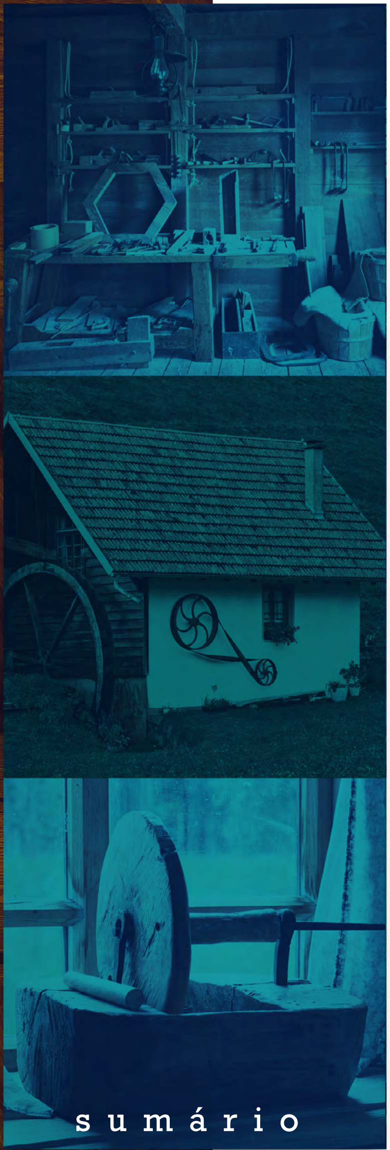


first part of this section, is absolutely essential to technological and industrial development in this area.

Unfortunately, for the Lorenz Company and for Brazil, neither of the above-mentioned prerequisites could be fulfilled at the time. the company did not have any tradition in the area of chemistry that would allow it to set up a sophisticated R & D department. Furthermore, there were not enough qualified personnel to provide a critical mass for scientific research or even to be hired by the company. And, Finally, there were no mechanisms and/or institutional programs to furnish support to the technological development of national industries. The Study and Project Financing Agency - *FINEP*, for example, only started its activities in 1975. Thus, the minimum necessary conditions to make such a technological innovation program feasible, both technically and economically, were lacking. Consequently, it was inevitable that there occurs a discontinuity in the technical base of the cassava starch industry in Brazil.

During that same critical year, 1974, the Lorenz National Industrial Ltda. was founded, in a place called *Itoupava Seca*, a municipality or Blumenau, this was an association of the *Indústrias de Fécula Companhia Lorenz* with the National Starch and Chemical Corporation. Through this new firm, it became possible for Lorenz to enter the chemicals-modified starch products market. This decision to form the new company seems to have been the right one, at least from the financial point of view, since by 1977 the revenue of the Lorenz National was close to 20% above the revenue of all the non-modified starch plants of the *Companhia Lorenz* together.

Regarding the *Companhia Lorenz's* and the whole of the starch agro-industrial segment's technological development, the impact of the introduction of a new technological paradigm on both the technical base and the economic and social structures was, and still is, important for the restructuring of the whole production structure of



that industrial branch. Firstly, it was an added thrust to the industrial concentration process in the State of Santa Catarina. According to some of the most important starch industry businessmen in the region of the *Vale do Itajaí*, the small starch plants will disappear at medium term (in five to ten years).

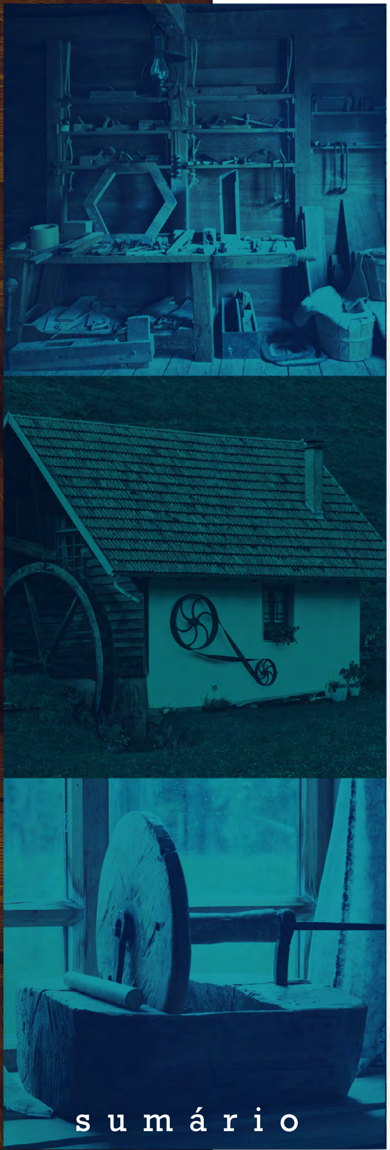
Secondly, it was important because it led the large firms, and particularly the *Companhia Lorenz* itself, to create R & D departments, duly manned by specialized chemical engineers. If, on the one hand, the significant changes which have occurred in the technical base of the whole country since 1974 are taken into account and, on the other, consideration is given to creation of more efficient institutional mechanisms for the support of the technological development of the Brazilian industries, it is possible to foresee that in a not too distant future the starch industries will reach the condition to regain control over their own technological innovation processes.

NOTES TO CHAPTER 5

THE SUBSISTENCE PRODUCTION SYSTEM

[71] The peasant farmers have had a variety of tenure arrangements throughout the Brazilian agrarian history. For a good discussion of the peasantry system in Brazil see Forman's The Brazilian Peasantry, especially chapter two (FORMAN, 1975).

[72] The shortage of foodstuff, especially staple goods, was one of the most serious problems faced by the population of the large urban centers, which quite often had to relay on imported products. That problem was extremely serious when the prices of those export-oriented crops rose in international markets. Then, the subsistence crops were neglected or even completely abandoned for commercial crops (PRADO, 1967). It is interesting to stress here the degree of importance given by the Portuguese Crown to cassava as foodstuff. The royal decree or 25 February 1688, which attempted to remedy the food supply problem, stipulated that: the cane sugar plantation owner has to plant at least 500 pounds of cassava for each slave employed in his plantation. Later, another decree of 27 February 1701, established that the ship owners engaged in slave trading should own lands in Brazil and cultivate cassava to feed their crews and the transported slaves (PRADO, 1967, p. 189).



[73] Despite a series of data and attempts to measure the Brazilian income demand elasticity for various income categories and regions, Phillips' analysis did not consider the problem of price fluctuations and its effects upon cassava production (PHILLIPS, 1973).

[74] As far as the development of cassava processing in other regions of Brazil is concern, the technological level is generally in a very rudimentary stage, particularly in the Northeast, where the sugarcane plantations are still predominant.

[75] This was the number obtained using the available historical data. It could have been greater than that, specially if the number of firms that had closed had been taken into account.

[76] It is interesting to compare Blumenau's development with Thailand's cassava pellets industry. In the later all machinery was supplied by two European firms. Even the investment capital came from abroad (BELL, 1978).

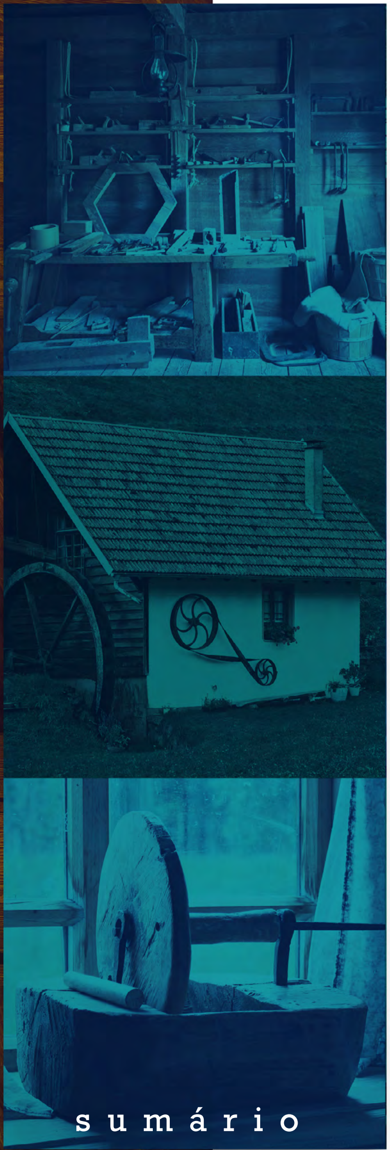
TECHNOLOGICAL DISCONTINUITY: THE PRODUCTION OF THE CHEMICALLY MODIFIED STARCHES

[77] The characteristics of the Brazilian patent regulation system, which does not grant patents for chemical products but only for processes - and in the case of pharmaceutical products the patent system does not apply at all, strengthen the restrictions of transnational corporations to transfer technology for this sector.

6

A NEW TECHNOLOGICAL DISCONTINUITY?

The brazilian alcohol program



INTRODUCTION

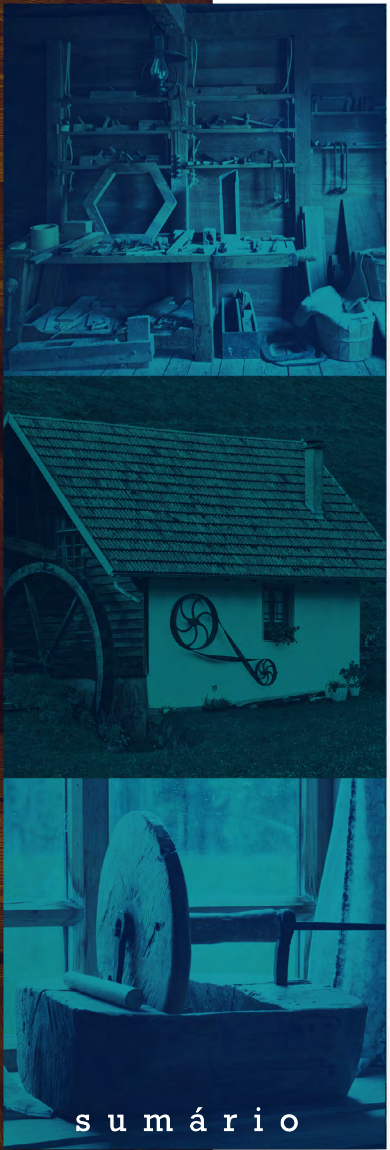
In this chapter a brief outline of the *Programa Nacional do Álcool – PNA* (Brazilian Alcohol Program) is presented as well as an overview of its likely erects upon the cassava agro-industry in Brazil.

Section 6.2 introduces the program's background and describes its main features. Section 6.3 gives an assessment of the use of cassava as raw material for alcohol production and highlights the major obstacles and constraints. Finally, in Section 6.4, the lessons drawn from the results of the *PNA* concerning cassava utilization as raw material for alcohol production are discussed.

THE BRAZILIAN ALCOHOL PROGRAM

On 14 November 1975, the Brazilian government launched the *Programa Nacional do Álcool - PNA* (Brazilian Alcohol Program), as a response to Brazil's increasing dependence on imported oil. The energy crisis resulting from the sharp increase of oil prices in 1973 interrupted the so-called Brazilian Miracle, the period from 1968 to 1973 which was characterized by very high rates of growth (over 10 % per year) and a relatively low rate of inflation (average of 18% per year). In 1979, more than 80% of the oil consumed in Brazil was imported, at the cost of US$6.7 billion.

The program seeks to replace much of the imported oil with ethyl alcohol produced from sugarcane and cassava. Such unique energy strategy, based on biomass, relies on two very special conditions. First, Brazil's vast reserves of unexploited land allied to quite favorable climate characteristics. Second, the existence of an already settled and reasonable developed sugarcane agro-industry.

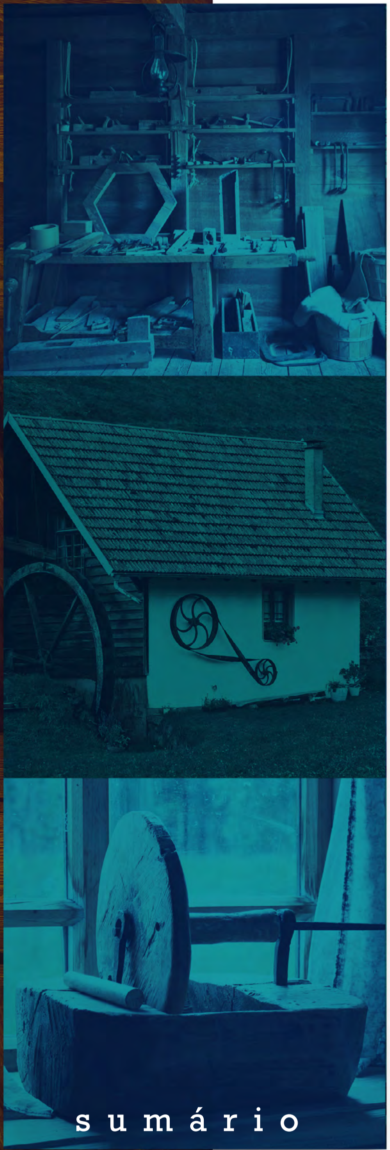


However, from 1932 to 1945, long before any importation of oil had ever taken place, some attempts had been made to produce alcohol, using either sugarcane or cassava as raw material, to replace petrol which at that time, and specially during the Second Great War, was in short supply. Since then, other factors had to come into being that turned those conditions, i.e., land, climate, and agro-industrial infrastructure, into the very presuppositions from which the Alcohol Program could spring.

The first and undoubtedly the most important factor was the 1973 oil crisis. As it is well known, that crisis shook the world capitalist economy and especially damaged the economies of the developing countries. Brazil's increasing dependence on imported oil and the negative impacts on its foreign trade balance, caused by the rise in oil prices, had disclosed some of the contradictions inherent in the accelerated process of industrialization and explosive urban growth that characterized the Brazilian process of capital accumulation during the previous decades.

The second factor was the fall of the sugar prices on the international market. In 1975, the Brazilian sugarcane agro-industry ran sugar price into serious difficulties due to the extremely low sugar price in comparison with the previous year record. That crisis deeply hit not only the sugarcane agro-industry as a whole but also a segment of the Brazilian capital goods industry that supplied equipment and machinery for its expansion.

According to the *Plano de Expansão da Indústria Açucareira Nacional* (National Plan for the Expansion of the Sugarcane Industry), set up in 1963/64, sugar production should increase from 2.5 to 5.5 billion tons, augmenting the share of Brazilian sugar on the international market, from 13% to 30% by 1973. Therefore, given such particular conjunction of circumstances, those industries which were most directly affected by the sugar crisis set up a strong lobby for alcohol production

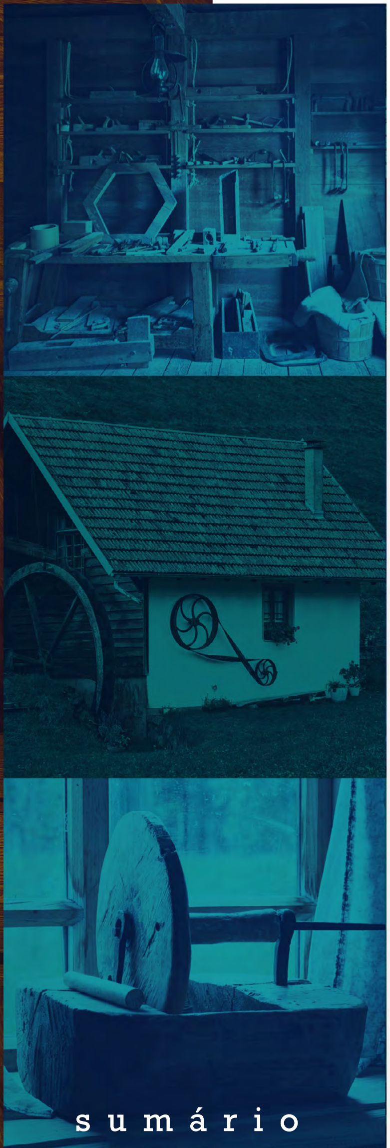


based on sugarcane, on the ground that it would represent the best solution for both crises: energy and sugar.

A third factor, perhaps not so much a determinant as the previous ones, was the prospects that the Alcohol Program offered in terms of reducing the negative impacts on the rural areas caused by an unequal process of economic development. From such a perspective, the utilization of cassava as a raw material for alcohol production was seen as very convenient way to tackle the problems.

The Alcohol Program consists of incentives to private enterprises in the form of subsidized loans. These loans are given after government approval of the projects that must be submitted to the National Alcohol Commission, an interministerial committee chaired by the representative of the Ministry of Industry and Commerce. The loan covers both agricultural and industrial investments. The alcohol production facilities can be either distillery annexed to existing sugar plants autonomous distilleries.

However, as far as the utilization of cassava as raw material for alcohol production to date its results have not been very significant. According to the 1981 alcohol report or the *Secretaria de Tecnologia Industrial - STI* (Secretariat of Industrial Technology) in 1980, sugarcane was (and still is) the overwhelmingly predominant raw material in the production of alcohol. Until that time, only one experimental cassava-based alcohol distillery was in operation, and the prospects for a change in such a trend seem even now very unlikely due to reasons which are discussed in the following section.

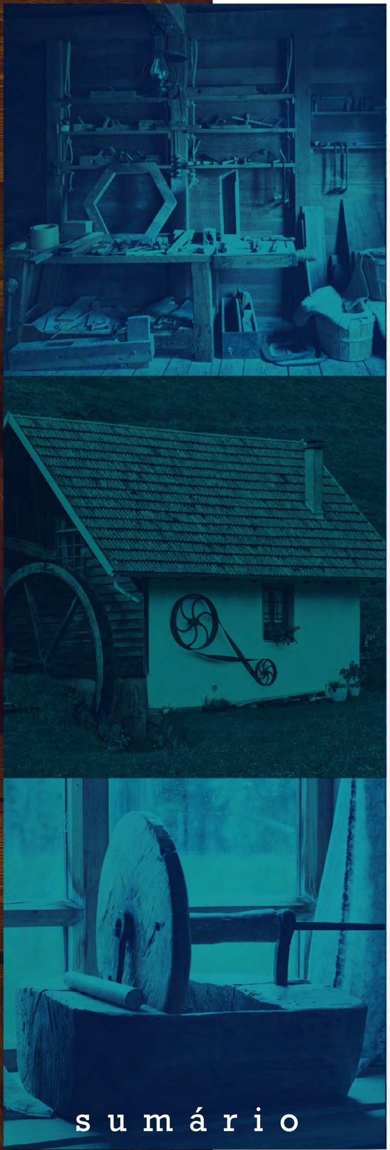


THE CASSAVA AGRO-INDUSTRY AND ALCOHOL PROGRAM: SOCIAL, ECONOMIC AND TECHNOLOGICAL CONSTRAINTS

The utilization of cassava to produce alcohol is not new in Brazil. Between 1932 and 1945, when the supply of petrol was very limited, particularly during the Great War, the production of alcohol from cassava was undertaken. Three distilleries were set up and, according to the available data one of these distilleries, located in Divinópolis, in the State of Minas Gerais, produced about 800,000 liters annually (MENEZES, 1978).

But such experience was short-lived, lasting only through the Second War's petrol supply crisis. Once the war was over and the petrol supply reinstated, the experience was abandoned. It is important to point out that the possibility of using cassava to produce alcohol had also been discussed in Blumenau, according to the local newspaper, "Der Urwaldsbote" January 17th, 1933, one of the main obstacles to produce alcohol from cassava was of economic nature. Cassava, it was said, cannot compete with sugarcane because the production of alcohol based on cassava costs twice as much as that based on sugarcane. Unless cassava "comparative advantage" was used, i.e., cultivate it in areas in which sugarcane could not g row. The experience of Divinópolis was also mentioned and according to this report 50,00 liters of alcohol had been produced by that time.

The high capacity of cassava to adapt and produce reasonably well under adverse soil conditions or low fertility, high acidity and aluminum toxicity which are quite common in large areas of Brazil, gives to this crop a significant comparative advantage. However, as it has happened in other sectors in which the argument of "comparative



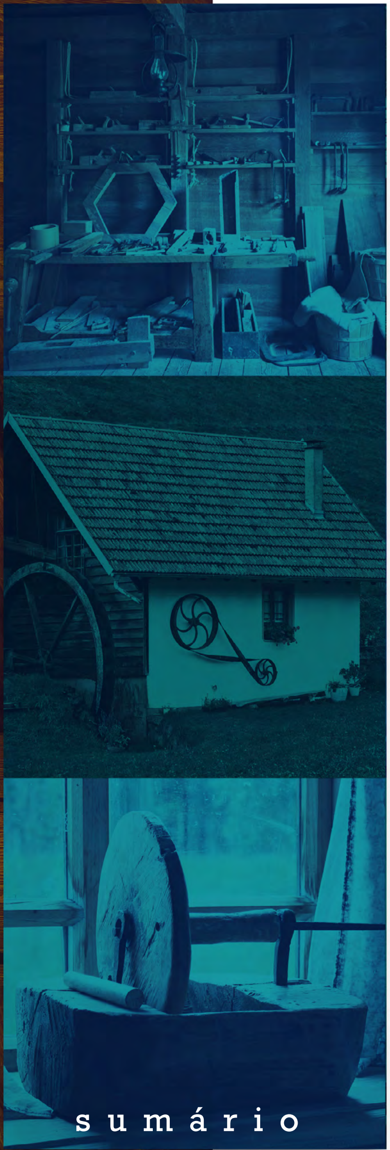
advantages" has been applied, specially for developing countries, the argument will only hold as long as the technological aspects are not taken into account. Moreover, it is equally important to consider the social and economic aspects.

Therefore, the utilization of cassava as a raw material in alcohol production has two distinct but deeply related set of problems. The first, of a technological and scientific nature, is concerned with the lack of knowledge of both cassava cultivation and alcohol industrial production. The second set, of social and economic nature, refers to the extremely rudimentary production structure of the cassava agro-industry.

Cassava yields present a wide degree of variability, but it is estimated that the small and medium farmers, using the known varieties and the best currently available technologies, can achieve an average yield of 18.5 tons per hectare per year, raising the current Brazilian average, which is about 12 tons/ha. However, to increase yield beyond that level would demand a great deal of scientific and technological research to improve the current knowledge on cassava.

The proper application of fertilizers, soil correctives and herbicides in a highly mechanized operation can increase the average yield, according to official estimations, to 26 tons per hectare per year. Consideration should also be given to some other critical points such as the selection of better cuttings, especially regarding sanitary control, as well as the correct timing and positioning during the planting operation. Weed control during early growth affects productivity significantly (*BRASIL/STI*, 1981).

The alcohol technology for cassava, on an industrial scale, differs from that of sugarcane during the initial stages of preparation and fermentation. The distillation stage is identical. As described in the previous sections, cassava has a starch content of approximately 25 to 30% by weight in fresh roots. The preparation stage does not differ from



that of starch production. After the starch pulp has been turbined to increase starch concentration, the solution is cooked and, at the same time, pre-saccharified through the addition of alpha-amylase enzyme. The next step, the saccharification process, resulting from the addition of amiloglucosidade enzyme and the fermentation, are conducted simultaneously. The resulting liquor is then distilled.

The diagram below (Figure 6.1) summarizes two distinct routes to produce alcohol from cassava. The difference lies on the saccharification stage, which can be carried out by two different processes. The first, the hydrolysis process, employs hydrochloric or sulfuric acid. It is not recommended because of its low productivity and the risks of accident caused by acid corrosion of the equipment. The second, a biological process, uses amylolytic enzymes that can be obtained from several sources. Currently, these enzymes are imported and cost about US$18 per 1,000 liters.

Considerable investment is necessary to meet the research and development requirements, especially basic research on cassava cultivation improvements, and to enhance industrial alcohol production. Therefore, the lack of scientific and technological knowledge and, consequently, the extremely low capability for technological innovations, were the main causes of the insignificant response of the cassava agro-industry to the Brazilian Alcohol Program. The data on scientific and technical information published in Brazilian specialized literature, collected during the field work, show that from 1925 to 1974, only 92 papers were published, giving an average of 1.87 papers per year, on a variety of issues concerning cassava cultivation, processing and on social-economic aspects.

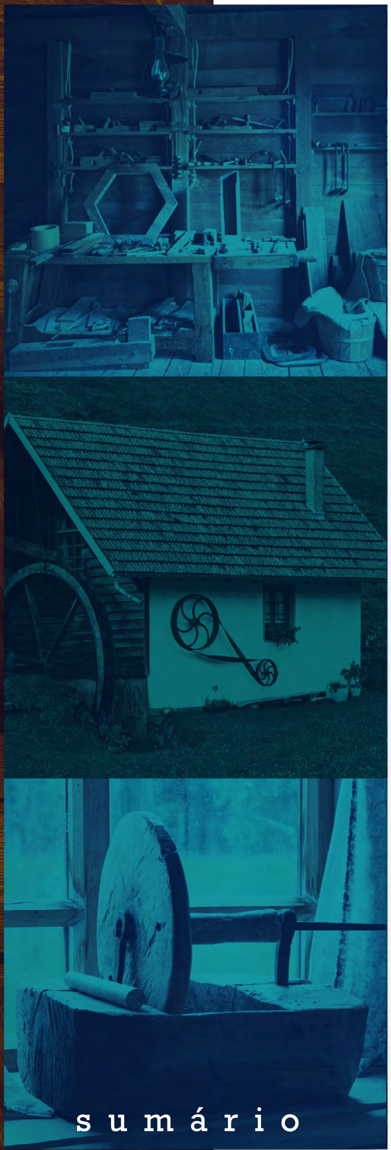
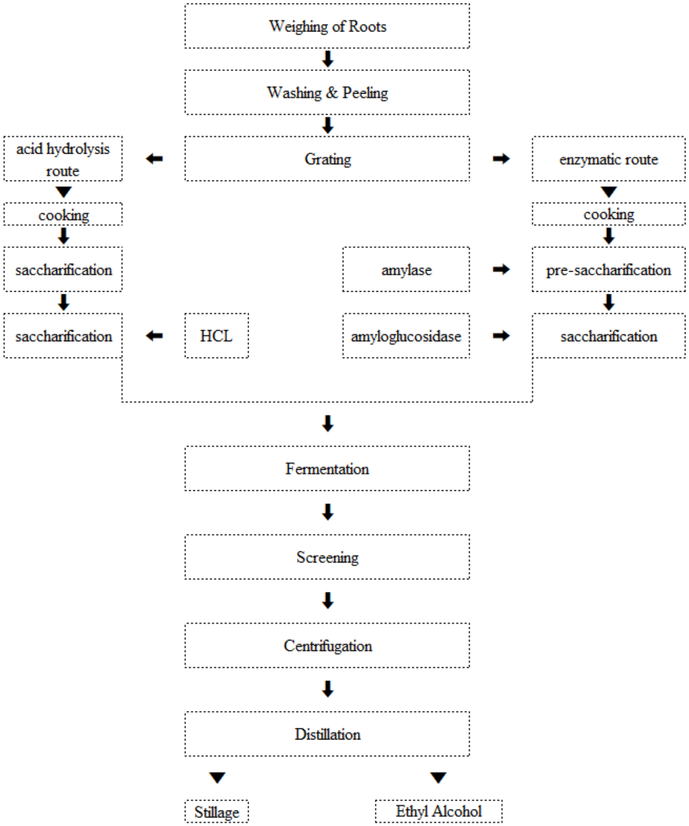
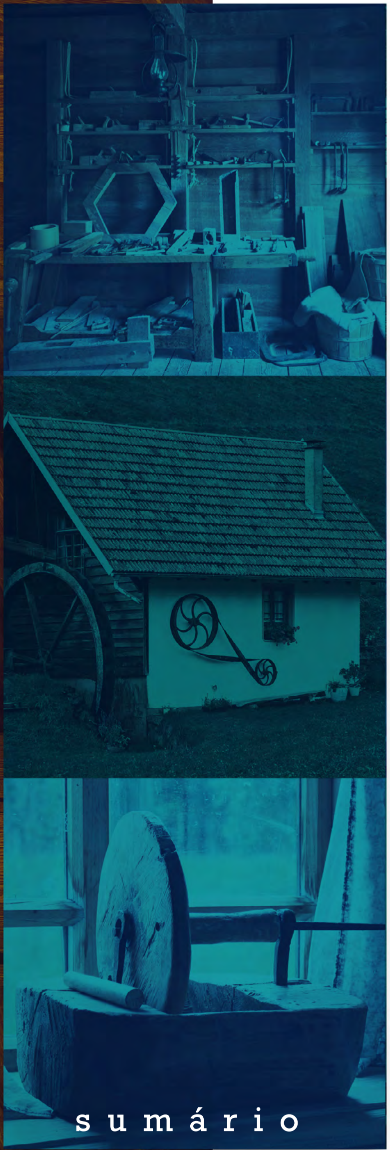


Figure 6.1 - Alcohol production from cassava.



Finally, there are the social and economic constraints, which as has already been discussed in this thesis, present a complex range of problems. From the economic point of view, the unstable market price for cassava and its equally unstable supply, are the most crucial obstacles for the stead development of the cassava agro-industry.



CONCLUDING REMARKS

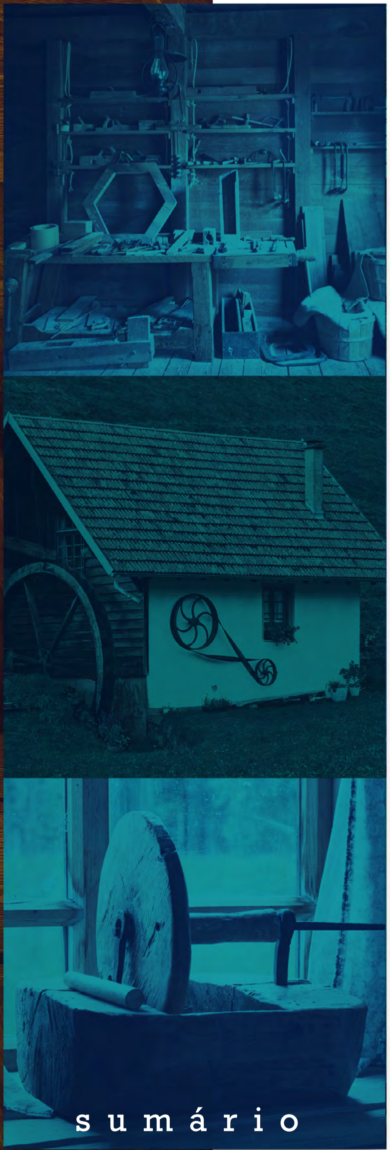
The first important conclusion that can be drawn from the cassava agro-industry experience, so far, in the Brazilian Alcohol Program, is that the government initially overestimated the role to be played by cassava agro-industry in alcohol production. The minimal infrastructure was missing in terms of both the available technical base and the social-economic organization of the cassava production system, to provide support to such a radical change. This was precisely the case, as was previously discussed, for the chemically modified cassava starch, in which the existing technical base could not respond, in the short run, to the new technological demand.

On the social-economic and political side, the lack of any institutional framework, such as that of the sugarcane agro-industry, for promoting cassava production, establishing rules and procedures in the relationship between independent farmers and distilleries, or improving productivity, makes a significant change on the current situation, extremely difficult.

Even in the case of Santa Catarina, where the cassava starch agro-industry reached a high level of development in comparison with the other regions of the country, the possibilities that it could respond to the alcohol challenge entirely on its own, without massive State support, are really very few. The high level of investment required for such an industrial transformation, including a sophisticated research agenda using biotechnology techniques ANCIAES, W. & J. CASSIOLATO, 1985), seems to be now far beyond the capacity of that industry.

7

SUMMARY AND CONCLUSIONS



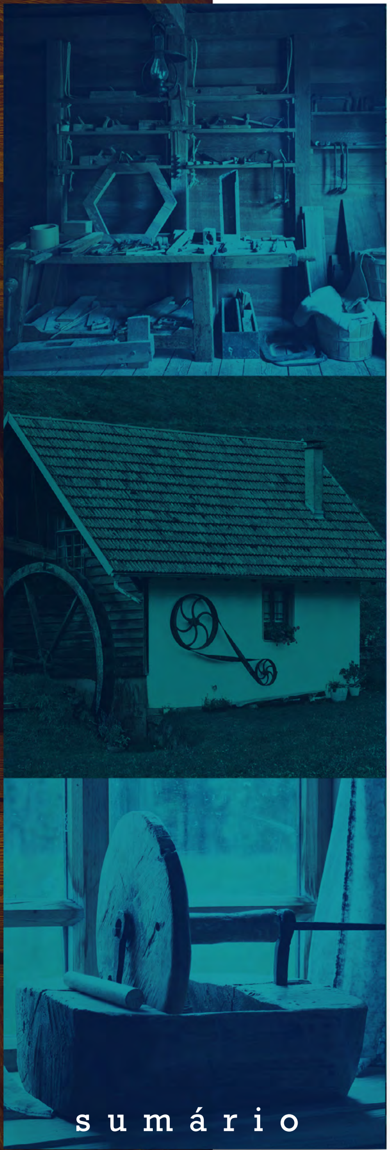
SUMMARY

This thesis has two main purposes. Firstly, from a more theoretical perspective, it seeks to explore the conditions by which the economy of a developing country can successfully achieve technological progress. The second can be seen as a complement of the first and focuses on the experience of the Brazilian cassava starch agro-industry in the State of Santa Catarina, seeking to explore to what extent the process of industrialization that occurred in the area of Blumenau, where this industry flourished, was determined by three sets of variables: (I) the pattern of capital accumulation, (II) the capability of the related technical base to both promote or absorb technological changes, and (III) the firms' strategies with regard to innovation.

Over one hundred and fifty years of history of the cassava agro-industry in Santa Catarina, particularly in Blumenau, were told throughout the chapters of Part Two. A historical approach was used to describe the development of this industry. Accordingly, the history of the cassava agro-industry was divided into five periods, each corresponding to a specific pattern of industrialization and to a related cycle of capital accumulation.

The first period, from 1600 to 1850, represented the initial phase of Santa Catarina history under Portuguese colonial rule. During this phase, the economic activities rarely rose above the subsistence level. The cassava agro-industry was at an extremely low level of technological development and its products (mainly cassava-flour) were produced by a very rudimentary process.

The second phase, covering the period between 1850 and 1880, corresponded to the establishment of settlements of immigrants mostly from Germany in the region (particularly in Itajaí Valley). At this stage, a local development occurred under very particular circumstances;

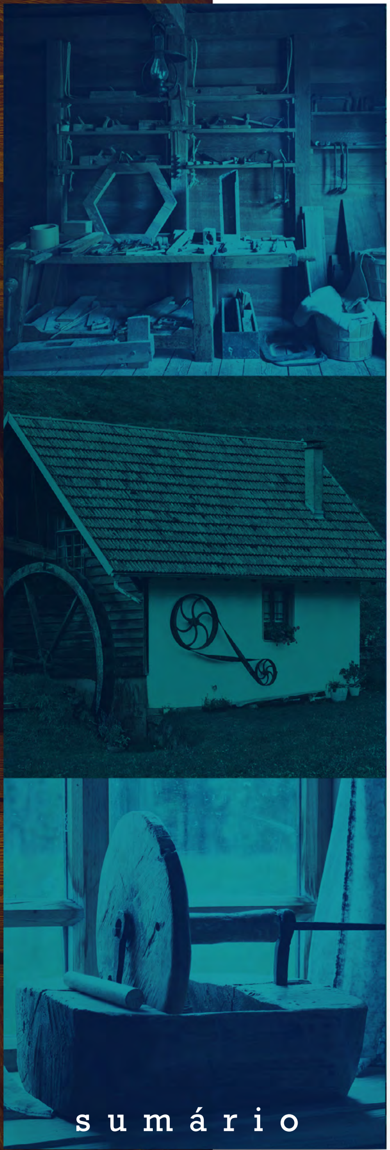


thanks to the emergence of a local system of commerce, which flourished along with the development of Blumenau's proto-industrialization, an endogenous process of capital accumulation took place. In this process, the central role was played by the retail traders and/or middlemen ("*vendeiro*") who later, during the third period from 1880 to 1914, became the agents of industrialization. Actually, those businessmen, backed by the capital which they had accumulated during the proto-industrialization phase, were to become the emergent industrial entrepreneurs.

Regarding the development of the cassava agro-industry, a relatively large number of cassava-flour mills emerged in the region of Blumenau during this period (in 1883 there were 152 cassava mills in operation in that area). The technology employed in such mills represented a significant step forward in comparison with the existing cassava-flour processing units usually called "*casa de farinha*"),

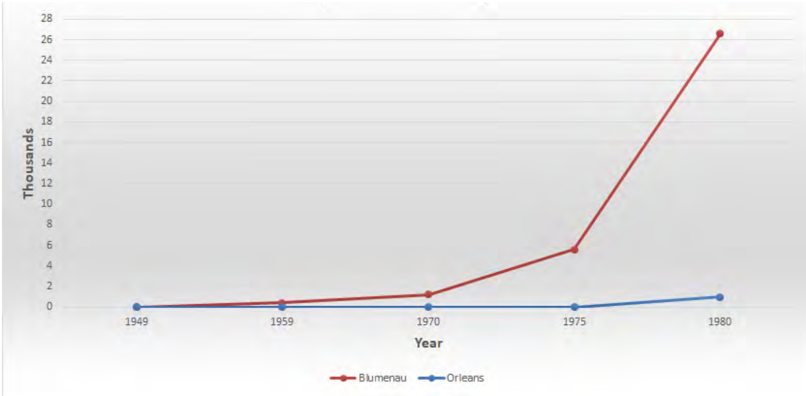
The third phase, from 1880 to 1914, represents a transition period from proto industrialization towards industrialization proper. The establishment of other immigrant settlements in the region of Itajaí Valley as well as the improvement of Blumenau's transport system, providing better access to the main Brazilian domestic markets at the time (Rio de Janeiro and, later, São Paulo), opened up a growing market for Blumenau's industrial commodities.

Although the region of Orleans, located to the South of Blumenau, had also been chosen as an area for immigrant settlements, its development did not quite follow Blumenau's footsteps. The main reasons for such difference were twofold. First, there were no local retail traders or middlemen in the settlement's area and all commercial transactions were made through the Colonial Company's trade post, which had its headquarters in Paris. Such arrangements did not foster any significant process of capital accumulation.



Secondly, the process of proto industrialization that took place in Orleans did not quite develop towards industrialization, as Blumenau's did. This was partially due to both the constraints imposed by the economic structure of the settlement, and the lack or development of a technical base. Consequently, Orleans became industrially stagnant. The sharp difference between Orleans' and Blumenau's process or industrialization is summarized in Figure 7.1. It shows a comparison between the evolution of manufacturing sector from 1958 to 1980.

Figure 7.1 - Blumenau and Orleans: evolution of the industrial sector - 1958/1980 (Index: 1949=100).



During the fourth and the fifth phases, from 1914 to 1960 and from 1960 to 1980, first the consolidation and afterwards the maturation stages were reached. This development followed the general process or Brazilian industrialization. Since then, a light capital goods industry has been established in the region of Blumenau, allowing a new pattern of industrialization. It is interesting to note that Blumenau's pattern, as compared to the State of Santa Catarina's and Brazil's patterns, have shown a much more intensive process of industrialization. This can be readily seen by the comparison of Tables 4 .9 (on Page 140), 7.1 and 7.2, below.

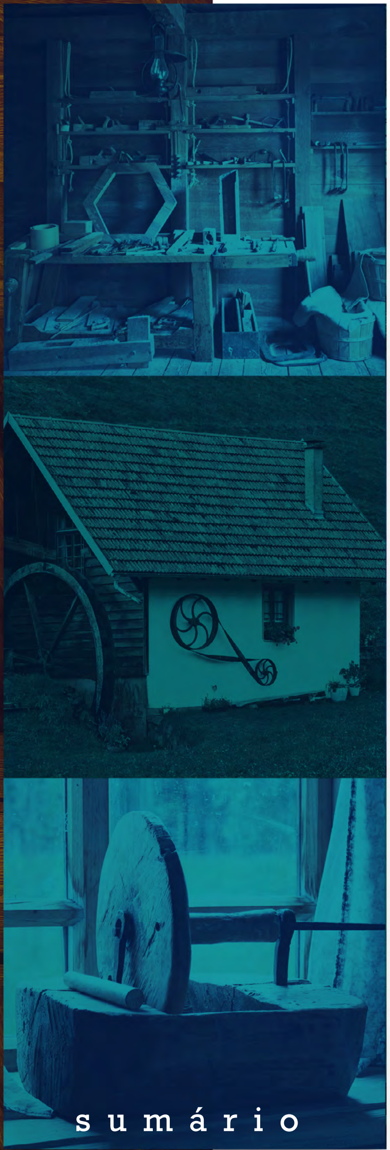


Table 7.1 - Santa Catarina: comparison between the industrial and agricultural labour forces - 1940/1980.

SANTA CATARINA: Comparison between the industrial and agricultural labour forces (%)					
	1940	1950	1960	1970	1980
Agriculture	93	87	n.a.	86	75
Industry	7	13	n.a.	14	25
Total	100	100	n.a.	100	100

Source: *BRASIL/IBGE – Censo Brasileiro* 1940, 1950, 1960, 1970, and 1980.

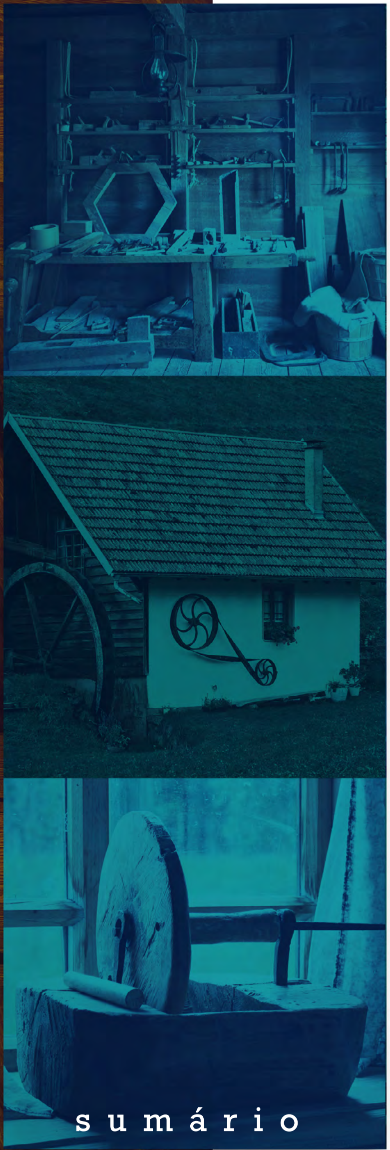
Table 7.2 - Brazil: comparison between the industrial and agricultural labour forces - 1940/1980.

BRAZIL: Comparison between the industrial and agricultural labour forces (%)					
	1940	1950	1960	1970	1980
Agriculture	92	91	10	72	-
Industry	8	9	90	28	-
Total	100	100	100	100	100

Source: *BRASIL/IBGE – Censo Brasileiro* 1940, 1950, 1960, 1970, and 1980.

The cassava starch industry was set up in 1917, during the fourth phase of Blumenau's general process of industrialization and its technological development followed a pattern similar to that of the other industries of the region. The local technical base played a crucial role in the process of Blumenau's industrialization and made it possible for the local entrepreneurs to conduct a strategy aiming at innovation and the strengthening of their firms' technological capability.

Basically, that strategy consisted of releasing as much as possible on the local technological capability to either develop or



absorb a specific technical change. The details of the strategy were discussed in Chapter 5.

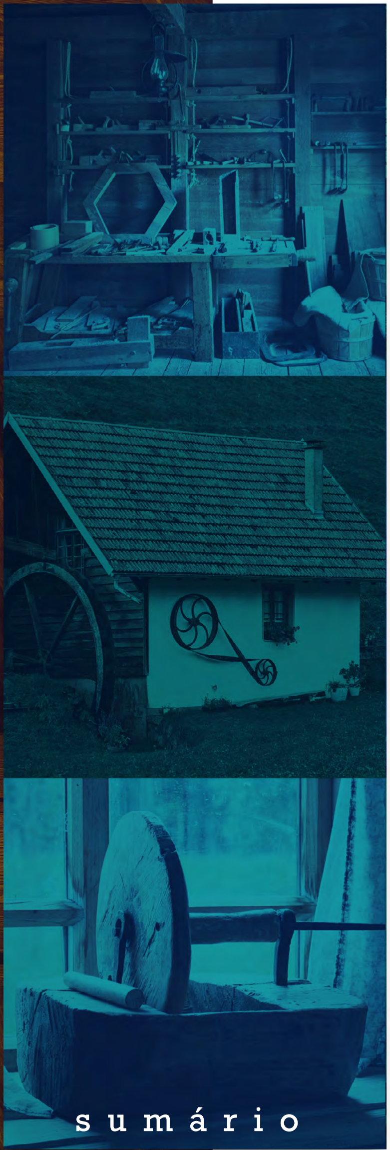
Nevertheless, the case study also illustrates the limits of such strategy, specially when the local technical base has neither the necessary knowledge nor the institutional infrastructure to cope with a new technological paradigm. This was the case of the cassava starch industry with regard to the introduction of the chemically modified starch, which forced the biggest cassava starch producer, the *Companhia Lorenz*, to radically change its traditional strategy for acquiring a technological capability.

In order to achieve this innovation, the *Companhia Lorenz* set up a joint venture with National Starch and Chemical Corporation, a multinational company. The new company followed the usual pattern. the recipient firm provides both investment capital and working capital while the suppling firm provides the technology. Consequently, the Lorenz lost control over its process of technological development, since the association was done on "packaged basis" i.e., the Lorenz Company was not allowed to alter either the processes or the products produced by the associated firm.

This case illustrates a very important finding of the thesis' empirical research, namely that a firm's strategy for technological capability has to be adapted or even suffer a radical change when facing a primary innovation.

THEORETICAL AND EMPIRICAL IMPLICATIONS

Concerning the theoretical issues raised in Part One, some concluding remarks can now be made in relation to the results of this case study. To begin with, the so-called technological dependency



type of analysis seems to be inappropriate for finding a satisfactory explanation of the process of technological progress that has taken place in some peripheral economies. This point has also been suggested by other authors.

The history of the technological development of the cassava agro--industry and, more specifically, or the cassava starch industry, clearly shows that such progress was based on local technological capabilities.

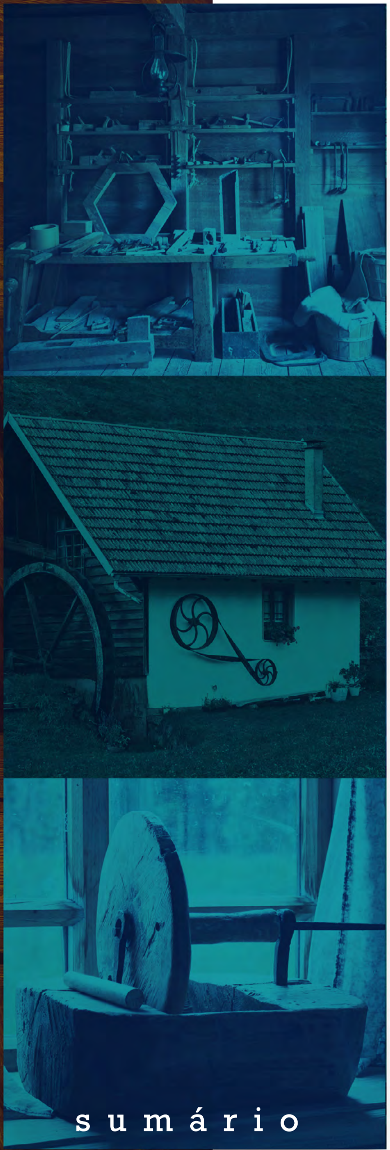
Secondly, the empirical evidence gathered in the case study suggests the need for a review or Brazilian economic history, particularly concerning the industrialization process.

Finally, and this is the thesis main finding, there is a strong indication, based on the analysis of the case study, that the development of a self-sustained process of industrialization presupposes the existence of an endogenous technical base, as it has been defined in the context of this thesis.

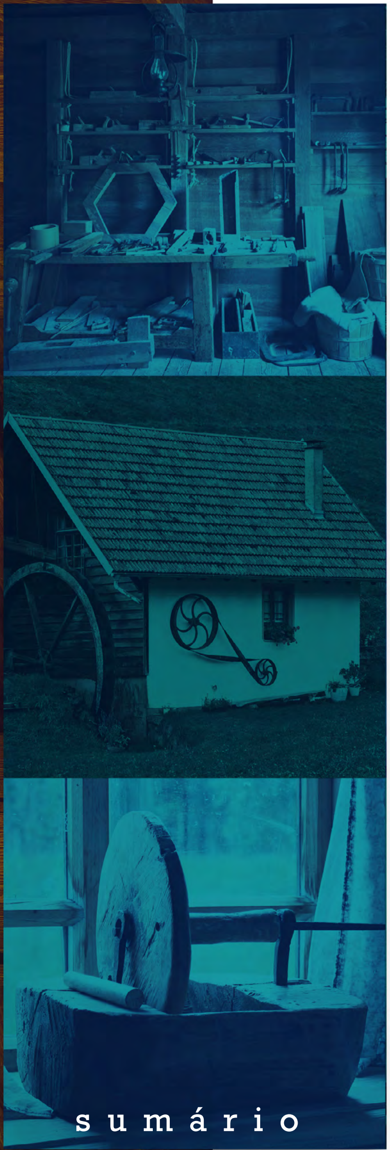
In this sense, to acquire a technological capability means, above all, to be socially capable of generating new scientific and technological knowledge and that firms' strategies for innovation can indeed foster such capability but cannot replace it.

As far as technological policy is concerned, most of the studies on technology and development in LDCs have mainly focused on issues related to the design of both the policies and their implementation mechanisms, Moreover, as mentioned in Chapter 1, such studies' approach to the problem of improving the endogenous technological capability in Less developed Countries - LDCs is generally based on case studies carried out at the level of the firm.

Undoubtedly, the implications of such policies, drawn from the analysis of those case studies, have thrown some light on important aspects concerning technological development in LDCs. However, from



the point of view of long-term perspective, the technological progress cannot be assessed by either the success or the failure of specific industrial experiences.



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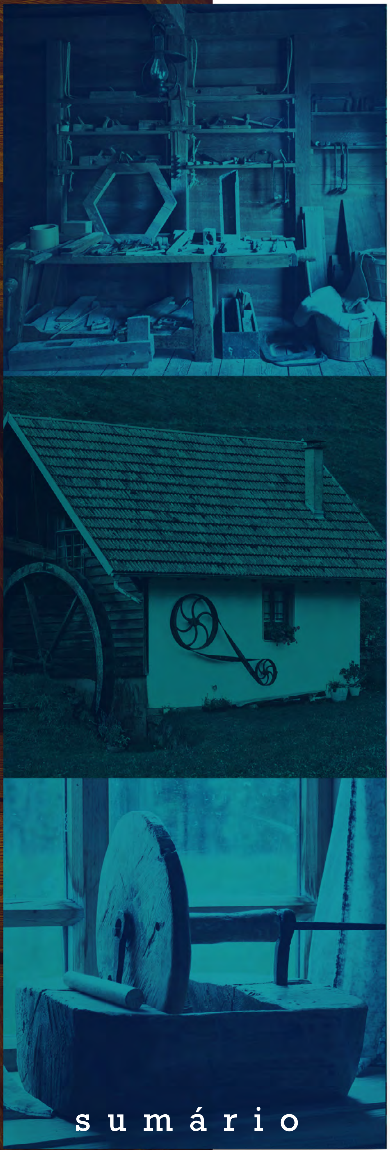

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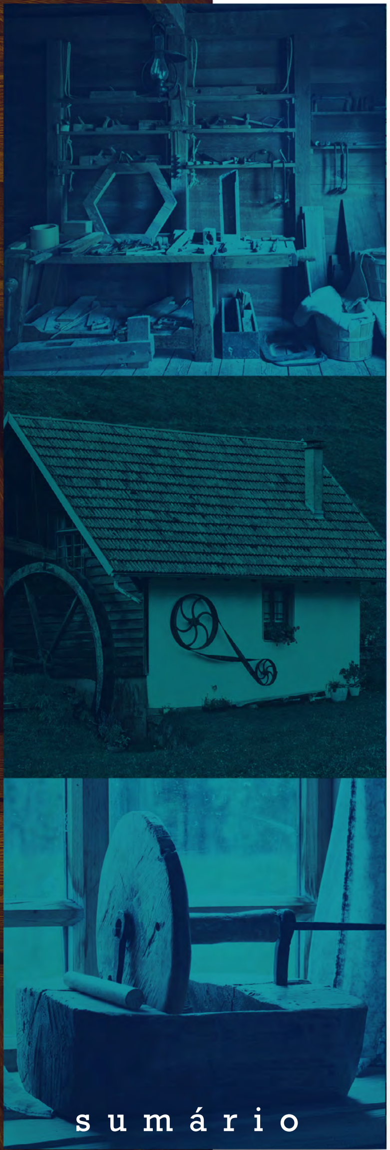

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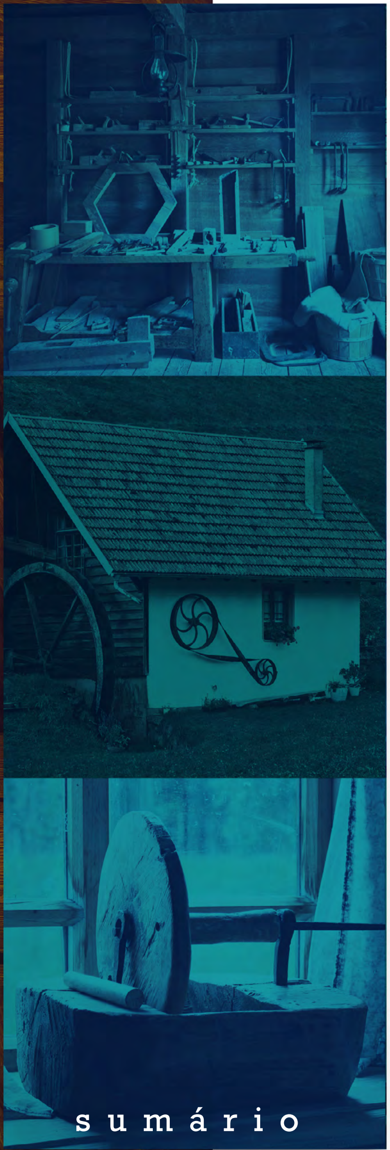

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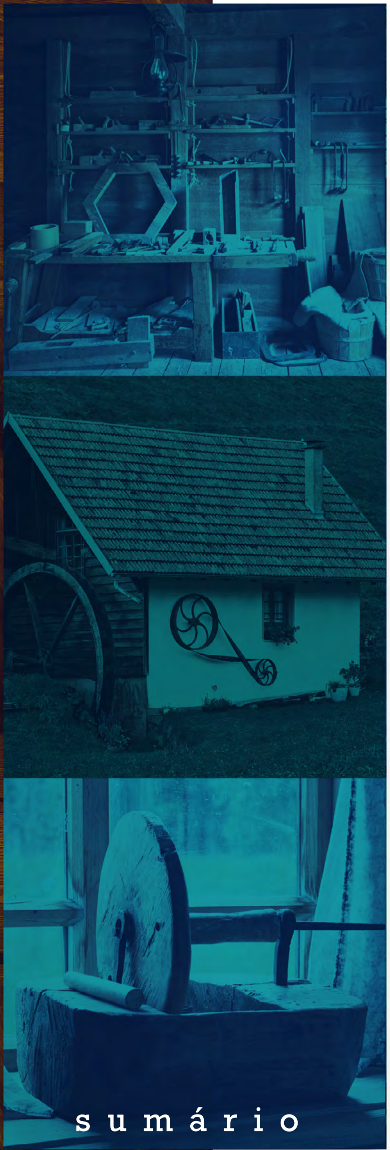

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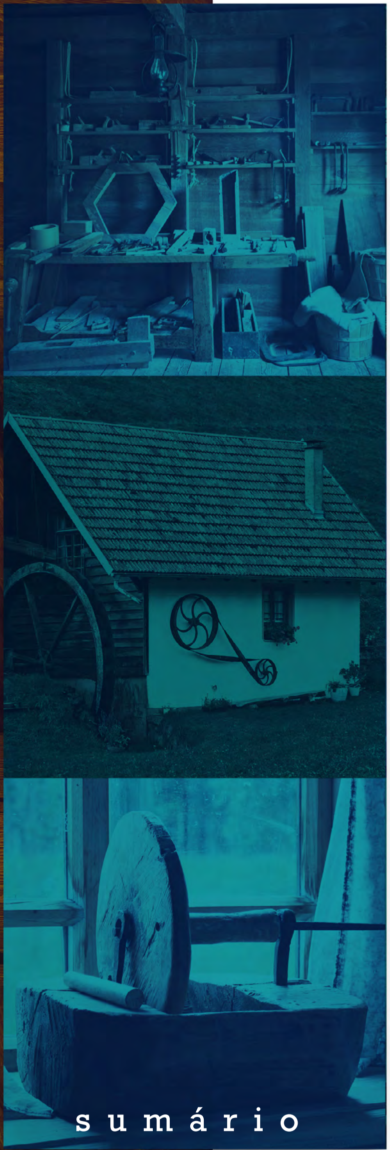

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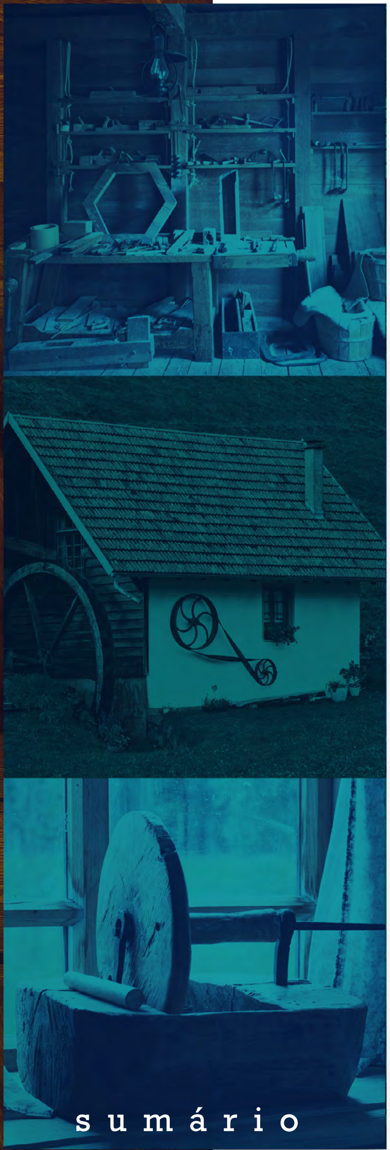

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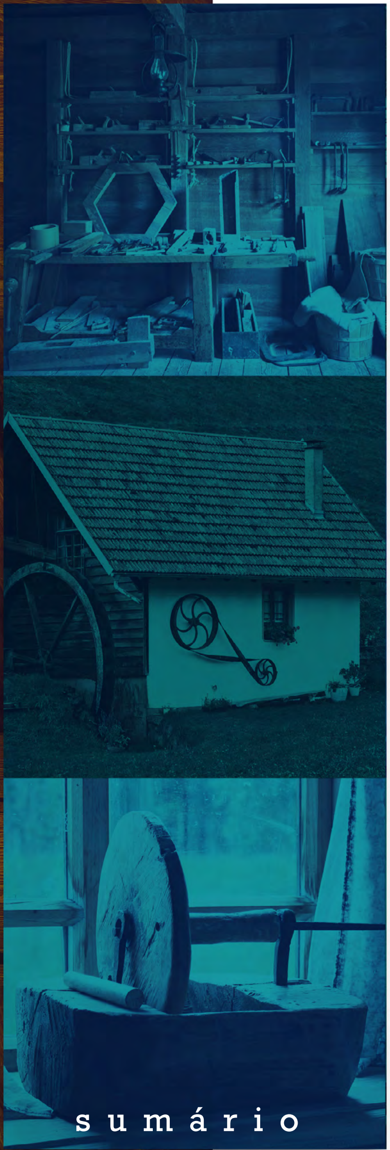

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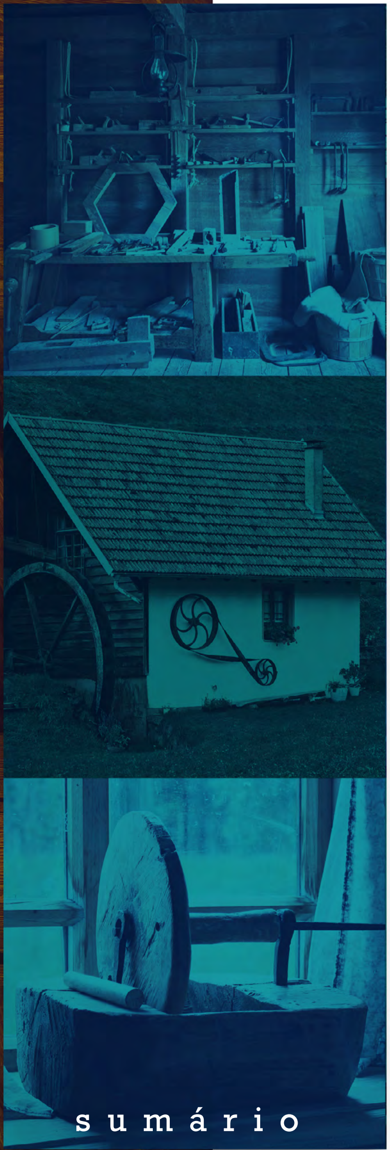

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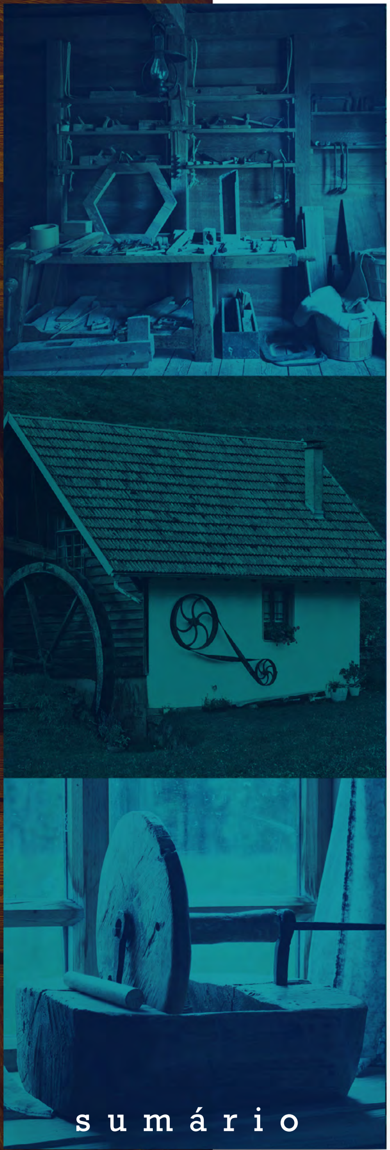

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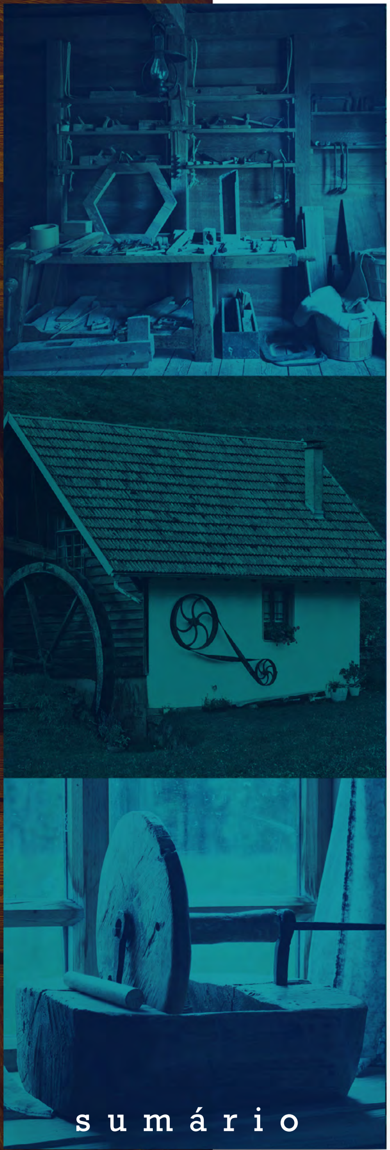

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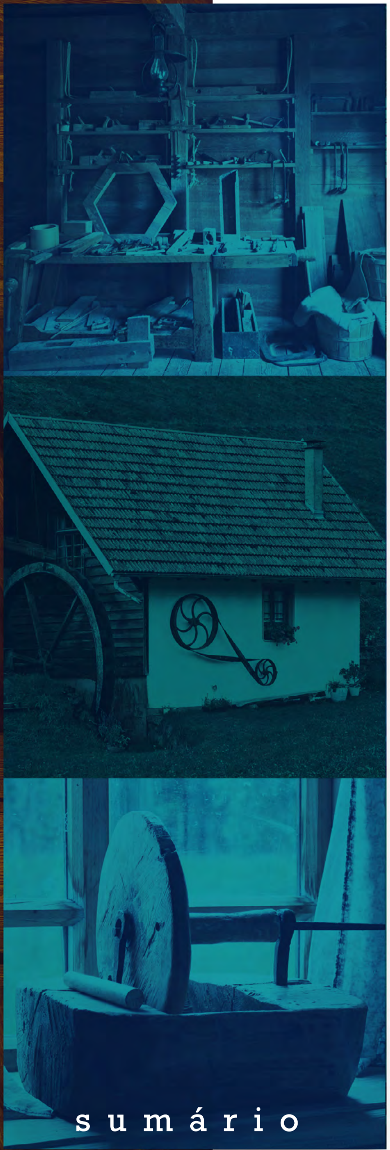

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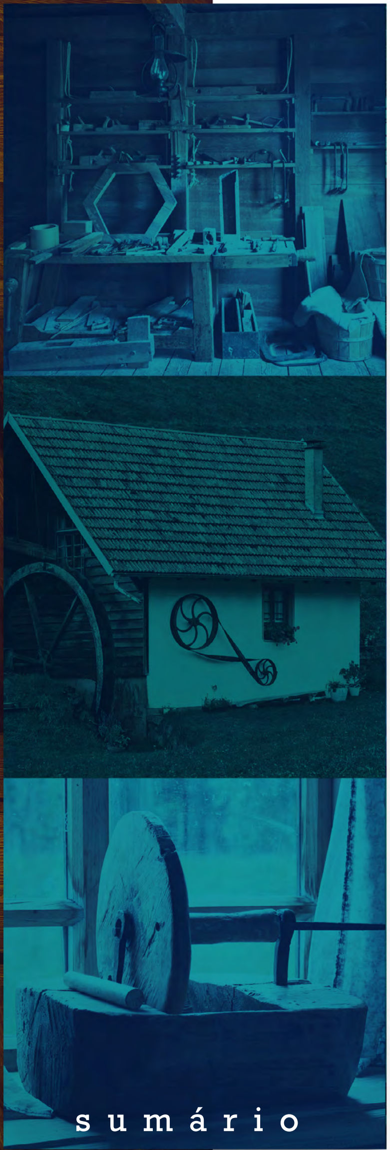

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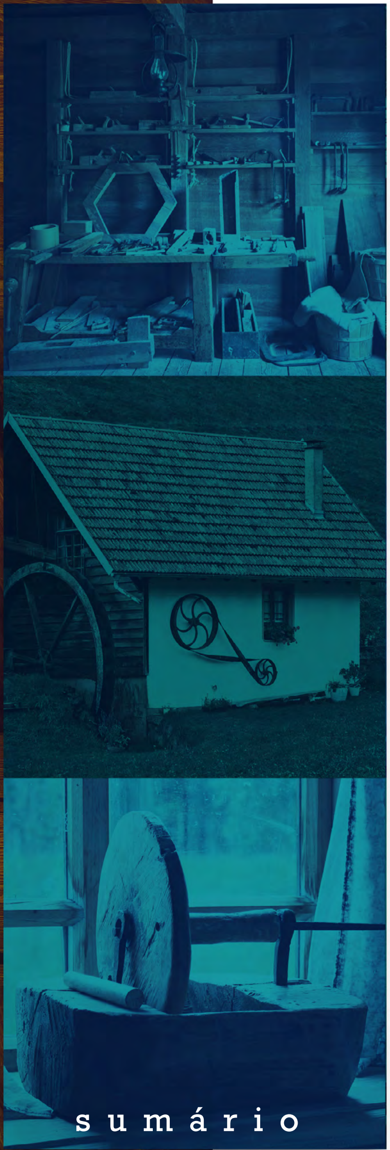

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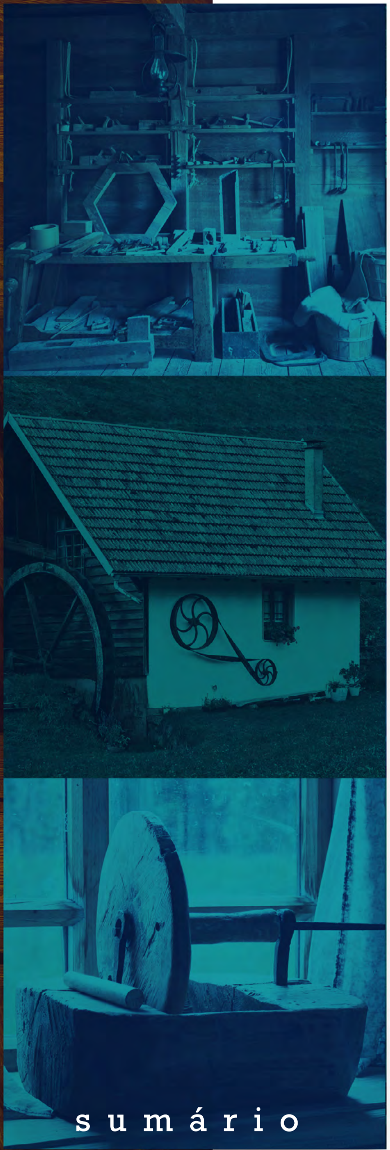
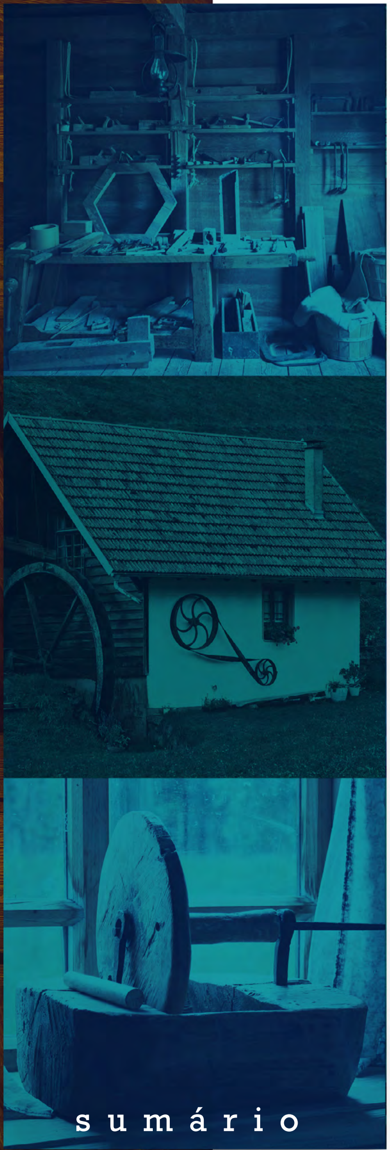


APPENDIX 1 - FIELD WORK METHODOLOGY - SUMMARY

The design of a research project is basically determined by the set of issues to be addressed and is limited by the amount and/or quality of the information available. In the case of research, which includes historical analysis or long time periods, a new difficulty is added to those already mentioned, namely the inconsistency of the available statistical data. This problem becomes more serious when the country in which the research is to be carried out does not have an established tradition of infrastructure in data collection and statistical data analysis. The methodology used was designed to overcome, as much as possible, the forementioned difficulties.

For the purpose of data gathering, two levels of information were considered in this research. The first level was macroeconomic information related to the analysis of two fundamental processes: industrialization and technological progress. At this level, consideration was given to historical, economic, and social information that permitted the identification of structures and mechanisms as well as the relationships among them - through which such processes occurred in the regions under study.

The sources used were essentially secondary in nature. The main historical sources are specified below. The records of the *Grão-Pará* colony (*Museu Conde D 'Eu, Orleans*, SC), especially the reports of the company which organized the migration. Part of these records were put on microfilm by the Department of History of the Federal University or Santa Catarina, with the support of the *Fundação Nacional Pró-Memória*. The analysis and the classification or the microfilms - approximately 50 spools with one thousand photograms each was carried out, during



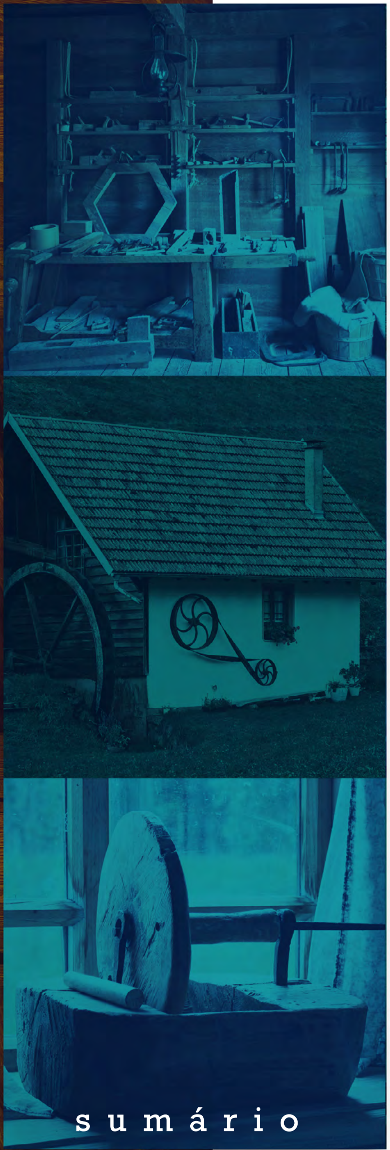
the field work, in cooperation with the Pró-Memória Foundation, which provided the necessary means.

The records at the *Museu da Família Colonial Arquivo Histórico* (Blumenau, SC), were extensively used, with particular emphasis on the reports on the early period of the colony (written by Dr. Blumenau), the reports on the Italian settlement in *Nova Trento*, and the most important newspapers from the colony: 'Blumenauer Zeitung', founded in 1881, and 'Der Urwaldsbote', founded in 1893. It is interesting to note that both newspapers were published in Gothic German from the year of their foundation until the period of the Second Great War, when the stopped publishing in 1938 and 1941, respectively (at the time or the first their publication were interrupted). Besides the records mentioned, there were also about ten papers on the history of the colonization of Santa Catarina, a few of which focus on the Itajaí Valley.

The main source of the data pertaining to the more recent history of the economy and the social conditions in the State of Santa Catarina was official publications, from both the federal and state governments. Mention must also be made to the academic work, notably in the area of economic history, that helped considerably in the analysis of the material cited above.

The second level of information, namely microeconomic information, has to do with the firms which operate in the specific field, the *feculárias* and the flourmills (the latter significantly inferior both in number and in economic importance).

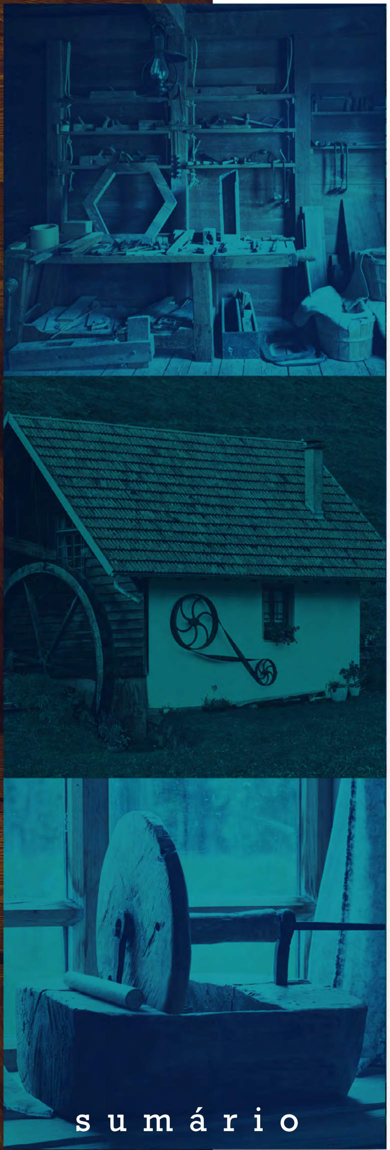
At this level, the data was mostly obtained from primary sources. For this purpose, a thorough survey was made of the firms which operate in this field. The survey used two methods of data collection. The first was interviews with the owner(s), using a previously established outline (see appendix 2). This interview went into more or less detail depending on the information potential of each interviewee



(some indicators were: time engaged in the activity and/or the skilled knowledge of the production process. In the more interesting cases, namely those interviewees who had a relatively significant information potential, the interview was recorded on tape and later transcribed. In all the other cases, the data was recorded in appropriated cards. Approximately twenty interviews were recorded on tape, with almost one-hour duration each. The interviews which were not recorded on tape were approximately fifteen. For these, notes were made of the more relevant data.

The second type of data collection was carried out using questionnaires (see appendix 3) which were applied to all the firms visited. These data were more quantitative in nature and permitted a more precise evaluation of the performance and technological evolution of the firms studied.

The data gathering and the various visits to the case study areas were carried out from January through November 1981.



APPENDIX 2 - INTERVIEW OUTLINE

0. Identification of the interview

Title:
Place:
Date:
Firm:
Interviewee:

1. Description of the plant of the factory

(To be drawn on a form annexed)

2. Origin of the firm

2.1 Brief historical outline

Year of foundation; founders; circumstance; main difficulties at the time; production: initial and present (products and scale - nominal capacity).

2.2 Businessmen and Capital

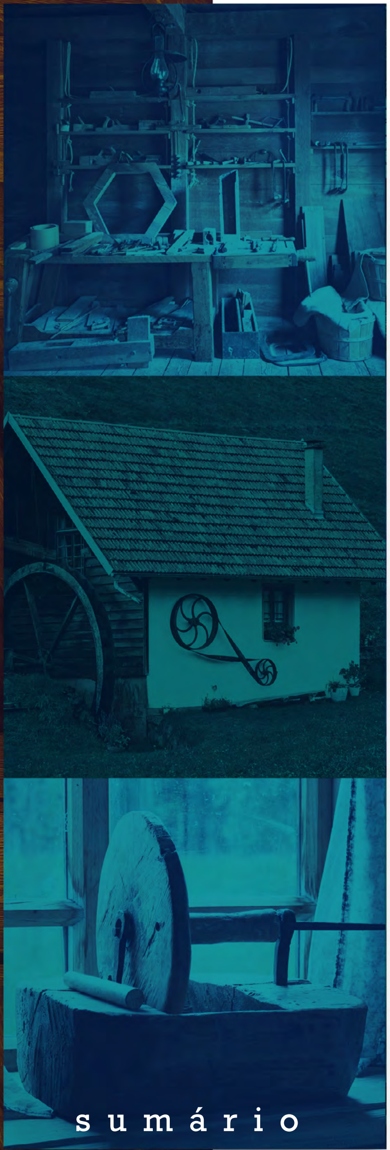
Origin (place, education, if immigrant - year of arrival, etc.) previous field of activity reason for investment; approximate value of fixed investment; origin of capital; other activities; time in management.

3. Production Process

3.1 Raw material

Main suppliers (places); relation with the suppliers: direct, through middlemen, mixed; family relationship with supplier (if any); kind of contract; regularity; quality variations in harvest price; forms of payment.

3.2 Manpower



a) With regard to the initial period of the firm: number of workers; family participation; length of the work day; relations of production; turnover; administrative personnel (%); main difficulties in hiring; categories which were difficult to recruit: unskilled, skilled (which), supervision and management, clerical and others.

b) The same questions applied to the present period.

3.3 Technical

a) description of past and present equipment; nominal capacity; processing time - from the time the roots enter the factors to the final product; origin; purchasing description of contract; technical maintenance; parts supplier(s).

b) process description (technical specifications).

c) technical change(s) and/or innovation in: process, equipment, production organization, management, and marketing. For each case, describe: when, why, information source, cost, funding, and results.

d) which was (is) the main source of technical information?

e) was (is) there a participation of the employees in the process of technical change?

f) was there any unsuccessful change? Describe.

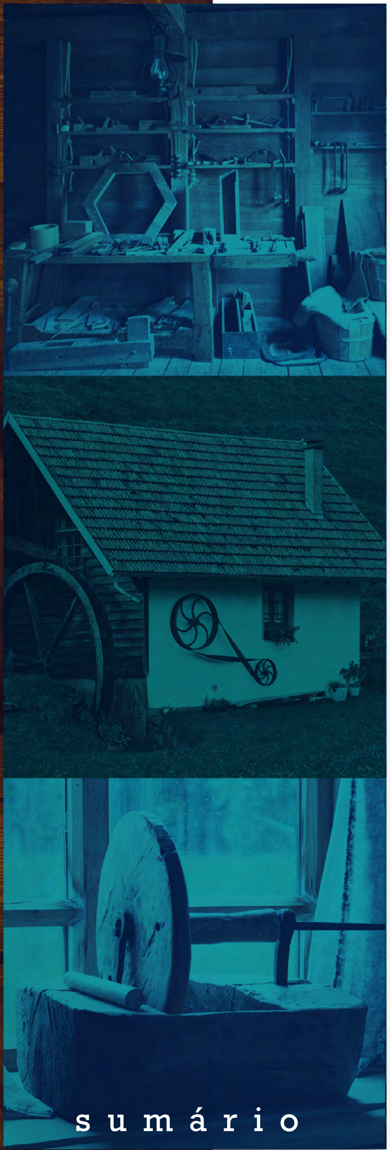
g) what were (are) the main motives for the change(s) or innovation(s)?

4. Commercialization/finances

Main consumer markets; commercialization forms - middlemen, representative, etc.; demand; forms of payment; main financial problems (interest rates, payment delays, working capital, others, no problems); where are the net profits applied? (reinvestment in the firm, reinvestment in other firms, real estate, others, no profit).

5. Competition

Level of competition; influences on the technical change process; dissemination; associations.



6. Government

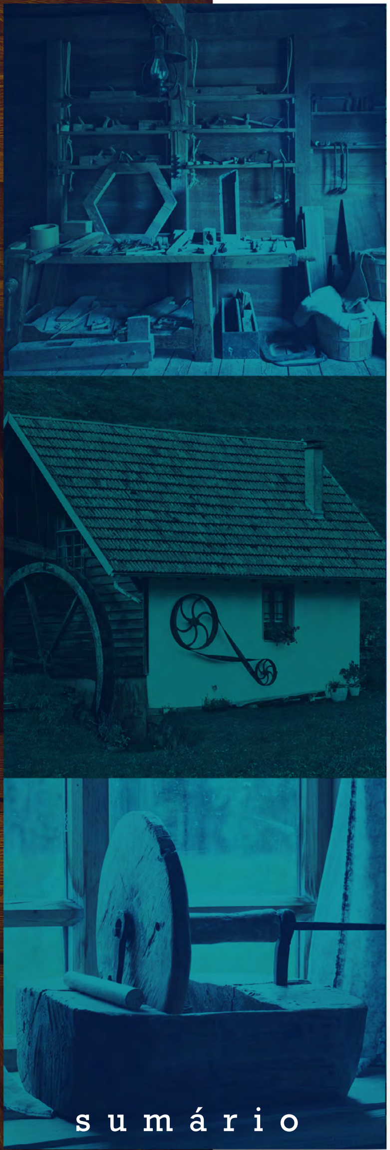
Production incentives; import policy (equipment); export policy (subsidies); use of official credit (type of difficulties - if any - in obtaining such credit).

7. Alcohol program

What is the firm's owner opinion of the program with regard to his industry; prospects - possibility of participation in a near future.

8. Balance

Comparison between the initial situation and the present one; what were the main difficulties of the past? Why? What are the main difficulties now? Which was the most successful technical change in the firm? to whom or what should it be credited? prospects.



APPENDIX 3 - QUESTIONNAIRE

Survey of data - Acquisition of machinery and/or equipment

0. Identification

Place:
Date:
Firm:

1. Year of purchase

2. Name of machine

3. Function

4. Does it substitute another piece of machinery?

5. Why did you decide to buy it?

6. Year it was manufactured

7 New or second-hand?

8. Maximum capacity?

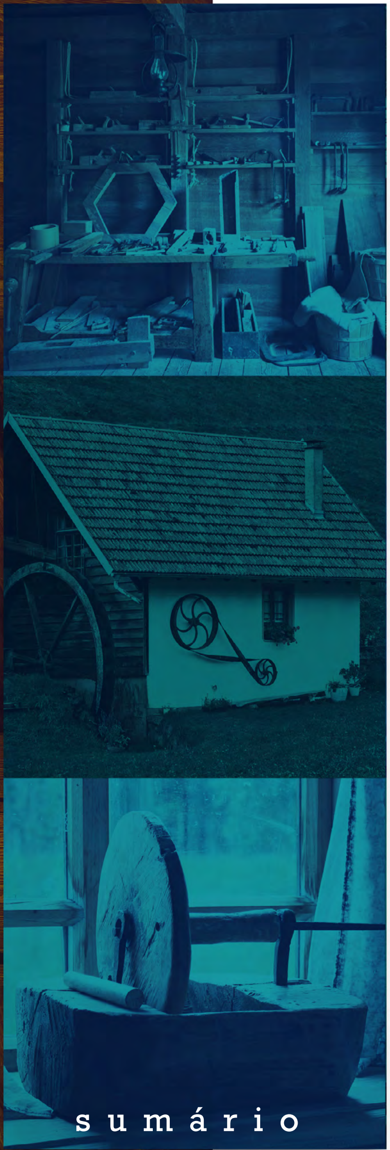
9, Previous capacity

10. Manufacturer - name and address

11. Salesman - if purchased second hand

12. How did you learn about the machine (catalogue, advertisement, salesman, heard about it, others - specify).

13. What was the source or funds for the investment? (self-financed, private bank, official bank, others - specify). What is the value of the investment?



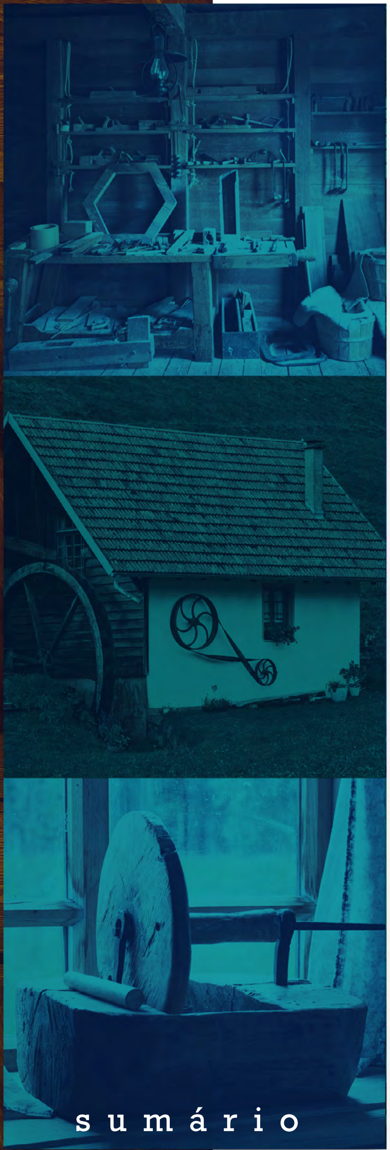
14. Results (excellent, good, satisfactory, not satisfactory, bad - explain).

15. Responsible for maintenance

16. Technical assistance

17. Was any modification made in the original specifications? if affirmative, why and who was responsible for the change?

18. Final comments



APPENDIX 3 - QUESTIONNAIRE (PART 2)

C.O.N.F.I.D.E.N.T.I.A.L

Research Project: A Survey of Data on the Development of the Manioc Products Industry in Santa Catarina

Identification

Place

Data

Firm

Survey of data - firm's performance Sheet 1

Base Year	Operation Period		Inputs						Manpower								
	From	to	Manioc roots		Energy				Period of operation				Outside the period				
				Electric		Charcoal (coal)		Production		Administration		Production		Administration			
			Tons	Cr$	kwh	Cr$	Tons	Cr$	emp.	Cr$	emp.	Cr$	emp.	Cr$	emp.	Cr$	

C.O.N.F.I.D.E.N.T.I.A.L

Research Project: A Survey of Data on the Development of the Manioc Products Industry in Santa Catarina

Identification

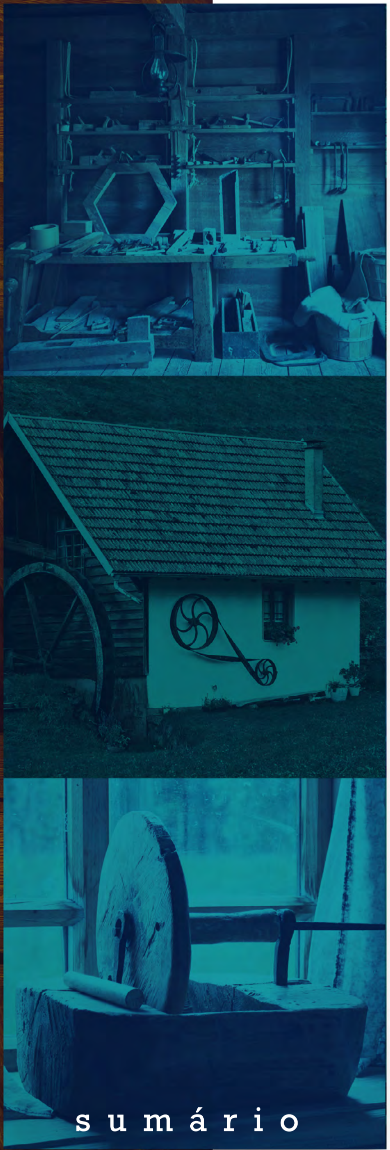
Place

Data

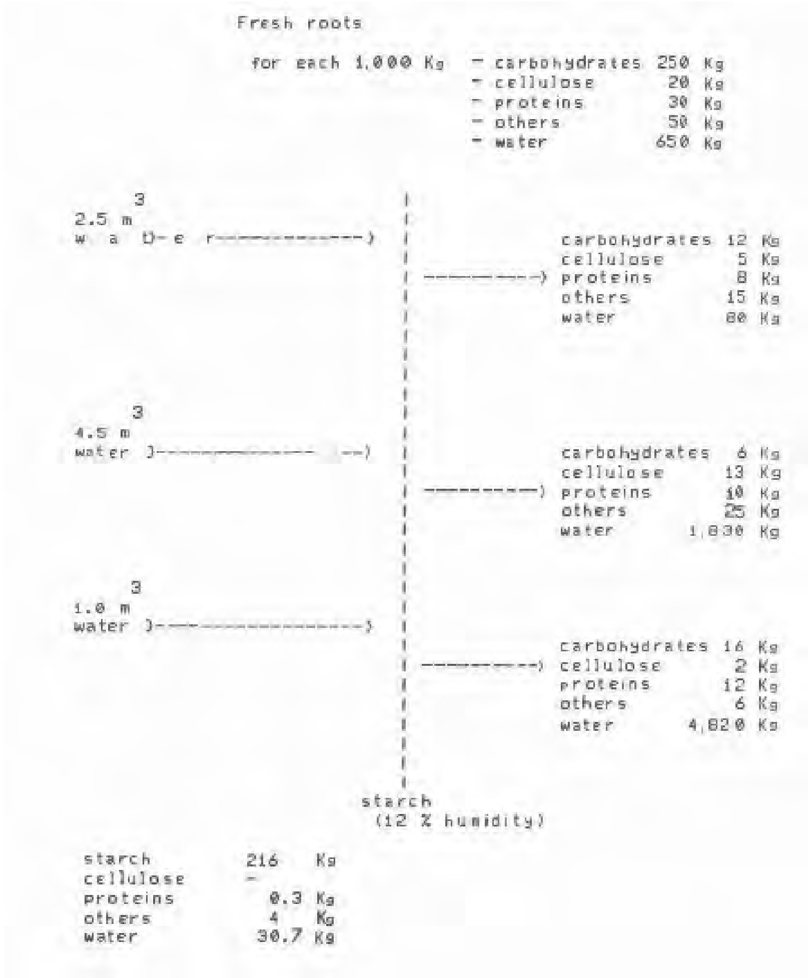
Firm

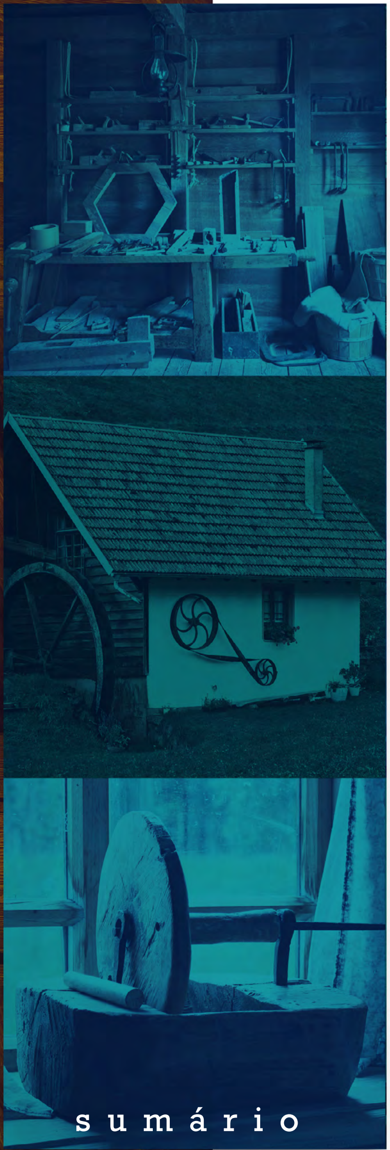
Survey of data - firm's performance Sheet 2

Base Year	Maintenance Expenditures	Technicals assistance expenditures	Misc. expenditures	Taxes & rates	Period Production	Revenue Cr$	Observations



APPENDIX 4 - TECHNICAL NOTE ON CASSAVA AND STARCH





APPENDIX 4 - TECHNICAL NOTE ON CASSAVA AND STARCH (PART 2)

1. Starch ($C_6 H_{10} O_{5n}$) where $n > 1{,}000$

2. Sources

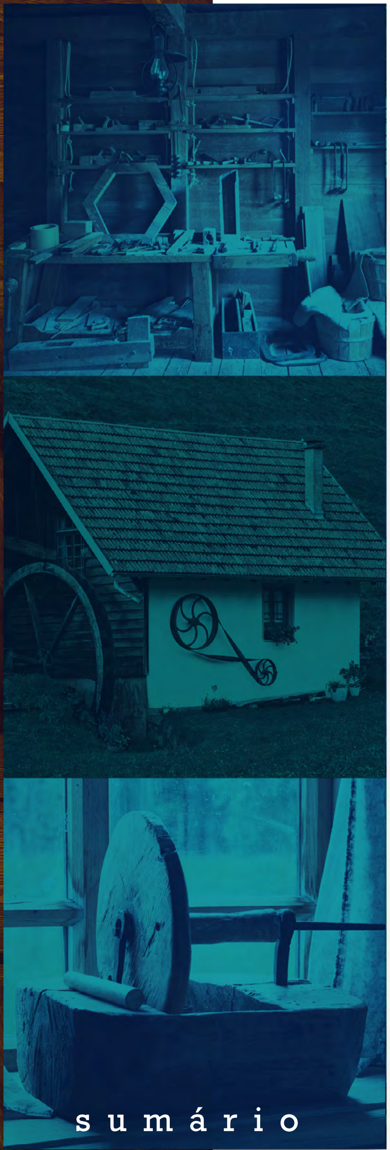
maize
cassava
potato
sagu
waxy-maize
wheat
rice
arrowroot

3. Main applications

foodstuff
adhesives
textiles paper
gelling
fillers
munitions

4. Main chemically modified starches

Starch dextrines
Tin-Boiling Starches
Oxidized Starches
Starch derivatives
Cross-Linked starches



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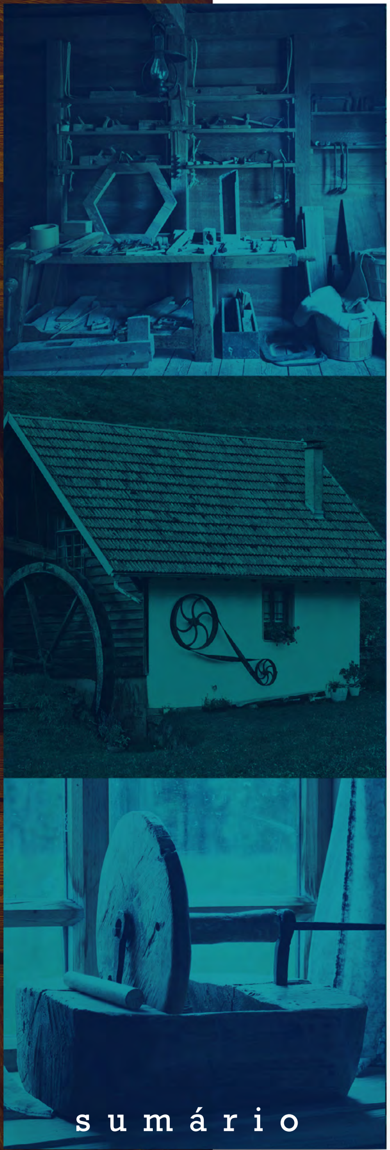

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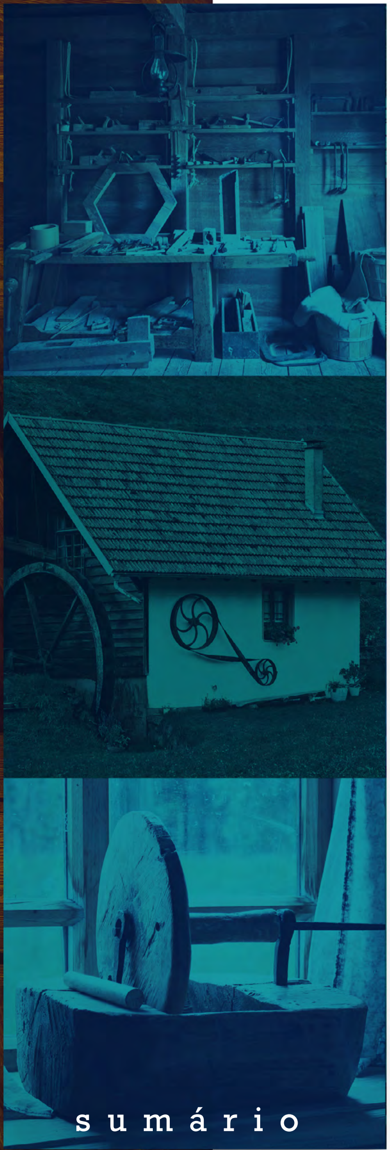
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