

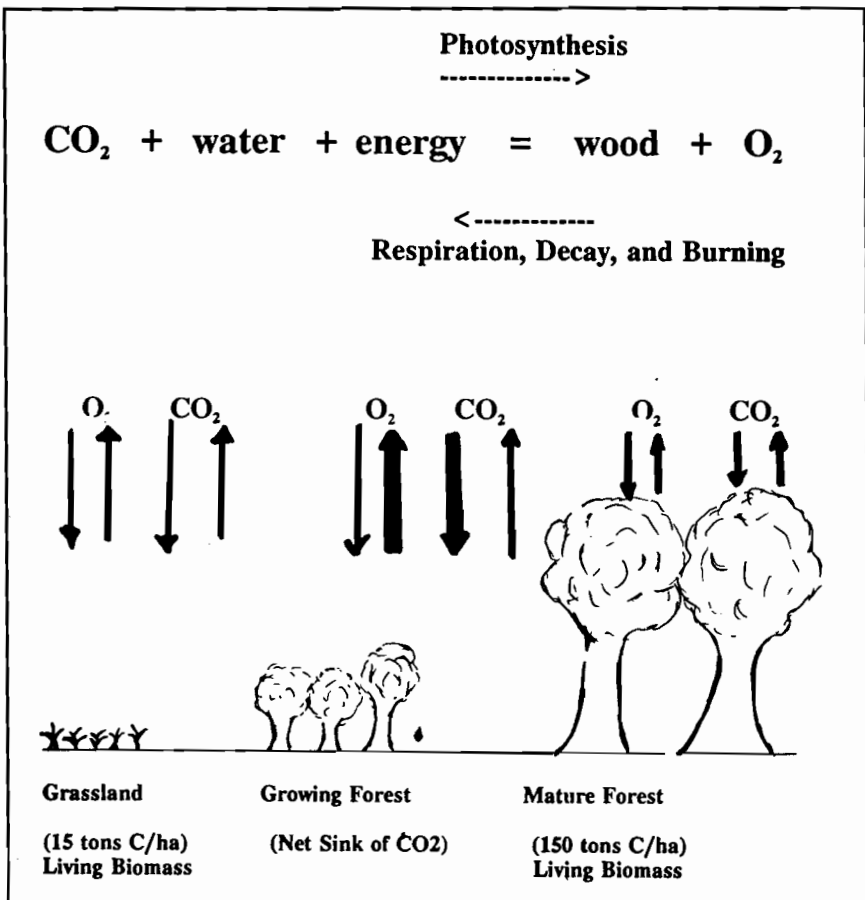
The Burning of Brazil: A Discussion with Foster Brown and Alberto Setzer

On Thursday, November 16, 1989, the Camões Center sponsored a symposium called "The Burning of Brazil: An Update," featuring Dr. Foster Brown of the Woods Hole Research Center and Dr. Alberto Setzer of the Brazilian Space Research Institute. Excerpts of their comments follow.

Foster Brown: Usually, when we talk about the Amazon and deforestation, people leave very depressed. I leave depressed. I'd rather start off with something a little bit more optimistic; something in Chinese that a colleague of mine, Dan Katz, who is president of the Rainforest Alliance here in New York, told me about. It's the Chinese symbol for crisis; and that is where I think we are right now. But there are two components to it. One is peril or danger and the other is opportunity. Most of what I will be talking about will be the danger and the peril, but we also have to realize that in this crisis we have an opportunity in terms of getting our act together globally as a human society.

I'd like to give a little background for those of you who are not familiar with what is probably the most important reaction in nature: when you take carbon dioxide, water, and sunlight, you make wood and release oxygen. If it goes in that direction, it is called photosynthesis. The return reaction, whereby you take wood and decompose it, or you respire organic matter or you burn it, this produces energy and carbon dioxide. Many of you may have heard that the Amazon is the green lung of the earth. That is not really accurate. The reason is as follows: Yes, trees produce oxygen. As they do so, they also produce wood. In the case of a mature forest, there needs to be a balance of carbon dioxide uptake and release and of oxygen uptake and release. Otherwise, there will be a change in the amount of biomass of the forest.

If the forest were producing oxy-



The Carbon Cycle

gen then it would be getting bigger. A mature forest does not do that. It maintains itself in a steady state. A grassland operates the same way, with a balance. During the day it can be photosynthesizing, producing oxygen. At night it can be consuming that same oxygen.

What is important is the change in carbon dioxide levels. Carbon dioxide is so important because it acts as a heat-trapping gas in the atmosphere that keeps the earth warmer than it would normally be.

This is the situation in Brazil now. Forests are being cut down and they are being burned. So you are changing from a situation in which you have a lot of carbon in the biomass, say 150 tons, and moving to a system that has a small amount of carbon, around fifteen. This process causes release of carbon. It is due to this process—going from forest to grassland or to pasture—that Brazil becomes important globally in terms of the release of carbon dioxide.

The other option for takeup can

occur if you plant trees in a pasture area. While the forest is growing, it will absorb carbon dioxide out of the atmosphere. There are cases of electric power companies that are planting trees, I believe in Guatemala, to compensate for the carbon that they are releasing by burning fossil fuels.

The amount of heat-trapping carbon dioxide dispersed in the atmosphere is equivalent to 750 billion tons of carbon. What we have in vegetation and soils is an amount about two to three times as much. This means that if you change land use, you can change fluxes. There is quite a bit of carbon that could be released and go to the atmosphere.

The annual flows are very large. Photosynthesis and respiration have fluxes on the order of one hundred billion tons of carbon a year. We think that they are rather balanced, although we do not have accurate data assessing those points. What is of concern, though, is that we do have a net pulse of carbon dioxide

going into the atmosphere from the burning of fossil fuels, and that is fairly well known, somewhere on the order of five to six billion metric tons a year. Another factor that is not well known is deforestation, primarily in the tropics, which releases between one and three billion metric tons.

If you sum the two of those together you get something on the order of six to nine billion tons a year that is being liberated. What we see accumulating is only on the order of three. Part of it is going into the ocean. But one of the great mysteries of the carbon cycle right now is that we have not been able to balance it. There is some amount that is going somewhere, and we do not know where.

The latest data indicate that there has been a surge in the release of carbon, going up to a rate of about five billion metric tons a year. It is still too soon to know whether it is just a temporary surge or whether we are actually seeing a major shift in carbon buildup in the atmosphere.

The known level of carbon dioxide concentration in the atmosphere is basically proportional to the billions of metric tons I was talking about earlier. The measurements are in parts per million by volume. Now, obviously people were not collecting gases in the 1700s to be analyzed for this study. These data come from ice cores where air has been trapped as bubbles and where dating has occurred. And at that time, in the early 1700s, the value of carbon dioxide in these bubbles is about 280 parts per million. That is accepted more or less as the preindustrial level of carbon dioxide. However, for studies that have gone back further in time to the last 160,000 years, the values vary greatly and go as low as 190 parts per million.

What is interesting is the curve. What we see between the earlier period and the value for the mid-1980s is an increase of about 25 percent, equivalent to more than 100 billion metric tons accumulating in the atmosphere. Half of that increase has occurred after 1950, which means the last forty years have seen

a tremendous input of carbon dioxide into the atmosphere, coming primarily from industrial activities in the developed world.

There is a past example of a minor surge that just sort of petered out. So we do not know with any certainty what will happen with the present surge, whether it will be temporary or persist.

Now let us turn to burning in Brazil and its contribution, because Brazil is the largest country in terms of the area of tropical forest. It has about 30 percent of the world's tropical forest, and it has the fastest rate of deforestation. So it is by itself the major contributor to the flux of carbon due to tropical deforestation.

The country of Brazil is larger than the continental U.S. Active deforestation is concentrated in an arc along the southern fringe of the Amazon. It extends from the states of Acre, Rondônia, Mato Grosso, and up into Pará. This is an area also of seasonal variations in rainfall. The drier period occurs in June, July, August, and September. This is a time of burning.

United States	
Industrial Emission:	1.3 x 10 ¹⁵ g C/yr
Population:	246 million
Per Capita Emission:	5 t C/yr
Japan	
Industrial Emission:	0.24 x 10 ¹⁵ g C/yr
Population:	123 million
Per Capita Emission:	2 t C/yr
Brazil	
Industrial Emission:	0.1 x 10 ¹⁵ g C/yr
Population:	147 million
Per Capita Industrial Emission:	0.7 t C/yr
Emission due to Deforestation:	0.2 to 1.6 x 10 ¹⁵ g C/yr
Per Capita Total Emission:	2 to 11 t C/yr

Carbon Emissions in the United States, Japan, and Brazil

This is also a critical area in terms of changes in climate, both regional and global. The Space Institute in Brazil has modelled what deforestation could do to rainfall distribution in this region. The tendency will be to prolong the dry season.

If that occurs on a regional basis we do not know what changes may occur on a global basis. What I have seen from models indicates that we will be going through periods of greater variability in rainfall. Last year, for instance, it rained tremendously during the dry season, so the burning was cut way down. The prior year, at least in Rondônia where we were doing the study, it did not rain for eighty days, and fires were entering the forest where they had never entered before. Increasing variability in this area where active deforestation and burning are occurring has the potential of resulting in major forest fires.

We are talking about disturbing an area that is larger than the country of France. It is also the area that is projected to be the energy center for Brazil in terms of hydroelectric dams. Here is one problem that Brazilians are faced with. How do you plan energy resources for a growing economy and a growing population, when you have greater uncertainty in terms of the water supply in those regions?

Now, to give this a comparative perspective, let us put it on a "per person" basis. That also personalizes what we all are doing in terms of the buildup of carbon dioxide. If you take the industrial emissions of the U.S., divided by the population, you come out with about five tons of carbon being released per year per person. We are just about the world champions in the release of carbon to the atmosphere. If we look at Japan we have a different situation. In their case they are releasing two tons of carbon per person per year. The West Germans are more or less the same as the Japanese.

Now there have been demands or suggestions that the U.S. should reduce its burning of fossil fuels by 50 percent. If that happened it would

Photo: Foster Brown

drop it down to two and one-half tons of carbon per person, which still does not achieve the level of the Japanese.

Until fairly recently there was an unquestioned dogma that increased energy use, and consequently carbon release, would result in a better standard of living. At least in terms of two indices—longevity and infant mortality—the U.S. comes out much worse than the Japanese. The Japanese are first in both of those—lowest infant mortality and longest life span. We are tenth and sixteenth in terms of countries of the world.

In Brazil we have a situation that is fairly common to newly industrializing countries, industrial emissions of about 0.7 tons of carbon per person per year. We have great uncertainties in terms of deforestation estimates. But using that value of 0.2 to 1.6 billion tons per year we get per capita total emissions of somewhere between two and eleven tons of carbon per Brazilian per year. So, Brazilians are somewhere between the release of the Japanese and two times that of the Americans. Brazil, according to José Goldemberg, is actually number four on the list in terms of carbon emissions.

Now I would like to move to a little different approach. This is the perspective of the developing countries. There are obviously a lot of uncertainties about the extrapolation of what will happen in terms of sea-level rise resulting from global warming, and so forth. But there is certainly enough evidence to cause concern. Imagine that you are from Bangladesh, a country of 100 million people, and 17 percent of your population is within one meter of sea level. There is a lot of concern in the developing world because they do not have the resources to compensate if the situation becomes as bad as some projections indicate. In effect, climate changes of geological proportions are occurring over time spans as short as a single human lifetime.

We Americans are leaders in the emission of carbon dioxide. Brazil is not the primary culprit, we are. What

happens tends to be newspaper cartoons stressing the hypocrisy of the Americans. But I'd like to end on a more optimistic note. That is that the Amazon will be developed. It is only a question of how. The current models are being questioned in Brazil and in other countries, but what can be done to substitute it? What other livelihood is possible?

Given the price structure that is typical for any group that is exporting raw materials, the price paid to a rubber tapper, for instance, or a collector of Brazil nuts is only a minute fraction of the price paid for these products in New York City. With that type of structure it is very difficult to develop sustainable economic activities in a country like Brazil. Cultural Survival, which is an organization based in Cambridge that works in the area of human rights with indigenous organizations around the world, is trying to help through the marketing process, particularly after it gets to New York City, and revert money to the rubber tappers and other primary producers, so they can begin to undertake various aspects of the refinement and the manufacturing of their products. That way there is a much greater chance that the Amazon forest will be both preserved and utilized to the benefit of the residents who live there.

Alberto Setzer: You have just seen the presentation made by Foster Brown about the carbon dioxide problem, and he mentioned many times the burning of forests in Brazil, which is contributing to some extent to this carbon dioxide problem. I will give some more details of this problem of biomass burning which is taking place in Brazil. It is taking place in many countries but I will talk about what we have done in Brazil so far.

Burning of vegetation is a very common practice in the tropics for many reasons. What we often see in the Amazon forest is the conversion of the forest into future pasture or agricultural land. Most people think of the fires in the Amazon forest as something raging uncontrolled, as occurred in Yellowstone in 1988. This

is not so. This is wet tropical forest. The only way you can have a fire in that forest is to chop down the trees and wait until they dry, then after two or three months you start the fire. Fire does not spread naturally in this region. It is very important to keep this in mind. That is why the boundaries are so clear in the satellite photographs, delineating where they cut the forest. The burning is usually done in an area of at least one kilometer in size.

This means, of course, that the fires in the Amazon forest are 100 percent man-made. There are some reports of fires spreading naturally in the Amazon forest at the beginning of this century. It was a very dry year, and we had some reports of this. Last year we also saw this, fire spreading inside the forest, but it always originated from a man-made fire. There are no natural fires in that area. Fires of this nature are not restricted to Brazil, by the way. They are also widely seen in Africa and Asia.

Another example of vegetation or biomass burning that is very common in Brazil takes place in the "Cerrado" which has a dryer, savannah-type vegetation. We estimate that the whole area covered by savannahs in Brazil is burned completely every two or three years.

We have many ways to monitor this burning. A few years ago we decided to evaluate how serious the problem was in Brazil. One of the ways is using aircraft photography with infrared film. The film is very good for this kind of work. But imagine mapping a country like Brazil with this kind of photography every year and every day. We would need thousands of airplanes and hundreds of thousands of persons working on this job, which is almost impossible to do.

Another possibility is using high resolution satellite imagery—a Landsat Automatic Mapper. This produces a very good image. It allows you to map the area that was burned. You can identify the roads, the lakes, the individual properties.

From this satellite imaging we can pinpoint individual properties from space. But once again it is impossible to map a country like Brazil with this kind of image. The cost is just prohibitive.

We also decided to monitor the fires using another kind of satellite, a meteorological satellite, which provides us with an image covering most of the South American continent. We have access to about four images of this nature every day. The resolution of the satellite is not very good. It is just one kilometer, very poor compared to the other images, but it has a very important advantage. We can have the images every day covering the whole country. We developed a technique based on this kind of image to monitor the fires in Brazil.

I will give you an example of what we do today. The state of Rondônia is very famous today because of the development taking place there. In the satellite photographs of the area we can identify linear features in a fishbone pattern; these are the new roads that were opened in the forest.

The same image processed in a little different way no longer shows the road pattern but shows the smoke produced by the fires that took place on that day in this area. If we use just the thermal channel of the satellite, we can identify heat sources on the surface of the planet. We can pinpoint the burnings that were occurring on that day.

So the work that we do now is the following: Every day we receive such images for South America and we find the geographical coordinates of each fire and send this information to different users, such as environmental institutions and forestry services in Brazil.

At the peak of the dry season, which is about the end of August, beginning of September, we may have up to eight thousand fires every day. They are very fast. They do not last more than a few hours because all the wood is dry. People wait two or three months before the wood is very dry and then light the fire. The flaming is over after, say, two or three hours. You have some smoldering

that will continue for the whole night, and you may have some hot trunks the next day, but the process is very fast in this area. So it is not a simple job. We have to find the coordinates for all this and coordinate the distribution of this data to different users.

Those of you who travel in this region during the dry season will know what massive smoke clouds are formed. This causes a lot of problems. Sometimes airports are closed for many days, in some cases even weeks, because of lack of visibility. The airplanes cannot takeoff or land; they just cannot see the airstrip. We have this problem every year when we go to check some of the fires with our airplanes.

The equipment we are using is very simple. We have a receiving antenna, and coupled to this antenna we have a microcomputer—a standard PC microcomputer—with a 206 microprocessor, just basic, regular, microcomputer equipment doing the processing. We have a telex interface, and we have the screen where we produce the pictures. Within two hours after the satellite has passed, the information with the location of the fires is available at the environmental offices or different users, so they can take some effective measures against the fires.

There are many reasons why we are doing this work. Let me just give you one of them. Article 27 from the Brazilian forestry code reads, "The use of fire in forests and other forms of vegetation is strictly forbidden." So, there is an interesting contradiction. I have just told you of thousands of fires every day, and on the other hand there is a clear law stating that fires are forbidden.

Article 31 tells us that it aggravates the burning if it takes place during the dry season and that is exactly what is happening. The law indicates that people will go to jail and will pay fines if they burn vegetation. So it is a very interesting situation. What to do with thousands of people who are going against the law of the land.

First, we are at least monitoring and providing the longitude and lati-

tude coordinates for the fires. We do this monitoring for small areas in the country, like the Federal District around the capital, Brasilia, and we do it for all the individual states of Brazil. This year we are also doing it for Uruguay, Argentina, Paraguay, and Bolivia, which also have intense burning activity.

We are also producing graphs—indicating the number of fires every day. For the Federal District of Brazil, an area of only about one hundred by one hundred kilometers, for example, we have 512 fires from June 20 to October 31, 1989. In contrast, when we look at a state like Mato Grosso, where a lot of deforestation is taking place, just for two months, June through August 1989, we had over twenty-six thousand fires.

Let me give you some more numbers to give you a better idea of how serious the problem is. This is our estimate for the year 1988. For the Amazon basin, we found 213,000 fires. And I have to stress again that most of them occur in Cerrado areas and not in forested areas. In terms of area we made an estimate that 120,000 square kilometers were burned just in the Amazon basin in 1988.

Foster Brown mentioned the problems of the emissions from the fires. Let me give you some of the numbers we obtained. Carbon dioxide is one of the most important gases in the greenhouse effect and is associated with the warming of our planet and the melting of icecaps. We think Brazil is emitting about one billion tons of carbon dioxide every year. This is about 5-10 percent of the world production of carbon dioxide. Of course, countries like the United States, Europe, or Japan are far ahead of us in terms of emissions. But if you consider that this is coming from one country, from one source, it is a lot. I think Brazil will have to play a role in the future control of carbon dioxide emissions.

A few words about some of the effects that we already see associated with the fires. Let me compare two pollutants, carbon monoxide and ozone, for different stations that Brazil

has, ranging from Brazil's Antarctic station to Cuiabá, to the Amazon forest, and also comparing São Bernardino dos Campos, a heavily industrialized town in the state of São Paulo. The concentrations we see in a place in the forest are already far superior to those found in other sites in Brazil and very close to the highest levels one can find anywhere in the country. Remember that carbon monoxide is produced by the fires and the ozone is a byproduct of the combustion elements produced by the fires.

Another thing I would mention about this study that we are doing is the effect we have had. If you pay attention to the news and TV, you know that, until a few years ago, nobody spoke of fires in the Amazon or deforestation. For some reason these satellite pictures have brought home to the public and the scientists the problem that existed in the Amazon region. All these pictures created tremendous pressure inside Brazil, from Brazilian environmental groups and also from other groups in different countries in the world.

The reaction was also strong. Let me translate a headline: "Amazon Divides Scientists in Brazil." That was the first reaction, an attempt to show that scientists who were working with deforestation studies did not know what they were doing—one was contradicting the other. It was very easy to show that this was not the case. Of course, there are always differences between numbers produced by different scientists. But this is part of the game we play. We had one thing in common. We all agreed that this was a serious problem. So, this did not go very far.

Then we had reactions from other groups like this from the largest entrepreneur of colonization in the Amazon basin. He went to the press and denounced a "movement" inside and outside Brazil to "internationalize" the Amazon. He claimed that the satellite pictures and other evidence were falsified. He accused the Space Research Institute of creating false information and gave his own figures for burning. Instead

of twenty million hectares, which was the number we produced, he said the real number was just two thousand hectares. And he mentioned something that I think is very interesting for those of you who are interested in international problems. He accused the industrialized countries of creating a movement to stop Brazil from producing grain. He thinks this is an organized effort to stop agriculture in Brazil on the part of those who fear the competition of Brazil.

Another interesting accusation, just to show you another point of view. This one was prepared by the president of one of the largest fertilizer companies in Brazil. He is denouncing a conspiracy that is afraid of competition from Brazil in the international market. The association is very clear. They say, "Well, we have to develop the Amazon area because that will produce enough food for the whole world. Brazil will then be a very rich country. Those who oppose this are against the development of Brazil." He also said that everybody has to be careful with those who choose the "green color" to disguise the "red color" and use the smoke of the biomass burnings to hide their real interests. In other words, he was implying in a very polite way that we were all agents of the KGB, receiving funds from the Communists and trying to destabilize the government of Brazil.

Some professors at the University of São Paulo, who had spent many years analyzing the Amazon project, wrote us an article saying that all of these stories were nonsense. In any event, that is just a sample of the reactions. I find this very interesting.

Still, the pressure was very strong from inside and from outside Brazil. We had thousands of articles and TV programs. Finally, the president of Brazil developed a program called "Our Nature." And he acknowledged that what triggered this program was the thousands of fires he saw in pictures provided by the Brazilian Space Institute.

What is the situation today? In my opinion, this is also very interesting.

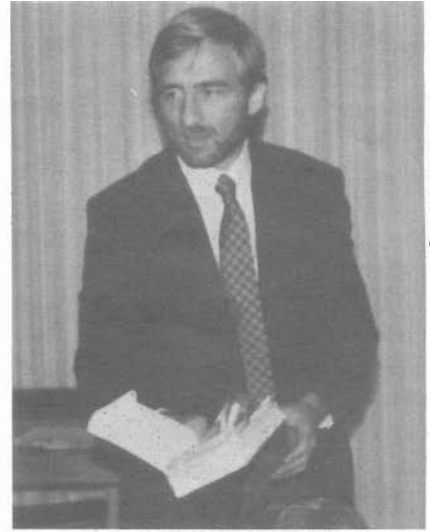


Photo: A. Young

Foster Brown Distributing Rainforest Crunch

In a little over a month the Brazilian Environmental Institute collected over 45 million cruzados in fines, which at the time corresponded to \$15 million. I think this is a very impressive number—\$15 million in fines for people who are burning illegally or deforesting without authorization. I do not know of any other country in the world that can match this record—\$15 million in fines for environmental matters in a single month. So this shows that something was effectively done in Brazil as a response to the problem.

What happens is that as soon as the environmental institutions received our telex, they send this in a closed envelope to a helicopter waiting with federal police agents, environmental agents. They only open the envelope when they are inside the helicopter, like in a military mission, and then they go to one of those coordinates, one of those locations. When they land they ask for the papers to see if everything was authorized or not.

The reason we have federal police agents in the helicopters is that in many cases the people are not so welcome. In one case a helicopter was shot twenty-five times. So, now the first to get out of the helicopters are two federal agents with machine guns in their hands just to be sure everything is calm. Then they start checking the papers. So some good results are coming of this work.

This year we had five helicopters working every day in different areas of Brazil. That is not very many. We do not have enough people or enough money for this program. The helicopters have their bases in different states in Brazil, and every two or three weeks they move from one place to another. We cannot catch everybody. But, as I said, \$15 million means that we did something.

The first part of our work was to show that a problem existed. People did not believe this at first. Now everybody accepts that much, but it is not easy when you are working against strong economic and cultural traditions.

It is part of the Brazilian culture and history to burn. In the southern states, which are very developed, we only have today about 2 percent of the original forest cover. Even in that 2 percent it is very hard to prevent people from destroying this little part that is left. If you see areas that were developed many years ago, I mean in the last century, the soil is completely unproductive now. The region where I live, between Rio and São Paulo, was the most productive coffee region in Brazil in the last century. There is nothing there today. It is just barren land because of the bad use of the soil. But it is not easy to change the cultural behavior. We know it can take many years to do it, if we ever succeed.

So we are working on two different fronts. First, we are trying to show people that it is not necessary to burn, that it is bad for the soil in the long run. Second, we are also catching those who are doing it illegally and giving people fines.

The burning is just one of the problems we face in the development of the Amazon. The goldmining is another problem. The pollution that results in the rivers of the region is something unbelievable. You must go there to see what is happening. And it is also something completely illegal. There are no official estimates, but we think that Brazil is now producing close to two hundred tons of gold in the Amazon basin. And 95 percent of that is smuggled out of the

country without any control, without any regulations.

There are two separate problems. First is the mercury, which they use to extract the gold. Second is the sand, because they start pumping water and washing all the hills around the rivers. A tremendous amount of silt flows to the river as a result, and that completely changes the aquatic environment.

Whither Goest? The Brazilian Literatura de Cordel in the 1990s

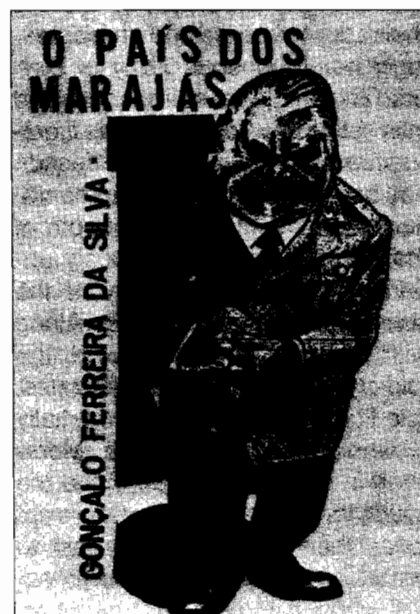
—Candace Slater

A great deal has happened, not just to the pamphlet stories in verse called *literatura de cordel* or *folhetos*, but also to Brazil in the last decade.¹ Back in the latter part of the 1970s, when I was doing research for my study of *cordel* poets and their "stories on a string," the gradual easing of censorship and relative liberalization of political activity, known as *abertura*, was just beginning, and the election of a civilian president was still only a glimmering hope. Although the boom years of the "Brazilian miracle" had passed and the nation's massive international debt was worrying economists, the sustained financial crisis of the 1980s was still largely just a threat. Likewise, while the impact of the mass media and of large-scale urbanization on previously isolated sectors of the country was obvious, it had not yet assumed the proportions of the 1980s. Ten years is not much time in the history of a nation, but the Brazilian present is strikingly different in many ways from the recent past.

Now, as in the past, the larger transformations in the nation's life find vivid, if necessarily indirect, reflections in the *literatura de cordel*. Although the beginnings of many changes were apparent in the late 1970s, they have greatly intensified. A decade ago, for instance, poets were involved in an increasingly bit-

ter struggle for survival in the *cordel's* traditional homeland, northeastern Brazil, while their counterparts in the urban south were discovering a new market in tourists, students, and reporters. Today, with the de facto demise of the last great *cordel* printing press (the Tipografia São Bernardo of Juazeiro do Norte) and the death or forced retirement of many older poets, the *cordel's* position has continued to erode in many parts of the northeast. To be sure, *folheto* classics are still sold in a good number of open-air fairs and public markets, and a small but significant number of poets persistently scrape together the money to publish a new "book." The only northeastern authors who manage to make a living from the *cordel*, however, are either the owners of tiny artisanal presses or else graphic artists who finance their writings through their illustrations. Indeed, not a few of the sons and grandsons of *cordel* authors have become printmakers and painters in São Paulo and Rio de Janeiro.

These young people have left home because of more favorable conditions for popular art forms in the south. Particularly in Rio, where the *cordel* is for some persons "the very essence of Brazil" and for others an appealing novelty, private and public foundations have continued to furnish poets at least a modicum



Courtesy of Candace Slater

The Land of the Maharajas