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Infection, nutrition, health. The Cauqué study
The difficulties of reality



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Access 1976 CIBA Foundation Leonardo Mata on the Santa María Cauqué study
Access 1978 Leonardo Mata The Children of Santa María Cauqué
Access January-February 2015 Geoffrey Cannon on Leonardo Mata here

Editor's note

The great work of Leonardo Mata (1,2) began over half a century ago. Himself Costa Rican, he was identified by Nevin Scrimshaw, founder-director of the Institute of Nutrition of Central America and Panama (INCAP), based in Guatemala, as a young investigator of exceptional promise. Already qualified in microbiology and clinical chemistry, he moved to Harvard University for his doctorate in tropical public health. Nevin Scrimshaw, by this time founder-director of the department of nutrition and food science at Massachusetts Institute of Technology, pressed him to apply for a US National Institutes of Health grant for research in Guatemala, formally based at INCAP, which he secured.

Between 1963 and 1972 he and his team worked with the people of the Mayan village of Santa María Cauqué, in the highlands of Guatemala. His study was not an intervention with predetermined assumptions designed to change any ways of life of the people, but an

observation designed to understand and learn from their realities, with primary health care support (3-5). His great idea came from a decade of working with the community, supporting its people as a microbiologist with good laboratory equipment and a team of co-workers.

What he observed contradicts orthodox nutrition policy and practice. Many children were malnourished. But there was always enough food. He realised that the driving force was not lack of food, but infection and infestation within insanitary environments. This led him to a radical view of peasant societies which also flies in the face of established attitudes. This is that except in emergencies, the people who usually best know how to feed their families and communities are the people themselves. Indeed, for endemic malnutrition, he believes that food aid programmes are typically a mistake. They are liable to confuse and demoralise the communities, who lose the skills and motivation to feed themselves. In sum, as a rule:

- Settled peasant communities, in normal circumstances around the world, even in marginal environments, usually have enough food farmed and stored for all seasons.
- When children recover from infections, they regain appetite. The problem is not lack of food and hunger. The main problem is infections that cause anorexia, weakness, loss of tissue, and death. Healed children rapidly regain appetite and tissue, and thrive.

He tells of the difficulties and realities he experienced, in his testimony following.

The meaning of Santa María Cauqué



This is dedicated to the women of Santa María Cauqué where I worked for a decade, nearly a half a century ago. Here children pose, a few years ago. They all look healthy, well nourished and clean

I will always be grateful to Nevin Scrimshaw, who found me in 1956 as a young man in the San Juan de Dios Hospital in Costa Rica and became my patron. He was already working on his thesis to show synergies between infection and nutrition (6,7). I visited him in Guatemala during his time as founding director of the Institute of Nutrition of Central America and Panama, and later associated with him when he was at MIT in Cambridge and I was studying in Boston at Harvard. I devised the

Santa María Cauqué study in 1962, while I was completing my doctoral thesis supervised by Nobel laureate Thomas H Weller. Nevin had asked me to write a proposal to obtain US National Institutes of Health funds for research in Guatemala. This had to be for a completely novel study, and Nevin wanted the protocol for the grant application completed in one week. He warned me that 'there is no money at INCAP, virology is expensive. Hope you get the grant' – which I did, $US 99,000 for three years.

When the money arrived I was already in Guatemala with a temporary job at INCAP, We had rented a house for the family (wife, one child born in Costa Rica, two born in Boston). Cauqué was chosen as typical of Mayan highland communities and for being just 30 kilometres away from INCAP, close enough for prompt transportation of specimens for virus isolation. A 'facility' already existed. We organised rooms for a nurse to live, for a laboratory, and for a clinic to receive mothers and children, plus a sanitary facility. We had water from a local pump. There was no electricity at first but later as a small miracle, a few bulbs for light at night. The microscope was used only during the day. The incubator to grow bacteria worked with kerosene.

We began collecting data immediately and by the end of 1962 we had a nurse, a physician, helpers from the village, and use of INCAP laboratories for enteric bacteria and viruses. We worked out how best to measure growth and development of infants and preschool children. We set up an office to process forms with computers to organise the data. I began as chief of microbiology under Carlos Tejada, a pathologist. Then the INCAP board created the division of environmental biology for the Cauqué study and the microbiological laboratories.

Moisés Béhar, Nevin's successor as director of INCAP, was a nutritionist and a pediatrician, who had also worked with microbes. He supported the Cauqué study from beginning to end. He protected our funds, and was always interested in the success of the study and always open to questions, ideas, doubts and needs. Moisés died as this commentary was being prepared. I remain grateful to him, too. The Pan American Health Organization was also supportive.

My first difficult reality was that like other Central American countries, Guatemala was unstable throughout the Cauqué study. Curiously though, violence never affected the village and there was no interference with the study. Both the military and the guerillas apparently respected INCAP and our work. High ranking officers helped me with import of supplies from the Canal Zone. The only weapons in the villages were machetes used for agriculture. The local 'police' carried wooden batons. We did not detect any domestic violence.

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Paradigms

My next difficult reality was that INCAP is an institute of nutrition. I was surrounded by colleagues of high calibre with many scientific publications. But they worked

within the conventional nutritional paradigm, thinking of health in terms of basic groups of nutrients. We all knew that the diet of the Maya was simple and relatively monotonous, being made up from *tortilla* and black beans, some vegetables, herbs and fruits, with virtually no meat, a few eggs and sometimes a little milk. The orthodox view of nutritionists then was that such a diet was deficient, and in particular of protein.

I was tolerated at INCAP when I started proposing that infection was more important than nutrition. I questioned orthodox nutrition science. We were interested in parasitic bacteria and viruses in the children's intestines. Indians and other impoverished populations live with parasites, which have been thought of as a natural part of them, always there, and not a cause of malnutrition. But we wanted to eliminate these parasites. Better, we wanted to prevent the state of parasitism, with clean water, proper sanitation, and hygienic habits.

Another view of orthodox nutrition is that children who are often short of food grow up less intelligent. I questioned this too, and from some direct experience of people from nations devastated by war and famine. I was born in 1933, and as a boy got to know some survivors of Nazi prisoner of war camps who had often been starved, who had then emigrated to Costa Rica, even to my own village of Santa María de Dota. I remember how much they ate, while our main food was *tortilla* or bread with beans. Survivors of the Nazi camps remained lucid, intelligent and enterprising, and often became well-to-do. So I have always questioned the proposed connection of hunger with loss of intelligence. Cauqué people today, who still subsist on their traditional fairly frugal diet, are intelligent, and children and young people speak fluently in their own language and also in Spanish, I think better than I do, without evidence of physical or mental inadequacy. They remain short.

Revelations

Our study was on infectious diseases of children. It also involved nutrition, growth and development, pediatrics, public health and public policy. It made us think hard all the time. Most people knew even then that infection in young children affects nutritional status. Nevin's own classic book *Interactions of Nutrition and Infection*, co-written with Carl Taylor and John Gordon and published by WHO in 1968 during the Cauque study, proved this. Studies of infectious and tropical diseases show loss of weight, stunting and severe malnutrition. But nutritionists do not often think of infection as an actual cause of malnutrition. The question we wanted to answer was: which comes first, lack of food, or microbes?

I spent most of my time in Guatemala at INCAP. The hard work in Cauqué was done by the physicians, nurses, dietitian, field workers and the people itself. The study was meticulous. Our laboratory in the village was as good as any in Guatemala City We examined children from birth, and frequently thereafter, first daily for one or two weeks, then once every two weeks until age three months, then every three

months until age 3 years. Thus the study records were at fixed intervals set by the protocol, every 3 months until age 3. We watched the health of children and mothers, and cared and supported them. We measured, weighed and spent a lot of time with the children and their mothers, under a planned programme of visits to their homes, and often visits of mothers and children to our clinic. We treated infections with antimicrobials. But mostly we observed and supported, in effect as ethnologists. Mothers felt we were with them. Villagers were fond of the physicians, Carlos Beteta (1963- 1965) and Juan Urrutia (1965-1974).

Conclusions

Our results proved the impact of infection and infestation as a primary factor. I wrote the Cauque book in nine months in 1974 during a sabbatical in Seattle, with support from Richard Kronmal of the department of biostatistics, University of Washington, who is still there. Nevin arranged publication by the MIT Press in 1978. He suggested that I take no royalties, so as to lower the price to $US 25. For a full account of the Cauqué Study, the reader is referred to the book and other documents available here (3-5). *The whole book can be downloaded here.* It now sells on the internet for upwards of $US 2,000. After publication we found (5)

> Many of the findings of the Cauqué study were either new, poorly understood, controversial, or unbelievable when first communicated to the scientific community… The most difficult postulate to understand was that the force of infection and infectious disease was the main determinant of poor health, growth retardation, malnutrition and death of infants and young children. Such ideas conflicted with prevailing dogma.

Our general conclusions included (5)

> Frequent symptoms and signs in children were despondency, prostration, fever, anxiety, and anorexia. These are common manifestations of stress triggered by interleukins and tumor necrosis factor released by microphages in response to infection. The main nutritional consequences of infection are reduced consumption of calories; loss of ingested foods; increased transit of food through the alimentary canal; altered digestion and absorption; protein-losing enteropathy; loss of electrolytes, vitamins and other nutrients; sequestration of trace elements; and nutrient diversion.

Specifically (5)

> Cauqué children consumed less food during periods of infectious diseases, regardless of etiology, severity, or target organ. The effect was more pronounced with fever, sepsis, diarrhea, and lower respiratory infection. One-third of children with whooping cough consumed only one-half of the customary amounts of tortilla in the first month of illness; maize intake was also significantly depressed in the second and third month. Food restriction is worsened by the traditional custom of withholding food during illness.

It became clear to us that anorexia and fever unleashed by infection in infants and young children were the overwhelming reason for their undernutrition, with all its consequences. Food was not the main problem. The issue was health. Infection was the dominant factor. This is what we learned.

We observed the following sequence of facts. Infants and preschool children, who were intensively breastfed, remained mostly healthy for 5 to 7 months at the breast. Foods were then introduced slowly in forms as traditionally consumed – *tortilla,* beans, vegetables, fruits, herbs, and so on. As mentioned there was very little meat or none. A few people drank some cow's milk. There was no electricity and no refrigeration. Average income was the equivalent of around $US 100 per year.

The water was unsafe. Foods were often contaminated by dirty hands, poor storage, and the like. Women brought soiled clothes for laundry to the main reservoir in the centre of town. This water was contaminated, but to treat or destroy the reservoir was impossible. Water was sacred and the people had lived like that for time immemorial. Water was carried home in jugs carried over the head. Most houses were dirty inside. Rates of infection and infestation were always very high.

Infection was beyond doubt, the driving force of malnutrition. This we established throughout the Cauqué Study. We were sure it remained true in Cauqué, in most of Guatemala, and no doubt elsewhere. Everywhere children are vulnerable to infection and infestation. Nor should it be supposed that this public health issue, of immense importance and significance, is confined to impoverished communities living in tropical countries in the global tropics and subtropics. Infection and infestation is a neglected issue in infant and young child nutrition all over the world.

Box 1

Incaparina and fortified maize

My next difficulty related to Incaparina. Good scientists at INCAP were devoted to this nutritional supplement, formulated at INCAP by local and US scientists. It is a mixture of vegetable protein with a value similar to cow's milk, used to feed children, the theory being that the diets of children are short of protein. The other supplement, maize flour 'fortified' with soy flour, amino acids, vitamins and minerals, was used to make *tortilla.*

We were invited to use these supplements in Cauqué. This was a challenge, to prove or to disprove the then prevailing hypothesis that the main deficiency in impoverished children was of protein, that the effect of 'maize 'fortification' would be positive because of feeding a 'better' food, and that we were wrong to propose that infection drives malnutrition. If 'maize fortification' resulted in better health, then the nutrition paradigm was the correct one. However, after four years of intervention the maize fortification experiment was agreed to have failed. It made no difference. This strengthened the evidence that the main causal factors were poor sanitation, inadequate personal and domestic hygiene, and frequent infections, and not the supposedly poor diet of *tortilla* and beans with some vegetables and fruits. The solution was not more or 'better' food. It was to improve hygiene and sanitation.

The Mayans were right to stay with their traditional diet. The Guatemalan authorities have in more recent years been right to improve housing, water supplies, education and sanitation. When people are healthy and educated, there is an increase in jobs, better housing, more women´s education, improved hygiene and sanitation. The 'nutrition problem' disappears. Guatemala now has excellent personal hygiene, decent housing, electricity, more industries and roads. Infant mortality, infectious diseases, and malnutrition in children have decreased. The stature of young people has increased.

Catastrophe

I left Guatemala and Cauqué in December 1974, and moved back to Costa Rica. I had to return to my family and our original home, after over 15 years at Harvard and in Guatemala. I had my mother and we have large families. I founded the Institute of Investigations in Health (INISA) in San José, of which I was director from 1975 to 1987, and am now emeritus professor there.

Now for the next difficult reality. In science it is conventional that the findings of studies, especially when these are striking and even controversial, need to be replicated, with relevant parameters held steady. Such precision, easy with rats, is less easy with humans. The Cauqué study can never be replicated in the circumstances in which it was carried out. In February 1976, at 3 one morning, a force 7.5 earthquake harassed Guatemala. About one million homes were destroyed throughout the country, with 23,000 people killed, mainly outside cities.

In Cauqué, all the houses were levelled off, except the house of our main nurse, built with better design and materials. The church and the municipal building were damaged. A total of 78 people were killed, 8 per cent of the Mayan population known to us, mainly women and young children who were sleeping separated from their mothers. Also 357 people were injured. As soon as I could get into Guatemala, about nine days after the quake, I visited the desolated village, and met and talked with the people. It was very sad to see the widespread destruction, interruption of roads, failing of all services. I took all the pictures I could afford, and then returned to Costa Rica. I could not stay.

Don Celedonio Chiroy Sebaquijay was the mayor at the time of the earthquake. He is one year younger than me. He ordered the burial of all corpses the same day, and set up places to sleep covered by plastic sheets. There was no water, and no food, until he sacrificed a cow without permission, in a plot within walking distance from Cauqué. Ever since then I visit Guatemala and Cauqué as often as I can, and see Don Celedonio and drink some *guaro* (sugar cane liquor) with him and his family.

Frustration

It is nice to believe in progress, but when I left Cauqué and Guatemala to come back to my country of Costa Rica, I ran up against the next difficult reality. 'Modern pediatric medicine' ruled, and 'American-INCAP orthodox nutrition' was a religion.

Severe malnutrition was everywhere accepted as just a problem of not enough food or the wrong kind of food, and the solution was accepted to be more food, or supplemented and fortified food, or different types of food. INCAP had been pushing the nutrition paradigm for more than 20 years and had succeeded, unfortunately. Their approach was good for the employment of physicians, nutritionists and supporting workers who were dedicated to interventions, and still are. I must have been seen as a renegade.

In Costa Rica I confronted the tragedy that official health policies commanded all pregnant women to deliver in hospitals. Eventually I got involved, as founding director of INISA, positioned within the University of Costa Rica. It was a fight, but I convinced friends and colleagues to initiate 'rooming in' at the largest *Hospital San Juan de Dios* where I had trained for eight years, so that newborns stayed with their mothers. In Costa Rica I talked to physicians, nurses and managers, and we began the rooming-in and other interventions. This was difficult at first, but as from 1976 we did it with success. We shifted from all infants at the bottle to all infants at the breast, except for 5 per cent with difficulties.

Changes

The notion that human circumstances can be held constant I know to be a myth, from my regular visits both to INCAP and to Santa María Cauqué, usually once a year. Olga and Palmira, formerly nurses in the village, are well. I was with them last November. The population of the village has continued to grow, with remarkable improvements. These are indicated by the obvious health of the children shown in the picture that introduces this testimony. Changes have been independent of nutritional efforts from INCAP because there were none. There were no more INCAP studies in Cauqué. A small clinic was supported by the government but without research. The violence in Guatemala continued but still stayed out of Cauqué. In 1996, 21 years later, a peace treaty was signed between the Guatemalan government and the insurgent forces. Violence and killings continued, but diminished, and were not necessarily part of the civil war.

The Mayans now have much better housing since the 1976 earthquake destroyed all their homes. An earthquake of much the same intensity as that of 1976 occurred in November 2012, without one single death in Cauqué, and without a single home being destroyed. The Mayans in Cauqué are healthier, better dressed, and there is universal wearing of shoes. We recently found the first 100 year-old lady! The village now has good safe piped water supply, electricity is universal, most have television, and cell phones are carried by most people. Refrigerators and stoves are prevalent, as well as flush toilets. It is these basic public health provisions that have improved the health and well-being of the people.

In 1998 I proposed to INCAP a survey of Cauqué, using similar variables and techniques we originally applied. The survey was approved but was inadequately funded. In 2000, for the new millennium, we conducted a whole-village survey. All homes were strong, with good and good roofs, strong and meshed walls, inside water supply, adequate waste and fecal disposal, no street garbage, people dressed with clean garments, illiteracy way down – and much better nutritional status.

We have vital statistics of Cauqué for almost 50 years. There is no endemic malnutrition now. The height of women has increased. Infant mortality and malnutrition have decreased. Some ladies are overweight but this remains unusual.

The tallest and strongest Cauqué Mayan males I met during this more recent study, now maybe around my age of 81, are as tall as me, but certainly much stronger than I am, and still visiting the plantations – they do not have a pension fund. They continue to eat the traditional diet of maize (as *tortilla*), beans, vegetables and fruits, with some herbs, and are still working and praying.

People are no longer barefoot, but they are still are exposed to enteroviruses and respiratory viruses. Polio and some other types of virus are under control. The Guatemalan government has done a good job in that regard. The municipal government in nearby Santiago Sacatepéquez is doing marvels. All streets are covered with stone *adoquines*; there are closed sewers, no garbage, and very little traffic in the streets. Many people have internet. Education of children continues. Many adults are engaged in small businesses. They do not seek out vaccines. We do not hear of epidemics.

We have done other short term studies up to 2012, and have documented all these advances. But we have difficulties to publish in Guatemala or Costa Rica. Funders want papers on molecular biology. I am now finishing translating the Cauqué book in Spanish. It will have six additional chapters. Added material to the Spanish version includes cytomegalovirus from birth to 1 year, rotavirus (retrospective), and the fortification of maize project, confirming that it had no effect on nutrition. I also will include the Cauqué study volume 2, starting with the year 1976 and the great earthquake, to date. The new book will include voluminous data, graphs and figures, and photographic documentation. I feel the need for another long term field study.

The book in Spanish will honour and respect the Mayan Indians, for their collaboration, friendship and patience. Then, the Mayans were deficient in Spanish and half of them spoke only Caqchiquel.

Testimony

The dominant forces in medicine and nutrition, and indeed in international agencies and governments, do not want to pay attention to our findings. It is easy to see why. We see world health in a way that continues to contradict the prevailing paradigm of more money, more food, more intervention, more medicine, more 'aid', dominated by the notion that those who 'know best', must help ignorant people who are hungry.

The explicit or at least implicit assumption of professionally trained people in all occupations, including administration, law, education, medicine, agriculture, and also nutrition and public health, is that they know best. Conscientious people with qualifications believe that their responsibility is to lead and guide the common people, in their own country or other countries. Of course it is true that in mutually respectful partnership, populations and communities without specific types of technical knowledge can learn from those with such knowledge who encourage and empower them to make appropriate use of it.

I am sure that the work I did with my team in Cauqué helped the people to reduce their risk of infections and infestations, by simple precautions such as wearing shoes, washing hands and cleaning homes, and also by pressing the need for clean water and decent sanitation. I would like to think that our work also has had some influence on public health policies and actions in Central America and in other countries also. But in Santa Maria Cauqué I learned at least as much as I taught. I tried to express this in my book, as follows.

> By standards of more advanced societies, the villagers of Santa María Cauqué would be characterized as primitive, in some respects barely emerging from the Middle Ages. Working with them, however, brought realization of a distinctive civilization that functions most humanely, of a community that conducts itself peacefully according to firm values, and with a sense of purpose that stems from the necessity to live, to create, to share with each other, and to suffer and die together – enviable qualities so frequently absent in many western societies.
>
> Life in the village centers on an incredibly complex framework of traditional attitudes that permeate all spheres of existence, challenging the stand of those observers who conceive of the spiritual world of the Indian as simple, monotonous, and dull. The highly constructive attitudes of the Indian toward birth, mother-child interaction, and childrearing, the ceremonial cultivation of maize, and the deeply felt respect for authority, all challenge that viewpoint…. The outsider from another culture or another way of life is inevitably impressed with how well the Indian society is equipped for survival – past any extent one would anticipate.

The people of Santa María Cauqué knew how to live in balance with nature within their environment. Almost all of the rest of us do not. In the word now much used, the way of life of the Mayans I worked and lived with was sustainable. If their beliefs, culture and ways of life become absorbed into the consumer 'lifestyle' that is devouring the planet, they will be the losers, and so will the rest of us.

Another one of my mentors and guides, beginning from when I was studying in the US half a century ago, was the microbiologist and philosopher René Dubos. In his book *The Mirage of Health* (7), published at the time I was at Harvard, he wrote

> Modern man believes that he has achieved almost complete mastery over the natural forces that molded his evolution in the past and that he can now control his own biological and cultural destiny. But this may be an illusion. Like all other living things, he is part of an immensely complex ecological system… Human life is affected not only by the environmental forces presently at work in nature but even more perhaps by the past.

I still believe that *tortilla*, beans, vegetables, fruits, herbs, and so on, are altogether as good as or better than a meal in a nice restaurant. Such meals and dietary patterns are natural and nourishing and do not cause overweight.

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