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Malnutrition, misery, and a medical mystery. The story of pellagra

A synopsis in English for Boel Berner's
Swedish book

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INTRODUCTION: A terrible disease in need of an explanation

Pellagra – a terrible disease, almost unknown today, but in 19th century southern Europe and early 20th century USA it affected millions of people. Hundreds of thousands died. The disease was named after its first symptom: a rough, cracked, red-flamed skin – *pelle agra* in a northern Italian dialect. In Spain, where it was first described by physician Gasper Casal in 1735, it was called *mal de la rosa*; in 19th century France, *mal de la misère*. That too was apt: the disease was in the misery. It only affected the poor, exploited, people in the countryside. The miserable ones.

Worst hit was northern Italy. Thousands of people fell ill every year in the mid-19th century, most of them in the three northern regions of Lombardy, Veneto, and Emilia-Romagna. First came the painful skin conditions, then fever, persistent headaches, severe diarrhoea, emaciation and exhaustion. Then, for many, madness. By the mid-19th century, pellagra was the leading cause of madness in northern Italy. The worst sufferers ended their days in mental hospitals or took their own lives in despair and confusion.

The disease attracted attention, also in far-away Sweden. About a hundred articles in Swedish newspapers described pellagra – “a disgusting disease”. The wonderful Italian countryside, readers learnt, was no paradise for poor farmers and farm workers: “The tourist who flies on an iron railway through this classical country, with its art and world-famous history, has no idea of the terrible misery beneath the beautiful Italian sky”, a local Swedish journal wrote in 1883. “Lombardy’s lush fruit fields and rich pastures do not betray to the stranger the poverty and decay of its farmers. And in recent decades, poverty has risen to a terrible degree ... And pellagra is the measure of poverty, for it is the disease of misery.”

Pellagra’s origin was a mystery. Was it caused by the scorching sun? By stale water or a deadly poison in the food? By an insect or a parasite?

None of these suggestions was correct.

It would take nearly two hundred years of scientific conjectures and endeavours to finally, in the interwar period, establish that pellagra is a *deficiency disease*. It is caused by a lack of vitamin B₃ (niacin) in the diet of poor and exploited people.

Thus, the story of pellagra is one of sustained, mostly fruitless but eventually successful, scientific efforts. The book follows in the footsteps of the three most influential, colourful, and controversial pellagra researchers: Cesare Lombroso (1835–1909), Louis Westenra Sambon (1867–1931) and Joseph Goldberger (1874–1929). Lombroso’s argument that pellagra was caused by a toxin in damaged maize met with scientific opposition, still, it became hegemonic by the end of the 19th century and influenced political decisions and reforms. Then Sambon’s theory that pellagra was an infectious disease got many followers, especially in the US. It delayed the acceptance of Goldberger’s results based on ingenious field and laboratory studies proving that pellagra was a deficiency disease. However, what exactly was lacking in the food of poor people was not understood until some years after Goldberger’s death in 1929.

I set the work of these scientists against a panorama of economic and political upheavals. Profound changes in patterns of cultivation, ownership and use of the land in 19th-century Italy and early-20th-century American South form the background to the disease; they were also its root cause. They brought misery and exploitation – and pellagra. The connection was not obvious to the actors of the time. Political opposition, personal ambitions, and scientific animosity influenced the search for a cause; new ways of looking at the origins of disease provided insights but also led astray.

The first two parts of the book cover the situation in Italy in the 19th century, while Part III deals with what happened in the United States in the early 20th century. In the final part, Part IV, I summarise and problematise Lombroso's and Goldberger's studies, using a "symmetrical" perspective that takes seriously both Lombroso's inaccurate and Goldberger's successful research. Both theories were based on multidimensional research, both met with strong opposition but also gained scientific and political acceptance. I disentangle the analytical and practical steps taken by both to understand the cause(s) of the disease (Sambon was less ambitious). I also discuss why it was not scientifically possible for Lombroso (or his contemporaries) to succeed in this task.

The book's closing chapter details the research that, based on Goldberger's insights, eventually led to the identification of "the pellagra-preventing factor" – niacin – and describes how it functions in the body. I then return to where the study started: why would the eating of maize have such disastrous effects? The Epilogue then brings the story up to date. Pellagra may not be epidemic anymore, but related forms of malnutrition exist today that threaten the health of poor people also in affluent societies.

My story of pellagra is based on archival sources, on contemporary scientific texts and newspaper articles and on extensive secondary material. Earlier studies tend to focus on either Italy or the USA, while this book covers the whole story and also provides detailed analyses of how researchers, each in their time, tried to solve the puzzle of pellagra, be it with varying foci and chances to succeed.

PART I: The disease

Chapter 1. "There are seven kinds of pellagra"

I outline the geographical and social distribution of pellagra in Italy and describe its peculiar symptoms, the four Ds, which range from terrible skin problems (dermatitis), via diarrhoea, exhaustion and pain to, in many cases, mental illness (dementia) and death. The multifaceted nature of the disease and its uneven trajectory – it often paused during summer and autumn – made it difficult to diagnose and understand. A variety of theories as to its cause(s) was put forward. Early on, however,

many realised that the disease had something to do with the consumption of maize.

Chapter 2. Maize and misery

From the late 18th century, maize became an important crop in northern Italy. It displaced other crops and led to financial gain for large landowners but misery and hard work for farm labourers and sharecroppers. The chapter shows how unequal ownership, maize cultivation, proletarianization, and extreme poverty formed the brew from which pellagra emerged in the countryside of northern Italy. Perhaps the poor people's one-sided diet based on cornbread and polenta was behind the emergence of pellagra? Exactly how this could happen was a matter of controversy during most of the 19th century.

Chapter 3. Blood

There were no known remedies for the disease. According to various superstitious beliefs, but also within some contemporary medical practices, pellagra, maize, and blood were intricately linked. The chapter discusses vampires and strange bleeding phenomena in polenta, as well as the desperate attempts of Italian doctors to cure mentally ill patients with blood transfusion. They then used blood from animals – lambs – as well as humans. What was the scientific rationale behind this therapy – and did it work?

PART II: The adventures of a pellagrologist

Chapter 4. In search of an unknown poison

The second part of the book takes us to the most important of the many 19th-century Italian attempts to understand and cure pellagra. How did the famous and charismatic professor Cesare Lombroso prove his thesis that pellagra was caused by a poison that develops in rotten or mouldy maize? His theory eventually became the dominant one in Italy and internationally (even though it was wrong). The chapter follows Lombroso on his adventurous journey through villages, mental hospitals, and research laboratories, and details his experiments with humans and animals leading up to his many, contested but also prize-winning, results.

Chapter 5. The battle for the cause

A series of scientific battles ensued in the 1870s and thereafter between Lombroso and proponents of an alternative theory, which held that pellagra was a deficiency disease caused by poverty and poor diet. There was not enough protein in maize, proponents argued. Lombroso did not agree. We follow the main conflicts around Lombroso's research (and, relatedly, his scientific reputation). His work was considered sloppy and his results unsubstantiated. Lombroso retorted. The debate turned acrimonious and quite personal. By the mid-1880s, however, Lombroso's "toxico-zeist" (poisoned maize) thesis became the established one. The chapter analyses the scientific and political reasons why this could happen and why the alternative theory (which was in principle more correct) could not assert itself.

Chapter 6. Reforms, not revolution!

Lombroso's long-standing interest in pellagra not only testifies to the change in medical research in the late 19th century: from patient diagnosis and clinical studies to laboratory experiments and examinations of cells under the microscope. It also shows the growing importance of hygiene and preventive medicine to combat disease, promote public health, and influence citizens' lifestyles. The chapter details Lombroso's many administrative, technical, and medical reform measures designed to prevent and cure pellagra. They gained political acceptance around the turn of the century 1900. They did not attack the underlying social problems – but perhaps they were effective anyway? Indeed, pellagra more or less disappeared from Italy during the first decades of the new century.

At the very same time, however, the disease – suddenly and unexpectedly – became a worrying public health problem on the other side of the Atlantic, in the United States. Millions of people were affected. Scientific and political confusion reigned as to the outbreak's cause, prevention, and cure.

PART III: An American pellagra panic

Chapter 7. Interlude: “Lord of the Flies”

Bacteriology and epidemiology made astonishing progress in the latter part of the 19th century; many devastating diseases were found to be caused by infectious parasites spread by insects or other vectors. So why not pellagra? In the early 20th century, British-Italian epidemiologist Louis Sambon gained international recognition for his infection theory of pellagra. It was based on fragile scientific foundations but it was to influence the debate in the United States in a decisive and, perhaps, disastrous way.

Chapter 8. An incomprehensible epidemic

In 1902, the first diagnosis of a patient with pellagra occurred in the United States. The number of cases soon increased. In particular, people in the American South, and in orphanages and mental hospitals, were affected. A sizeable proportion died from the disease. Panic spread through the population. The cause of pellagra was still a mystery – so how could a widespread epidemic be avoided? Lombroso’s theory of spoilt corn had supporters but Sambon’s infection theory gained more traction. Major investigations were launched into the spread of pellagra, targeting infecting insects and rural hygiene, but confusion remained and the victims tended to be blamed for an epidemic that was growing each year.

Chapter 9. When three M gives four D

It is winter 1914 and a man steps off the train in a small town in Virginia in the American South. He has been sent by the Federal Public Health Service in Washington to solve, as its director phrases it, “one of the knottiest and most urgent problems facing the Service”. The visitor’s name is Joseph Goldberger, he is an experienced epidemiologist – and he will produce the answer to the riddle of pellagra.

In a brief time, 1914-17, Goldberger, together with a team of talented co-workers, conducted groundbreaking studies in mental hospitals and villages, on orphans and prisoners, as well as on himself, his colleagues and his wife. He soon rejected the infection theory and proved that pellagra was a deficiency disease caused by the traditional, but one-sided, “three M” diet of bread baked on maize meal, together with molasses and pork rinds (meat), among poor Southerners. He understood that

without radical changes in the economy of the southern states, pellagra could not be eradicated. It was an effect of a monoculture of cotton, of racism and the exploitation of farm labourers and mill workers, and of the limited access to nutritious food for the poor.

Chapter 10. The riddle solved?

After his, as it seemed, correct analyses and thorough research, many observers regarded Goldberger as a public health hero and he was nominated for the Nobel Prize in Medicine. But influential local elites questioned his proposals for a better diet and a change in the economy of the South. The miserable conditions remained – and the number of sufferers increased by the thousands. Goldberger therefore set out, in the 1920s, to identify in laboratory experiments the “pellagra-preventing” substance in healthy food, possibly a vitamin, that could save people from the disease. He died in 1929 and never learnt what this substance might be. But before that, he had found an antidote in brewer’s yeast, which saved thousands of lives during serious outbreaks of pellagra in the late 1920s.

PART IV: Understanding pellagra

Chapter 11. A scientific balance sheet

The pellagra story told in this book unfolded across two continents – actually elsewhere, too, since the disease was common also in, for example, apartheid South Africa and Siberian prison camps during the Soviet era. The main search for its cause was, however, a southern European and a US affair. I see the efforts of Lombroso, Sambon and Goldberger as linked together in a complex and contradictory chain of analyses. Lombroso opposed the deficiency theory of his critics, Sambon then rejected Lombroso’s toxico-zeist arguments, and Goldberger showed that the Sambon-inspired infection theory, used by his opponents in the US, did not hold. Pellagra was a deficiency disease, but the missing substance was not protein, as argued in 19th century Italy (and dismissed by Lombroso), but an unsuspected and unknown entity – later known as a “vitamin”.

In agreement with the so-called “symmetry principle”, advanced within science-and-technology studies, I have given Lombroso’s incorrect and often inaccurate research equal attention to that of Goldberger’s more

exact work. It was influential and it was based on important 19th-century ideas: about the necessity of finding the *one cause* of a serious disease, and about the possible noxious influence of an *external microbiological entity*. Lombroso also, just like Goldberger but with less skill, followed three of the four steps outlined by philosopher of science Paul Thagard about how scientists normally explain disease. He identified pellagra as a disease, outlined a possible cause, and then tried to prove it in experiments. What Goldberger (but not Lombroso) also did was to disprove the alternative, in his case the infection theory, in experiments. Thus, both followed a reasonable trajectory when they tried to understand the cause of pellagra – but, in Lombroso’s case, there are many questions concerning his scientific acumen. What neither of them did, or could do, was to identify the *mechanism* by which the supposed cause worked in the body to give the terrible symptoms of the disease.

The pellagra story raises an interesting philosophy of science question: what is epistemologically *possible* for scientists to conjecture and investigate at a particular time? I show that not until Goldberger’s time were theories and methods available to understand the cause of pellagra. In the 19th century, the right answer was unthinkable, and impossible to reach. It was not conceivable that the *absence* of an unidentified, unknown, minimal substance in what people ate could cause a disease as severe and multifaceted as pellagra. This understanding was met with scientific scepticism and outright opposition also in the US in the 1910s and 20s. There was political and economic resistance in the South to accept the new evidence and to improve conditions ever so slightly for the affected poor.

Chapter 12. Niacin

In 1937, Conrad Elvehjem at the University of Wisconsin proved that pellagra was caused by a lack of nicotinic acid, later called niacin, or vitamin B₃. The discovery paved the way for vitamin fortification of flour during the Second World War. There was then a dramatic decline in the number of affected people.

However, all the mysteries surrounding pellagra did not disappear at once. Why did milk help to prevent pellagra, even though it does not contain much vitamin B₃? How exactly does niacin work in the body, and what happens there if you do not get enough of it? And what was wrong with maize? What role did technological innovations play in how maize was harvested and milled, and thereby perhaps contributed to

outbreaks of the disease? And how was it that, for hundreds of years, poor Mexicans had based their diet on polenta without getting pellagra? Perhaps much suffering and stigma could have been avoided if European farmers had imported – not only the wonderful maize plant – from the Americas but also the Mexican way of preparing maize for cooking polenta that made its niacin available to the body?

EPILOGUE

In November 1938, a ship arrives in Barcelona from the United States. It brings a gift of solidarity to the thousands of Spanish people suffering from pellagra in the wake of the civil war – 270 000 doses of nicotinic acid. By now, medical science could bring immediate relief and cure the disease.

But, as my story has shown, the real solution to the pellagra conundrum lied elsewhere. It involved profound economic and social change. This happened gradually in Italy between the 1880s and 1930s when emigration and crop diversification brought better conditions to the Italian countryside. In the US, it would take two historical disasters – the Great Depression of the 1930s and the subsequent World War II – for economic conditions to improve in the South and for pellagra to become a thing of the past. In retrospect, it was clear that pellagra, during the whole period and for social and political reasons, overwhelmingly affected Black people more than White, and women much more than men – and Black women much, much more than any other category. It was indeed “a disease of misery” and a “measure of poverty”, as the Swedish newspapers put it, but also, and significantly, one of racism and gender oppression.

Today, the disease is extremely rare. It is only seen in refugee camps with poor provisions, or in people who, for reasons of alcoholism or mental illness, have a diet lacking in vitamins. But other human-caused diseases, based on ready access to cheap, filling, but non-nutritious, often processed, food now form a severe public health hazard, in similar ways and to similar segments of the population as pellagra once did.

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