

RANDOM HOUSE  BOOKS



Sugar

Sanjida O'Connell

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About the Book

Sugar is produced in 121 countries worldwide and annual production, which already exceeds 120 million tonnes globally, is increasing year on year. Sugar has been described as a medicine, a necessity, a drug, but its tale is one of both life and death - it is in every cell of our bodies. Humans are all dependent on sugar for life, but it was responsible for the enslavement and death of millions of Africans and is at the root of one of today's most serious health problems: over one fifth of adults in the UK and third of adults and half of the children in America are clinically obese.

Our lust for sugar has changed the shape of the world economically culturally and socially. Sanjida O'Connell reveals, in accessible and scintillating prose, the extraordinary and illuminating story of sugar's journey from a grass to world domination.

Sugar

The Grass that Changed the World

Sanjida O'Connell



AUTHOR'S NOTE AND ACKNOWLEDGEMENTS

Lozenges of coloured light from the stained-glass windows fell across the table. A monk glided over to us, folded his hands together and passed us a menu. Vaughn scrutinised it through his rose-tinted glasses, sighed, chose and then, after I had ordered, launched into a diatribe against sugar.

I was making a documentary on the science of kissing; we were in Atlanta filming a demonstration of thirty different sorts of kisses and Vaughn Bryant, an anthropologist from Texas A & M University, had flown over for the day so that I could interview him - and so he could watch the kissing demo. He'd spoken eloquently on the subject of kissing: he believed kissing was a learned phenomenon and that many tribes only kissed because they'd seen Westerners do so. He told me that Roman men were permitted to kiss women in the street because it was forbidden for women to drink and by kissing them they could check for alcohol on their breath. He said the Celts believed kissing under the mistletoe was the equivalent of a legally binding promise to marry the woman you had kissed, and that you'd be sued if you didn't honour your promise, but I thought this was an example of the ubiquity of American litigiousness clouding our understanding of an ancient Celtic custom.

To thank him I'd brought him to a restaurant set in a church where the waiters were dressed as monks and the food was tastefully presented. Vaughn's real job is as a palynologist, a person who studies pollen - in his case, fossilised pollen. He told me that his problem with sugar began about thirty years ago. He had grown overweight and

was self-conscious about it. He was about to begin an archaeological dig in Texas when an idea struck him. He shared it with his students - while they were excavating the remains of cave people, why not eat as they had? The students - I'm not sure how readily - agreed. Vaughn had a pretty good idea what humans had eaten in that part of the world because he analyses coprolites - 10,000-year-old fossil faeces. So in the mornings he and his students did not eat breakfast, but instead foraged for berries as they walked to the dig. They ate cacti, roots, grubs, lizards and rats. Unsurprisingly, Vaughn lost some weight.

Back at campus he wondered whether he could continue with the diet. Obviously, roast rat with a side of steamed cactus was not going to work in a university setting, so he thought about the type of food his ancestors had been eating. He came to the conclusion that they ate a lot of fruits and vegetables, lean meat occasionally and the odd egg, but no refined carbohydrates, no dairy products, little fat and certainly no sugar. Trying to translate this into the kind of food you can buy at the supermarket was initially a challenge. He was shocked to discover that almost all processed food has sugar in it. Even baby food contains sugar: anyone of a slightly cynical disposition might think this was a ploy on the part of manufacturers to hook consumers at as early an age as possible. Sugar, after all, is not required by babies; it is not even a nutritional necessity for adults.

Vaughn told me of an experiment reported in William Dufty's book *Sugar Blues*, in which half the mental patients in a hospital were deprived of sugar and half were allowed to eat as many sweets as possible. After two years the patients who had eaten the sugar had lower IQs, their memories were impaired and their mental health had deteriorated in comparison with the other patients. He said sugar was responsible for obesity, heart problems, diabetes, hyperactivity and schizophrenia. It made sense: our bodies

are not designed for sugar. We have evolved to subsist on meagre rations – eating highly processed and refined foods means our bodies think we have come across an unbelievable bonanza and store the energy for leaner times. We have not yet found a way to let our bodies know that, for many of us living in developed countries, the bonanza is all around us, every day. Still on the caveman diet, Vaughn is fit and trim despite the fact that he's edging up to retirement. Neither of us had dessert.

Back home, intrigued by his story, I looked sugar up on the Internet. I was amazed to discover that sugar is a grass. It looks like bamboo and grows several metres in height. How, I thought, have we gone from being cave peoples scrabbling around for roots, nuts and berries, plus the odd lizard, to cultivating a type of grass that we grind down in order to extract its juice and boil until we have fine, white crystals and then eat this strange food stuff at practically every meal? How did this type of grass end up being responsible for the deaths of millions of indigenous people in the countries to which sugar cane was transported? How did whole nations of Africans lose their lives in the growing of it? Why did entire European economies wax and wane according to the harvesting of this crop, which was entirely dependent on a lot of rain, free labour, low taxes and the absence of plagues of caterpillars? And how has it come to pass that we cannot survive without this sweet concoction and, as a result, are suffering from chronic obesity, a situation that is costing the health budgets of nations millions worldwide?

It is thus to Vaughn Bryant that I owe the inspiration for this book. I have another major debt that I must also acknowledge. At about the same time as I started working on the kissing programme, I began a relationship with James Fair, an editor at *BBC Wildlife* magazine. By the time I had researched my idea for a book on sugar and agreed with

Virgin Books to publish it, James and I were married. I now, somewhat ironically, found myself wedded to a sugar family. James's father, Neil Fair, his maternal grandfather, Kenneth Brown, his uncle, Peter Brown, and some of his other relatives all worked for Tate & Lyle. It is due to Jennifer and Neil Fair's help and generosity – in spite of their amusement over my chosen subject matter – that I have been able to meet Michael Grier, Community Relations Manager for Tate & Lyle, who kindly let me use the company library, and ex-directors Michael Attfield, Colin Lyle and Sir Saxon Tate. These men and their wives were good enough to welcome me into their homes and answer my simplistic questions; Michael Attfield, in particular, was probably shocked to see such a profound display of ignorance over the futures market. Colin Lyle and Saxon Tate put me in touch with Chuck Vlitos, ex-director of Tate & Lyle's research laboratories at Reading. Neil and Peter both lent me books, and Peter provided me with useful contacts in Barbados. Their views are, of course, their own and should not be taken to represent the views of Tate & Lyle.

I would also like to thank all those academics who gave their time and expertise and sent me papers and references. In particular, I would like to thank the following: Sandra Bellamy, Gordon Birch, Harm de Boer, Angélique D'Hont, Jock Galloway, Matt Griffiths, Peter Havel, Patrick Holford, Anthony Kennedy, Frieder Lichtenthaler, Mike Lindley, Seshagiri Rao, Aubrey Sheiham and Toni Steer. Louise Osborne thoroughly, meticulously and swiftly carried out some preliminary research for my original proposal. I have used many books and papers, but the most useful by far on the history of sugar has been Noël Deerr's two volumes on sugar published in 1949 and 1950 – his breadth of knowledge and attention to detail is unparalleled. Philippe Chalmin's Master's thesis on Tate & Lyle proved immensely helpful, as it is dense with a richness of detail unrivalled by any other books on the subject. Bristol University's excellent

library held many key books and Bristol Central Library's staff have been extremely efficient, procuring those the university did not have. Kew Gardens kindly let me visit their Economic Botany library. I'm very grateful to the staff of the Christopher Columbus Museum in Porto Santo who opened it although it was closed. In addition, David Smith and Annette Green, my agents, have provided me with unflinching support and dedication, as have my family and newish husband! James Fair, my father, James O'Connell, and my sister Sheila have all read parts of my book and made useful comments. I would also like to thank Kirstie Addis for her thoughtful editing and Ian Allen for his careful copyediting, as well as the rest of the team at Virgin Books. Any mistakes are my own.

Note: All monetary figures are given as the value they had at the time, unless otherwise stated.

INTRODUCTION

IT WAS THOUGHT singularly impolite not to wear a hat. In fact, the whole uniform, pith helmet and white suit included, was a requisite. I was watching a dying breed – the last great white sugar farmers from a bygone era – on a flickering reel of black-and-white film in the stables of a Jacobean mansion on Barbados. The film was taken in 1935 by plantation owner Laurence Cave but only discovered 45 years later by his grandson. These ten precious reels documented the final days of nonautomated sugar production. They depicted a windmill made of coral with canvas sails that small Barbadian boys climbed aboard for a hair-raising home-grown roller-coaster ride as the internal wooden cogs crushed sticks of sugar cane to extract its molasses-dark syrup; guinea fowl wandered in front of the mill, and horses toiled through the fields, pulling carts laden with freshly harvested sugar cane; sugarcane juice bubbled in *taches* – huge, round copper pans almost as high as a person.

I had come to Barbados to research the story of sugar cane from its origins ten thousand years ago to the present day and, as I sat and watched this amateur film, I realised that Barbados *was* the history of sugar cane, in microcosm. I had driven through a tunnel created by the heavy branches of age-old mahogany trees to reach St Nicholas Abbey, a Jacobean mansion, complete with an English knot garden crammed with herbs and overblown roses, and fireplaces and chimneys, requested by an owner as yet unaccustomed to the heat of the Caribbean. The house had been built in 1650, less than 25 years after the English had seized Barbados and around the time they had decided that sugar

was to be their main cash crop. Sugar cane, however, had probably been on the island long before it was reintroduced. It had probably been brought by tribal peoples, just as they had originally transported it around the world at the dawn of its domestication. On Barbados the people who brought it were the original inhabitants, the Amerindians, who were wiped out by the Spanish before the English appropriated the island.

Until recent technological innovations, sugar cane was an incredibly labour-intensive crop that needed to be planted, weeded, manured, irrigated and harvested by hand, before it was crushed for its juice, which was then boiled to extract crystals of sugar. In order to make this economical, the English, like other colonial powers, sent African slaves to Barbados. The majority of Barbadians alive today are descended from these original slaves and some of the remaining white plantation owners are related to the first white settlers. St Nicholas Abbey, like many other wealthy plantations, had its own windmill for crushing the sugar cane and its own factory for boiling the sugar-cane juice to extract unrefined muscovado sugar. The remnants of these buildings are still here today. The house itself feels dark, hemmed in as it is by the giant mahoganies, grown to house and furnish the descendants of the plantation; but also because the house, the factory and windmill still exist today in a charmed circle, surrounded as they are by 220 hectares of sugar cane, a grass that can reach heights of six metres, with a jointed bamboo-like stem and thick tassels of cream-coloured flowers.

Today the island itself is still covered by vast fields of sugar cane and the history of the island is laced with the story of black slaves, white plantation owners and sugar. In the Barbadian Museum is an appeal for a runaway slave, which was published in the *Barbados Mercury* on Saturday 12 April 1788. It describes her as 'silly looking' with 'slim legs and a round belly'. Later, in 1834, the slaves were

emancipated in the British Empire; in 1838 they made up the following song ('Jin-Jin' means Queen Victoria, 'licks' are beatings and 'lock-up' is a jailing):

Lick and lock-up done wid,
Hurrah fuh Jin-Jin;
Lick and lock-up done wid,
Hurrah fuh Jin-Jin.

God bless de Queen fuh set we free,
Hurrah fuh Jin-Jin;
Now lick and lock-up done wid,
Hurrah fuh Jin-Jin.

In spite of, or perhaps because of, the horrors of slavery, places like the Caribbean and the southern states of America now have a multicultural society; without sugar, it could be argued, we would not have the blues or rock and roll, musical genres that had their birth in the slave-owning counties of the USA. It is also no surprise that Barbadians, surrounded by sugar, have one of the highest rates of diabetes in the world. When I had a traditional meal, which included sweet potato pie made with added sugar, followed by a four-tiered sponge cake with butter cream and fondant icing, I could see why.

Without sugar, whole areas of land, be it in Barbados, Thailand or Australia, wouldn't have been altered so dramatically as native forests were felled to make way for field upon field of sugar, with the concomitant rise in pollution from the pesticides, herbicides and fertiliser this hungry crop requires. Today Barbados, a coral atoll in the Caribbean, still has its cap of sugar cane but, like many small countries facing pressure from imminent changes to EU legislation, sugar cane soon will no longer be economical to grow and export to its traditional sweet-toothed importer - Britain.

'People complain to me the whole time. They feel demoralised and demotivated. The sugar industry is running at a loss,' Harm de Boer tells me. A lean man whose ginger hair is greying, originally from Holland, he speaks English with a Dutch accent and a Scottish twang. A trained agronomist, he arrived in Barbados in 1981 to discover that the legacy of slavery still hung over the sugar-cane industry. Some Barbadians are still racist, referring to their workers as 'niggers', he adds. As soon as Barbados became independent in 1868, yields plummeted and have never recovered. Now de Boer, thinking of the imminent legislation and falling yields, has other reasons to be concerned.

De Boer's office is the nicest he's ever had. It's on the top floor of an old plantation house, and has a wooden floor, cream walls and cool jalousies - small roofs over each window so they can be kept open even in a storm without the rain running in. There are windows on three sides overlooking acres of sugar cane. But these are no ordinary fields of cane: de Boer works in the Agronomy Research and Variety Testing Unit and stretched below him are 3,500 experimental strips of sugar cane. An unusual mixture of quiet precision and enthusiasm, he's hoping that these plants will rescue Barbados.

Once sugar cane was a wild grass that contained very little sugar at all. Over many generations, people bred it to become sweeter and sweeter and learned to extract crystals of pure white sugar from its sap. While de Boer's colleague Dr Anthony Kennedy is scientifically continuing this process to create the world's sweetest sugar cane, de Boer is hoping that sugar cane will also yield other products, such as lignin, a chemical valued by pharmaceutical companies, or fibre to fuel power stations or make paper and cardboard.

People once desired sugar so badly that whole nations were wiped out, countries went to war, cultures were destroyed, trade blossomed and multinationals bloomed. Now there are surplus sugar mountains and sugar lakes;

people in the West have grown obese through sugar indulgence. It is a quiet irony that the very plant we have manipulated for centuries to provide us with the maximum amount of sugar could well now be used to generate electricity and shore up our medicine cabinets.

As I watch the island of Barbados spinning out of view from the plane window, with its idyllic beaches, fields of sugar cane, jagged limestone outcrops and houses the colour of boiled sweets, modelled directly on the chattel houses the slaves once dwelled in, I realise how much sugar cane has changed us. More than any other crop, be it cotton or cocaine, sugar has shaped our culture, landscape, politics, geography, economics, race, music, health, the very food we eat and what we drink in a way that no other commodity has throughout human history. This is the story of sugar.

1. STONE HONEY

The juice of the sugar-cane, if the stalk is chewed with the aid of the teeth, increases the semen, is cool, purges the intestines, is oily, promotes nutrition and corpulency and excites the phlegm.

*Charaka, in Charaka-Samhita, AD
78*

GOD MUST HAVE a sweet tooth. Sugar cane has been transported, almost without fail, throughout the world by men and women carrying faith and this overgrown grass. The handmen and maidens of the Gods belonged to practically every major religion - Hinduism, Buddhism, Christianity, Islam - and, wherever they took their message, they carried sweetness.

It all began on New Guinea ten thousand years ago on a small island in the South Pacific. The story goes that, once upon a time, two fishermen, To-Kabwana and To-Karvuvu, found a piece of sugar cane in their net. They threw it into the sea, but as they hauled their net in on the second day they saw that the same section of sugar cane was tangled in the folds. They cast it into the water, but, at the end of their third day of fishing when they pulled their net in, the cane was again snarled at the bottom. Thinking that this must be an omen, they kept it and planted it. From the stubby knob of cane grew a thick, strong plant. A few weeks later a beautiful young woman stepped from between the dense cluster of leaves. She cooked a meal for the men that night but as the moon rose she slipped back between the folds of cane. This became routine until one day To-Kabwana caught her before she could retreat into the sugar cane. He asked her to become his wife and she consented. They had

children together and these children became the founding members of the whole of the human race.

Or at least, this is what the Polynesians believe. And *to* is their word for sugar cane. The Polynesians have a number of legends like this in which sugar cane and the genesis of humanity are intertwined; they show how important sugar cane is to the people from the lands where sugar cane has its origins.

Sugar cane is a giant member of the *Gramineae*, the grass family, often growing up to six metres tall. Its closest living relatives are maize, rice and sorghum, but sugar cane looks like bamboo: a long, thick stem joined in segments like an insect's leg. Some are thick burgundy with the midnight-grey glaucous bloom of a plum, or vermilion, with turquoise joints; others are flushed pink, with a pearly suffusion at the end of each segment, the colour of a crustacean's inner claw. Yet other varieties can be grasshopper-green or mustard-yellow, tinged with the brown of dying leaves. One kind, *badila*, is almost blue-black, while another has a glassy, white transparency. Wild sugar cane, *Saccharum spontaneum*, looks more like grass: it is tall, slender and vigorous and its sugar content is low.

But the grass that changed the world was Creole. The Creole cane is a freak of nature - it's sterile; it cannot survive without human help; it's pathetically susceptible to disease and, above all, its thick, segmented stem is packed full of sugar. All plants obtain their energy from the sun in a process called photosynthesis. The result is a simple sugar, glucose, which the plant uses to make its cells. To tide them through winter, for instance, many plants store their energy by converting glucose to starch and secreting it in special organs - potatoes are literally balls of starch. But very few plants store glucose as sucrose, a more complex sugar, which is the white sugar you buy in packets. Sucrose is an

odd choice as a means of storing excess energy because it has to be dissolved and held in liquid form.

By a quirk of nature, some ancestor of sugar cane mutated and stored some of its energy as sucrose in the juice of its stem, instead of as starch in its roots. Nevertheless, that sucrose was used after the plant had flowered to help it grow the following year. But then, more than 8,000 years ago, someone tasted that cane and noticed that it was sweet. Instead of allowing the cane to continue to use up its reserves of sucrose, they cut it down and chewed on its sweet length. They kept it and grew it in their gardens, each year selecting the sweetest canes for chewing. This continued for thousands of years and, since the cane was unable therefore to use up its reserves, it became sweeter and sweeter until a fifth of its stem contained pure sucrose.

One other plant, apart from sugar cane, also stores sucrose in sufficient quantities to be used commercially – the sugar beet. Refining and growing sugar beet are complex, costly operations, but sugar produced from beets would eventually challenge the supremacy of sugar from sugar cane because it can be grown, harvested and refined in Europe. Sugar cane can only be grown in the tropics; the refineries, which are expensive to build and run, are almost always in developed nations.

Ancient peoples learned to extract sugar from sugar cane by crushing the plants' stems to procure its syrupy juice, at first by using primitive pestle and mortars; later wooden and stone mills were invented that were powered by animals, people or the wind. This juice is the colour of swamp mud, and tastes of liquid brown sugar, heavy with caramel and molasses and with a harsh, green, saplike aftertaste. This liquid would be boiled and the water allowed to evaporate until dark-brown sweet crystals were left.

Throughout the history of sugar there have been technological advances, such as the one in Barbados, called

the Jamaica train. This was a series of copper pans; syrup was ladled from one vessel to another as more and more water was evaporated. Reagents were added, such as charcoal or bull's blood, to precipitate out the impurities; the final supersaturated syrup was left to dry in clay vessels that allowed the sugar to crystallise out. Even today most sugar-producing countries refine sugar to this extent. Now, of course, the technology is much improved and vacuum pans are used. The syrup is heated with steam at high pressure in giant stainless-steel vessels in order to evaporate the water at a lower temperature. The end result is a pale-brown sugar that is around 97-99 per cent pure.

This sugar is then sent to refineries, such as Tate & Lyle's in London, for those final impurities to be removed. The process is similar - the sugar is melted in water; the water is evaporated and the sugar is crystallised out and dried, but, at each stage, another fraction of a percentage of impurities are removed. These refineries produce the purest food substance known - almost 100 per cent white sucrose. It's a complicated process with an underlying simplicity: as Mark Twain said in *Life on the Mississippi* on 'The process of making sugar - the thing looks simple and easy.'

There has never been anything like it before - a natural substance produced by a plant that, using rudimentary technology, can give a fast shot of the substance most desired and craved by anyone anywhere - for even a newborn baby loves sugar. Yet our hominid ancestors would never have experienced sugar - ripe fruit and occasional honey was the closest early *Homo sapiens* would have come to this mind-blowing sweetness.

Leaving myths to one side, one of the reasons why people suspect that sugar cane originated in New Guinea is largely due to the relationship a species of beetle has with a particular fly. Noël Deerr, the world's most prolific expert on sugar cane (he devoted two volumes to the subject

published in 1949 and 1950), discovered a beetle that is indigenous to New Guinea and is parasitised by a fly. The beetle feeds on sugar cane and cannot survive without it. The fly cannot live without the beetle. For such an exclusive relationship to have evolved, Deerr reasoned, sugar cane must have been established in this region for thousands of years.

There are hundreds of varieties of sugar cane growing wild in New Guinea, but until relatively recently it was thought that there was just one: *Saccharum spontaneum*. The cane that actually conquered the world originally also evolved in New Guinea – the Creole cane (*Saccharum officinarum*). This cane would eventually be described by the famous botanist and founder of the modern taxonomic system of classification Carl Linnaeus in 1753. *Officinarum* means ‘of the apothecaries’ shops’, since sugar was, for a great deal of its history, considered to be a medicine and was thus sold in the medieval equivalent of a pharmacy. The phrase ‘an apothecary without sugar’ came to describe a state of utter helplessness.

We now know that it was this Creole cane that the Polynesians subsequently carried with them on their migrations, chewing on the stalks to boost their energy. They took it to Indonesia, the Philippines and the northern tip of India around 8,000 BC. Later it travelled to Fiji, Tonga, Samoa, the Cook Islands, Marquesas, Easter Island and Hawaii. The Hawaiians offered it to the Sun God and carried it with them as they migrated northwards. From Hawaii sugar cane was taken to the rest of India, but when this occurred is unclear.

The earliest reference to sugar itself is in *Patimoksha*, the first record of the Buddhist life, which may have been handed down orally from the Buddha himself. *Patimoksha* said that, whenever the Buddha is not sick, he ‘shall partake of delicacies to wit, ghee, butter, oil, honey, *gur*, fish, flesh,

milk curds'. *Gur* is the Indian word for sugar. The Buddha (c. 563–483 BC) grew up and taught in a region where sugar cane was cultivated and so his life and teachings have become enmeshed in a sticky web of sugar.

What is extraordinary about sugar in India is that somehow sugar cane became synonymous with both major religions, Hinduism and Buddhism. Why this occurred is difficult to tell: it may be because the Buddha lived in a sugar-cane-growing region, or perhaps because sugar-cane cultivation evolved in tandem with the growth of religion in India. Despite what we now know about sugar, it is a force for good and a positive influence in these religions. Sugar must have seemed luxurious, a small indulgence in a hard life, and an even sweeter gift for both Hindu and Buddhist monks and nuns following vows of piety, poverty and chastity.

It may have been a linguistic misunderstanding that led to the link between Buddhism, Hinduism and sugar cane. There are numerous legends that are common to both faiths of a mythical kingly race of India, descended from Ikshvaku, founder of the solar dynasty, and himself the son of Manu, father of all humankind. The Sanskrit word for sugar cane is *ikshu*, which has no connection to Ikshvaku, but the words are so similar there seems to have been some confusion and, in later tales, the Ikshvaku race became intertwined with the origin of sugar cane.

In one tale, a priest tells the story of a rich and powerful king, Subandu. One morning he discovered that a sugar cane had begun to grow in his bedroom. The king was perplexed about the cane and consulted his Brahmins who told him that it was a good omen and a cause for rejoicing. The king left it alone and the cane flourished. It grew and grew until one night, while the king and his queen slept, the cane split apart to reveal a baby. Surucira, the queen, accepted the baby as her own, and the following day a

ceremony was held to celebrate the arrival of the new prince. On the advice of the Brahmins, Subandu and Surucira called the prince Ikshvaku, which means sugar cane. Ikshvaku had many descendants, the hundredth of whom was the Buddha.

This legend appears in the *Mahavastu*, in which the life and teachings of the Buddha are related, and is just one of many that refer to the origin of the Buddha and the importance of sugar cane. One of the legends in the *Mahavastu* tells of the Buddha, at the end of his seventh week after enlightenment, resting under a tree by the roadside. Two merchants, Trapusa and Bhallika, were passing and recognised that he was a holy man. They gave him a piece of peeled sugar cane. This joint of cane was the first food he'd eaten since enlightenment and, as a result of their kindness, Trapusa and Bhallika became the first official Buddhists.

Another tale is of Ajatasastru, King of Magadha, who gave the Buddha a field of sugar cane. But one day a man was leaving this field with a bundle of cane and refused to give any to a child who asked him for some. In his next existence he was condemned to be a ghost in a luxuriant field of sugar cane that beat him to the earth every time he attempted to eat it.

One of the signs that a Buddha has descended are that ghee, honey, molasses and sugar never run out in the house where he lives. The Buddha used many metaphors derived from sugar: he said that his teachings were as full of sweetness. The Buddha's son, Rahula, had a foster mother who wanted to become a nun, but the Buddha would not allow women to enter any religious orders. She followed him from Kapilavastu to Vesali and pleaded with him. Ananda, favourite disciple of Sakya Muni, supported her petition. The Buddha relented but said, 'Just as when the disease known as *manjitthika* falls on a field of ripened sugar cane, that field does not last long, even so, Ananda, in whatever

discipline of *Dhamma* women are allowed to go forth from the home to the homeless life, that godly life will not last.' *Manjitthika* means the 'colour of madder' and is a red dye still used in India today. The most widespread sugar-cane disease is red rot; it is caused by the fungus *Colletotrichumfalactum*. Red rot is prevalent in Vesaili; its devastating effect only becomes apparent as the cane is about to be harvested. This is very likely the first description of the disease.

In the Indian state of the United Provinces, the Hindu festival held in the middle of November that celebrates the god Vishnu awaking from four months of sleep has become a celebration of sugar. Traditionally the zemindar, who plants the sugar cane, worships Hindu gods in a field of the crop. Five girls collect sticks of sugar cane: five of these canes are placed on the eastern edge of the field, and five canes each are given to the priest, the blacksmith, the carpenter, the barber, the washerwoman and the landowner. The landowner arranges his five canes in a pyramid round a footprint on the floor to symbolise the god Vishnu. The women sing songs to raise him from his sleep and a priest then recites a prayer: 'Rise, O God, you lord of the universe, from your sleep. By awakening, the three worlds will also awake.' The priest then describes the miraculous origin of sugar cane and the subsequent birth of the Buddha. Feasting and festivities follow and the harvest can then begin.

The earliest references to how sugar cane was processed come from Buddhist works. A sugar mill is mentioned in AD 100; in AD 500 the various operations carried out in a sugar factory are used as a metaphor to teach Buddhist maxims. In another analogy, the Buddha describes what we now call 'bagasse': 'As a sugar-cane stalk is thrown to the ground to be dried for burning after all the juice has been extracted by pressing in the mill, so the body pressed in the mill of old

age awaits the funeral pyre.’ However, sugar cane was generally processed by being crushed in a mortar and pestle. Even today in some parts of rural India, the only technological innovation has been the creation of a giant mortar and pestle turned by an ox.

Even at this early stage in the development of sugar, there were several varieties of sugar cane. In the *Charaka-Samhita*, a medical textbook written around AD 78 by Charaka, the Kashmiri physician to a Buddhist king in Peshawar, there is a reference to a white cane called *paundraka*. The cane was named after the region it came from: Pundra, in northwest Bengal and northeast Behar. Originally the people, the Paundrakas, were of a military origin but had fallen from grace, becoming a lowly caste known as the Puds or Pods. They were the world’s first professional sugar boilers. The region’s name, Pundra, derives from the Sanskrit root meaning to pound or reduce to powder: now Pundra is described in Sanskrit dictionaries as ‘the country of the sugar cane’. According to Deerr, ‘There appears therefore just a possibility of the country having been named from the fact of its possessing sugar-cane plantations.’ He goes on to say that there is a place in Bengal called Paundra-varadhana where the Paundras lived and the cane flourished leading him to suggest that Bengal was the first place in India where sugar cane was cultivated. Furthermore, in Bengal there is a city, now ruined, called Gaur, a very similar word to that for the most common kind of sugar sold in India – *gur*.

In spite of primitive extraction systems, India perfected sugar refining very early in its development and they had names for several different grades of sugar: *phanita*, a concentrated syrup; *matsyandika*, which was partially solid; *guda*, solid but amorphous, sold as *gur* or jaggery today; *khanda*, a low-grade white sugar; and *sarkara*, a higher

grade of white crystals. The best-quality sugar was called *sitopala*.

So, it is to India that we most likely owe our word for sugar. The Sanskrit word *çarkara* was derived from the Prakrit *sakkara*, which originally meant sand or gravel, and later became *sukkur* in Arabic. The Sanskrit *khandā*, meaning to break, has become candy.

Ancient texts, such as the *Arthashastra*, which probably dates from AD 100–200, give explicit instructions on how to grow cane:

Sugar-cane plants are propagated by cuttings, which are plastered at the cut end with a mixture of honey, clarified butter, the fat of hogs and cow dung . . . lands in the neighbourhood of flooded areas are best for long pepper, grapes and sugar cane. Always, when sowing seeds a handful of seeds bathed in water with a piece of gold shall be sown first, when this mantra call be recited: 'Salutation to God, Pajapati Kasyapa. May the Goddess Sita flourish in my seeds and gods.'

Until the 1800s most physicians, like Charaka, believed that sugar was a medicine. He wrote, 'Wine made from sugar is agreeable to the mouth, is a slight intoxicant, fragrant, destructive of all diseases of the anal canal, aids digestion and when old promotes cheerfulness or relish and improves the complexion.' He also thought it promoted sperm production.

However, sugar wasn't only treated as a medicine. The Indian epic the *Mahabharata* mentions sugar including punch made from sugar, lemon juice, water, spices and rum (our word 'punch' comes from the Indian word for five; there are five ingredients in this traditional punch). The Indians also made wine from sugar and date palms, and to some concoctions *dhataki* flowers or fruit juice were added. The Chinese traveller Hiun Tsang observed in AD 620, 'They feed themselves generally on cakes of parched gram, which they mix with milk, cream, butter, solid sugar and mustard oil.' Later the great Arabic traveller Ibn Battuta visited India during his sojourn in the East (1325–54) and wrote that at a

fête in Delhi he was given an unusual drink: 'They offer cups of gold, silver and glass, filled with sugar-water. They call it sherbert and drink it before eating.' The sherbert, he said, was flavoured with essence of rose petals.

In the *Arthasastra* the author provides instructions for the Superintendent of Elephants: 'The rations of an elephant shall be a strengthening drink of ten *palas* of sugar and one *adhaka* of liquor, or two *adhakas* of milk.' And under the section on 'Wonderful and delusive contrivances', the author has the following advice: 'The scum prepared from a mixture of the root of *kasruka* [a water creeper], *utpala* [sugar cane], and mixed with *bisa* [water lily], *durva* [grass], milk and clarified butter will enable a man to fast for a month.'

It was in India that Westerners received their first taste of sugar. The earliest Western written reference to sugar cane dates from 325 BC when Nearchus, an officer in Alexander the Great's army, which invaded the Punjab, described eating a milky rice pudding sweetened with sugar. This is still a popular dish in India today. It contains pudding rice coated in melted margarine with spices such as cinnamon, cardamom and cloves, as well as sultanas, desiccated coconut and possibly almonds, all simmered in milk with a fair amount of sugar. When I was a child my mother used to make this same dish for me but using rice vermicelli. Although it has a proper Indian name, *seviyan*, we used to call it string pudding.

Another mention of sugar cane was from the Chinese Buddhist pilgrim Fa Hien, who entered India east of the Indus in AD 399. He wrote, 'As you go forward from the mountains, the plants, trees and roots are all different from those in the land of Han, except the bamboo, the pomegranate and the sugar cane.' This indicates that sugar cane was also well established in at least parts of China. It had been taken there, possibly along with the process by

which it was manufactured, by the Indian Buddhists in around AD 50. About this time Buddhism split into two – the Mahayana, the Greater Vehicle, and Hinayana, the Smaller Vehicle – and the Mahayana sent missionaries to China.

One Chinese story described by Li schi tsching, author of an encyclopaedia, *Pen ts'ao kung mu*, tells of an Indian Buddhist, Zou, who had settled at See tschuan and lived in a hermitage. He owned a white donkey and when he wanted provisions he sent the donkey to market with some money and a note asking for salt, rice, firewood or vegetables. The local people would attach his goods to the donkey and send it back up the mountain to him. One day his donkey got into a field of sugar cane owned by a Mr Huang and created considerable damage. As compensation Zou showed Mr Huang a superior method (to the Chinese one) of how to make sugar from his cane. At this time the Chinese made *shimi*, which literally means 'stone honey'. They squeezed the juice from the sugar cane and boiled it, but it was still thick and dark with molasses. Zou's process created a finer, whiter sugar.

The Emperor T'ai Tsung is alleged to have sent a deputation to Behar in AD 640 to learn the art of sugar boiling and, as a result, it was announced that Chinese sugar was superior to Indian sugar. Even so, many years later, when Marco Polo was travelling through China during the fourteenth century, he wrote of Fukien (now Fujian):

They have an enormous quantity of sugar. From this city the Great Kaan gets all the sugar that is used at Court, enough to represent a considerable sum in value. You must know that in these parts before the Great Kaan subjected it to his overlordship [Gengis Khan's Mongolian invasion], the people did not know how to prepare and refine sugar, as is done in Babylon. They did not let it congeal and solidify in moulds, but merely boiled and skimmed it, so that it hardened to a kind of paste and was black in colour. But after the country had been conquered by the Great Kaan, there came into the regions men of Babylon [Egypt] who had been at the court of the Great Kaan, and who taught them to refine it with ashes of certain trees.

Because sugar cane had been brought to China by the Buddhists, it is no surprise that sugar continued to be associated with Buddhism in China. Fasting monks and nuns would drink sugared water and there was a sugar ceremony to worship the Buddha on his birthday, the eighth day of the fourth month. Water fragrant with herbs was boiled with sugar; called *yu Fo shui*, it means 'bathing the Buddha water'. Buddhist icons were carried in a procession by monks and nuns and were then soaked in the sugared water. This water was distributed to the onlookers for blessing themselves. The ceremony derives from the belief that when the Buddha was born the heavens opened and he was showered with sweet, scented water. In the eighth century a procession took place in the city of Loyang where a thousand Buddhist statues were carried through the city, watched by over a million people. When one considers that sugar was eaten widely in the monasteries - at this time there were over a quarter of a million monks and nuns and several hundred thousand novices in the country - and used heavily in this ceremony, China must have required an enormous amount of sugar.

At this time it was still only the religious orders and the elite who had access to sugar, the latter eating honeyed bamboo shoots, honeyed ginger, pickled crab and a cake made from sugar, rice powder and milk. The rest of the population could not afford sugar. But, by the time of the Song Dynasty in the early thirteenth century, sugar had become a luxurious necessity, even for Chinese peasants. The novelist Wu Zimu, in *The Past Seems a Dream*, described a night market in Hangzho that had no less than seven shops specialising in sugar. They sold honey cakes, flower-shaped candy, sweet rice porridge, spun sugar, sugar pastes, musk-flavoured sugar, preserved sugar - in total 37 varieties of cakes, candies and syrups made from sugar. They made a kind of marzipan from ground pine nuts and sugar and used it to press into moulds to create sugar

flowers. Edible sculptures of spun sugar in the shape of lions, birds, flowers and fruit were also common. Teahouses sprang up, and with the tea they served wine, pickled vegetables, salted melon seeds, and fruit preserved in sugar. Elaborate porcelain jars filled with preserved fruit became fashionable gifts among the Song urban elite.

It was at this time that the Chinese started making 'rock candy' by boiling sugar-cane juice until it was supersaturated and thick. It was dried in the sun before being packed in jars and called *Tang shuang* - sugar frost. In Li schi tsching's earliest work, the *Tao hung king*, written during the Liang dynasty between AD 502 and 560, he described six different kinds of sugar and sugar products: *Shimi* and *Tang shuang*, as well as *Tschi tang*, a thick, brown juice; *Panmi*, concentrated syrup; *Sch tang*, sugar clarified using milk; and *Scha tang*, sand sugar (it's possible that the latter was derived from the Indian word *sakkara*). He also listed four different kinds of cane: the *Tschu tsche*, a soft green cane with very sweet juice; *Ti tsche*, the western cane, which may mean that it came from India; *Tek sia* or *La tsche*, the wax cane, referring to its thick rind; and the *Hung tsche* or *Tsie tsche*, a brown or purple cane that, he said, 'can only be enjoyed when eaten. Sugar is not made from it. If the juice expressed by a mill is drunk, it is pleasant enough, but not so delicious as when the cane is eaten whole.'

Sugar was also carried by the Indian Buddhist missionaries to Japan in AD 755. By the eighteenth century sugar was being manufactured by Japanese clans, the most famous of which was the Takamatsu who made Sanuki sugar, known to the west as Sambon White.

But the most important introduction by the faithful was from India to Persia, now Iran, 600 years after the birth of Christ.

Though there is little other written evidence, documents show that a tax levy was imposed on sugar cane cultivated in Mesopotamia during AD 636–44, so sugar cane must have arrived in Persia prior to this time. It's again mentioned in an account of the capture of Dasteragad, a palace near Baghdad used as a residence of the Persian king Chosroes II, by the Roman Heracliys in AD 627. One Persian tale refers to his predecessor, Chosroes I, who lived during the sixth century. The Sultan was passing a beautiful garden when he saw a girl and asked her for a drink of water. She brought him a cup of sugarcane juice cooled with snow. It was so delicious he asked her how she made it. She said that sugar cane grew so well in her garden she could squeeze the juice from it with her bare hands. He asked her for another cup and, when she was gone, he thought to himself that he must remove the girl and her family and make the garden his own. To his surprise the girl returned without his drink and burst into tears. When he asked her what was wrong, she said that his intentions towards her had changed. She said she knew this because she had been unable to wring a single drop of juice from the canes. Chosroes realised the injustice of his thoughts and gave up his idea of owning the garden. He told the girl to try again and this time she quickly came back with a full cup of juice. This story is repeated in the *Arabian Nights*, but Hollywoodised - the Sultan was about to impose a tax on anyone who could grow that much sugar; in the end, he marries the girl.

The Persian sugar industry survived until 1300. The last Sultan, Mostasim, was executed by the Mongol Hulagu, Ghenghis Khan's grandson, in 1258 when his army captured Baghdad. The collapse of the empire followed and the sugarcane industry subsequently disintegrated.

One hundred years after sugar cane had reached Persia, it spread to Egypt and flourished alongside the Nile. By the tenth century it was an important crop, growing along the

Persian Gulf, the southern shore of the Caspian Sea, in Mesopotamia (now Iraq), the Damascus oasis, the valley of Jordan and Egypt.

Despite this expansion, it was an event that happened when sugar cane was first introduced to Persia that led to the world domination of sugar cane – the Arabian army’s quest to convert the world to Islam. In their conquest of Persia they came across sugar cane and it seems likely that, from then on, sugar cane was transported throughout the western world by the Arabic Islamic faithful.

What made sugar so special? A number of crops came from India and spread to the Mediterranean via the Middle East at around the same time as sugar cane: cotton, bananas, mango and taro, and yet we don’t have an economy fuelled by mangoes. In addition, sugar cane is difficult to grow: it needs a lot of fertiliser and huge amounts of water (28 irrigations per crop in Egypt; even cane grown in areas that were not as hot still required large amounts of water); it can take eighteen months to mature and, as a result, doesn’t fit into any crop rotation schemes so cannot be grown with other food crops. It was plagued by hordes of voracious mice and caterpillars and could be devastated by dogs, elephants and hippopotamuses. Above all, it was growing at the limits of its tolerance in the Mediterranean where the summers were too dry and the winters were too cold.

Professor Jock Galloway, who now teaches Geography at Toronto University, Canada, and has become an expert on sugar cane, believes that initially ‘the barrier to the diffusion westwards from India was not just environmental; it was political, cultural and institutional’. Galloway’s introduction to sugar cane was a somewhat unusual one. ‘One snowy March morning many years ago, Professor Theo Hill of the Department of Geography, McGill University, stopped me . . . to ask me if I’d like to spend the coming summer at McGill’s Bellairs Research Institute in Barbados. How could I