



Brain Fuel: 199 Mind-Expanding Inquiries into the Science of Everyday Life

By Dr. Joe Schwarcz

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Dr. Joe – as he is affectionately known to millions of readers, listeners, viewers, and students – brings his magic formula to Doubleday Canada with **Brain Fuel**.

As with Dr. Joe's previous best-selling books, **Brain Fuel** informs and entertains on a wild assortment of science-based topics. But this is not "science trivia." If you are looking for serious scientific discussions, you'll find them here. If you are looking for practical consumer information, that's here too. If you are searching for ways to stimulate interest in science, look no further, Mom. And if you are simply wondering why the birth of Prince Leopold was so different from Queen Victoria's previous seven; or why an iron rod that went through a man's head is now on display in a museum in Boston; or why white chocolate has such a short shelf life; or why eggs terrified Alfred Hitchcock – and what all of this means for the rest of us, and why – then bingo.

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Editorial Review

Review

"Falling in love, we all know, is a matter of the right chemistry. Schwarcz gets his chemistry right, and hooks his readers."

— John C. Polanyi, Nobel Laureate

"Informative [and] fascinating."

— *The Globe and Mail*

"Packed with scientific answers to questions you didn't even know you had."

— *Chatelaine*

About the Author

Dr. Joe Schwarcz, a professor of chemistry, is director of the Office for Science and Society, dedicated to demystifying science for the public, at McGill University. He writes a weekly column in *The Gazette*, hosts the Dr. Joe Show on Montreal's CJAD and Toronto's CFRB, and has made hundreds of television appearances on the Discovery Channel, CBC, and CTV. He is the author of the bestselling **An Apple a Day**.

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Introduction

We humans are a hungry lot. Like all other animals, we of course hunger for food. Unlike our fellow creatures, though, we hunger for something else as well. We hunger for knowledge. Some of this is for practical reasons. We want to know what to eat, what medications to take, what toxic substances to avoid and what to do about climate change. But we also hunger for knowledge just for its own sake. We are innately curious about our history, about the possibility of extraterrestrial life, about why a rose smells like a rose and about why we are curious about so many things. Our brains, like our bodies, constantly need fuel. This book aims to help satisfy that hunger.

This book aims to challenge, too. But, most assuredly, it is not a book of "science trivia." Far from it. Each entry serves a purpose. Some offer serious scientific discussions relevant to daily life; others are designed to provoke a "Gee, I didn't know that!" reaction. If you are looking for practical consumer information, it's here as well. If you are searching for curious anecdotes to spice up a conversation, you'll find plenty. And if all you want is some personal edification, just keep the book by your bedside, thumb through a few questions every night, and you'll be smarter in the morning! **Brain Fuel** is nutrition for the brain. Digest the whole book and you'll have a pretty good feel for what the pursuit of science is all about.

I also admit to another motive. To me, the pursuit of science is wondrous and satisfying. I of course realize that not everyone shares my passion, and nor does everyone need to, but I do feel that too many are missing out on the benefits that the fulfillment of scientific curiosity can bring to life, and I would like to remedy that. Curiosity, it has been said, is to science what a spark is to a flame. My hope is that at least for some of you, I can kindle that spark into a roaring flame. You will enjoy the internal warmth it provides. I certainly do.

So let's get going. And the best way to get going is to take a look at where we have been. Let's start by going

back . . .

Potions from the past

What substance became known as “anaesthesia à la reine” after it was introduced in the nineteenth century?

Chloroform. The “reine” involved was Queen Victoria, the first monarch to give birth to a child under anaesthesia. Prince Leopold, the Queen’s eighth child, was born in 1853, after her physician, Dr. John Snow, had administered chloroform by holding a handkerchief saturated with the chemical over her majesty’s mouth. The results were so satisfactory that the Queen asked for chloroform for her next delivery as well, after which the chemical came to be known in Britain as “anaesthesia à la reine.”

Chloroform was first made by the French chemist Jean-Baptiste Dumas, who reacted acetic acid with chlorine, but its use as an anaesthetic was pioneered by James Simpson, a Scottish physician. On the fourth of November, 1847, Simpson and his friends, aware of the euphoria-inducing effects of substances such as laughing gas (nitrous oxide) and ether, sought a little entertainment by inhaling chloroform. After some initial hilarity, they all passed out. Simpson’s reaction, on waking, was that “this is far stronger and better than ether.” (Ether had been introduced the previous year by William Morton in Boston.) Four days later, Simpson successfully delivered a baby after chloroforming the mother. Within a month he had used chloroform on more than fifty patients, one of whom was so delighted with its effectiveness that she named her newborn daughter Anaesthesia.

The procedure was not without risk, and in 1848 the first death attributed to chloroform was recorded. The death of young Hannah Green was probably caused by improper administration of the anaesthetic. Green’s death, along with the Calvinist Church of Scotland’s opposition to chloroform, cast a shadow on its use. The Church opposed the use of any anaesthetic in childbirth, reasoning that God had punished all of Eve’s descendants by ensuring that women would bring forth children in pain. (It seems that Eve’s decision to tempt Adam with that fruit of the tree of knowledge was not a good one.) Opposition to the use of chloroform, however, evaporated when Queen Victoria agreed to be anaesthetized for the birth of Prince Leopold. Approval by the Queen was as close as you could get to approval by God, and the use of chloroform proliferated. Soon it was even incorporated into various patent medicines such as Chlorodyne and Hamlin’s Wizard Oil. These “cure-alls” were not only useless but dangerous. Ingestion of significant amounts of chloroform can cause liver damage.

Today, chloroform is no longer used as an anaesthetic, but since it is a by-product of chlorination we are exposed to small doses in our drinking water. Whether or not this presents a lifetime risk is debatable, but chloroform is readily removed by using a home water filter. Bottled waters do not contain any chloroform because they are not treated with chlorine.

The 1905 Nobel Prize in Chemistry was awarded to Adolf von Baeyer for the synthesis of a compound that eventually proved to be important to blue jean manufacturers and also reduced starvation in India. What was this compound?

Indigo – which Adolf von Baeyer synthesized, and determined the exact molecular structure of, in 1880. He

was awarded the Nobel Prize by the Royal Swedish Academy of Sciences in 1905 for “his services in the advancement of organic chemistry and the chemical industry, through his work on organic dyes and hydroaromatic compounds.” Indigo occurs naturally in the shrubs of the genus *Indigofera* and was well known since antiquity. It was the dye used to colour all sort of fabric blue, including that used to make the uniforms of British sailors. The shrub was cultivated in India on huge farms and exported to Europe. Baeyer’s discovery made possible the synthesis of indigo from chemicals readily isolated from coal tar. Levi Strauss used indigo to dye his famous blue jeans. More importantly, the discovery of a process for making synthetic indigo freed up thousands and thousands of acres in India for planting with cereal crops. This fed far more people than the indigo export business ever did.

In 1903 a French chemist dropped a glass flask. It shattered, but the fragments did not fly apart. What had he discovered?

Edouard Benedictus’s clumsiness led to the discovery of safety glass. When Benedictus examined the flask he had dropped on the floor, he realized that a film had formed on the inside of the vessel. The flask had contained an alcohol solution of collodion, a plastic made by treating cotton with a mixture of sulphuric and nitric acids. When the solvent evaporated, a film of plastic was left on the inside of the glass. Benedictus thought no more of this until he read a story about a young girl being cut by glass in one of the first automobile accidents. He spent the night trying to make a coating on glass and within a day had produced the first sheet of “safety glass,” which he named triplex since it consisted of a sandwich of two sheets of glass with a film of cellulose nitrate between them.

In 1909 Benedictus obtained a patent, and triplex went into production. The first practical use turned out to be in the face shields of gas masks in World War I, but by the 1920s triplex was a standard item in American automobiles. One problem, however, was that the cellulose nitrate yellowed with age. In 1933 triplex was replaced by cellulose acetate, which was not quite as strong but did not yellow. The synthetic resin polyvinyl butyral eventually was found to be superior and has been standard in windshields since 1939. And it all began when a chemist couldn’t hold on to a flask.

At the 1937 World’s Fair in Paris, the German company Rohm and Haas was awarded a gold medal for a novel material it had produced from acetone. On exhibit was a transparent violin made of the substance. What was it?

Polymethyl methacrylate, better known as Plexiglas. The Rohm and Haas Company of Darmstadt had developed a crystal-clear break-resistant plastic by linking individual methyl methacrylate molecules into long chains of polymethyl methacrylate.

The starting material, methyl methacrylate, was made by reacting acetone with hydrogen cyanide, followed by treatment with sulphuric acid and methanol. The first applications of Plexiglas were for watch glasses and lenses for protective goggles, but soon curved windshields for buses and airplane canopies were being manufactured from the material. Today, Plexiglas has a wide variety of uses, including protecting spectators from flying pucks in hockey arenas.

Why is a 3-foot (1-metre) iron rod on display at the Warren Anatomical Museum in Boston?

Because it passed through the skull of Phineas Gage in 1848 without killing him. It did, however,

dramatically alter his personality. The unfortunate event turned out to be a landmark in the history of neurology, demonstrating that different parts of the brain had different functions. Apparently, catastrophic injury to the frontal lobes of the brain could be sustained without causing significant neurological deficits, but not without affecting behaviour.

To this day, a memorial plaque marks the spot where the spectacular accident occurred on September 13, 1848, in Cavendish, Vermont. Gage was employed by a railroad company as a foreman in charge of a crew laying new track. One of his tasks was to blast apart any boulders in the way. This involved boring a hole into the rock and filling it with gunpowder using a long iron tamping rod. On the fateful day, a spark ignited the powder prematurely, propelling the 11-pound (5-kilogram) rod through Gage's left cheek and out the top of his head, landing some distance away. Miraculously he survived, in spite of having lost a significant portion of his brain. Not only did Gage survive but within minutes he was walking and conversing normally. The only immediate consequence was loss of vision in his left eye, which apparently did not prevent him from sitting down and recording the event in his notebook.

Gage's luck, however, did not last long, as he developed an infection that left him comatose for a month. During this time he was looked after by Dr. John Harlow, who skilfully covered the head wound and later recorded the fascinating case in the *Boston Medical Surgery Journal*. In his account Harlow described how the physical injury had altered the victim's personality to the extent that he was "no longer Gage." Although his memory was not affected, the formerly mild-mannered Gage now became capricious and obstinate, often peppering his speech with obscenities. He lost his job and for a while exhibited himself with the famous iron rod at P.T. Barnum's circus.

Gage's most unusual adventure stimulated Scottish neurologist Dr. David Ferrier to investigate the role of the prefrontal lobes in brain function. Ferrier removed the lobes from monkeys and noted that there were no great physiological changes as a result, but the animals' character and behaviour were altered. Today, it is well understood that the prefrontal cortex of the brain controls the organization of behaviour, including emotions and inhibitions.

Phineas Gage died of epilepsy twelve years after the celebrated accident, leaving behind a fascinating legacy and advancing our understanding of the relation between the mind and the brain. Gage's skull has become a relic and is on display along with the famous iron rod at the Warren Anatomical Museum in Boston. One could say that Gage needed the job with the railway company like he needed a hole in the head.

What substance was responsible for the Chinese ceding Hong Kong to the British in 1842?

Opium. After the discovery of tobacco in the fifteenth century, tobacco smoking became very popular among sailors, who introduced it into China, India, Japan and Siam. In China the practice became so widespread that in 1644 Emperor Tsung Chen prohibited the use of tobacco. The people then turned to opium. By the end of the century one-quarter of the population was using opium. There wasn't enough to go around, though, and the British East India Company began to meet the demand by supplying huge amounts, mostly smuggled into China via Canton by British and American merchants and traded for tea. The Chinese government got fed up and decided to put an end to the illegal trade in 1839, when a thousand tons of opium were seized and destroyed. The port of Canton was closed to the British, who didn't take kindly to this, and the first Opium War was under way. It lasted till 1842, during which time ten thousand British troops captured several ports and the Chinese capitulated. At the peace conference in Nanking, the Chinese ceded Hong Kong to the British and had to concede greater trading rights. Opium flowed into China, and with Chinese immigrants made its way to America and Australia. So it was immoral British behaviour in the early 1800s that

eventually resulted in the worldwide opium problem we have today.

Users Review

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