

#BENEFITS

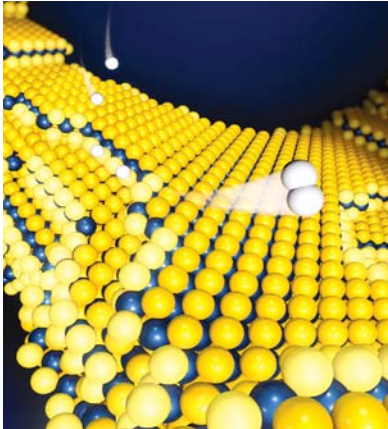
USE OF CARBON DIOXIDE

Carbon dioxide is commonly used as a raw material for production of various chemicals; as a working material in fire extinguishing systems; for carbonation of soft drinks; for freezing of food products



Rutgers scientists have developed catalysts that can convert carbon dioxide, the main cause of global warming, into plastics, fabrics, resins and other products. The electrocatalysts are the first materials, aside from enzymes, that can turn carbon dioxide and water into carbon building blocks containing one, two, three or four carbon atoms with more than 98 per cent efficiency. Two of the products created by the researchers, methylglyoxal (C3) and 2,3-furandiol (C4), can be used as precursors for plastics, adhesives and pharmaceuticals. "Toxic formaldehyde could be replaced by methylglyoxal, which is safer."

The discovery, based on the chemistry of artificial photosynthesis, is detailed in the *Journal Energy & Environmental Science*. "Our breakthrough could lead to the conversion of carbon dioxide into valuable products and raw materials in the chemical and pharmaceutical industries," said study senior author Charles Dismukes, Distinguished Professor in the Department of Chemistry and Chemical Biology and Department of Biochemistry and Microbiology at Rutgers University-New Brunswick. He is also a principal investigator at Rutgers' Waksman Institute of Microbiology. Previously, scientists showed that carbon dioxide can be electrochemically converted into methanol, ethanol, methane and ethylene with relatively high yields. But such production is inefficient and too costly to be commercially feasible, according to



study lead author Karin Calvino, a chemistry doctoral student in Rutgers' School of Graduate Studies. However, carbon dioxide and water can be electrochemically converted into a wide array of carbon-based products, using five catalysts made of nickel and phosphorus, which are cheap and abundant, she said. The choice of catalyst and other conditions determine how many carbon atoms can be stitched together to make molecules or even generate longer polymers. In general, the longer the carbon chain, the more valuable the product is.

Based on their research, the Rutgers scientists earned patents for the electrocatalysts and formed RenewCO2, a start-up company. The next step is to learn more about the underlying chemical reaction, so that it can be used to produce other valuable products such as dials, which are widely used in the polymer industry, or hydrocarbons that can be used as renewable fuels. The Rutgers experts are designing, building and testing electrolyzers for commercial use.

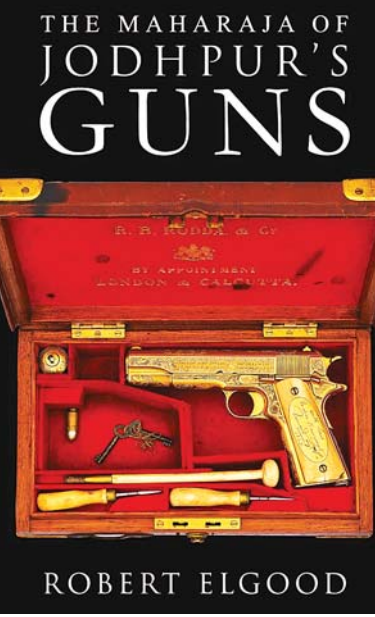


Rajputs Did Not Take To The Gun Easily

Badayuni, present at the battle, makes no mention of them on either side but one of the Rana's elephants was injured by a bullet. The Rajputs are often said to have fully adopted Mughal culture by the late sixteenth century but their attitude to guns and cannon certainly differed from that of the Mughals. For centuries, Hindu kingly tradition had extolled the importance of becoming a chakravartin, a great ruler dominating by force of arms neighbouring lesser kings. It was unthinkable by Rajput warriors that this status could be achieved using gunpowder weapons. The Rajputs never lost their virile belief that war was a matter of individual combat for personal glory. They largely ignored other societies' tactical development of firearms, which diminished the individual's ability to show his skill with edged weapons and his courage.



Even small numbers of matchlocks gave great military advantage in regional warfare in Asia in the early sixteenth century. Much is made of the consequences for firearms development due to the Portuguese arrival in India and further east but the role of the Turks in the development of firearms in this vast region is scarcely mentioned, though they too in the same period became an Indian Ocean power with particular interests in pilgrim traffic, the spice trade and jihad. Ayalon's first recorded use of a handgun (as opposed to a cannon) in Egypt is 1490. In the Indian Ocean, the Mamluks looked to the Turks for cannon and guns with which to fight jihad against the Portuguese. Alliances made by the Turks explain why some places between India and China have Ottoman-style gun locks and others Portuguese. These two styles of gun replaced such gun design influence as the Chinese had disseminated in the East, though archaic firearms continued in use among the poorest people into the early twentieth century. In 2004, the arms historian Iqtidar Alam Khan wrote: "Contemporary evidence can be cited to prove the wide use of a



Babur's army in battle with Rana Sanga at Khanwa.

primitive type of gunpowder-based artillery in the whole of India as early as the middle of the fifteenth century. But similar evidence for the handguns is not strong." The matchlock mechanism used in India until the twentieth century was first created in Nuremberg in the fifteenth century and copied by the Turks. After the Persian defeat at Chaldiran in 1514, the Persians captured and copied Turkish guns. Ottoman gunstocks closely copied late fifteenth-century European guns, depicted in the Codex Monacensis of c.1500. Apart from stock similarities, the chamber end of Indian barrels is invariably marked on the exterior by a raised band or astragal, an early Ottoman detail, intended to reinforce the chamber, which was made of thicker metal than the rest of the barrel. The comb back-sight with a sighting notch or hole also derived from Ottoman barrels as is the decoration of some muzzles. These sights offered the shooter's right eye some slight protection from exploding barrels. The Mughal emperor appear to have either had access to European guns or copied European designs from at least Humayun's reign (1530-40 and 1555-6) because his Memoirs describe him owning a double-barrelled gun in 1539.

The historian Saxena suggests that cannon and matchlocks were adopted in Rajasthan following the battle of Khanua in 1527. Until the Rajputs established trusted relations with the Mughals, it is hard to guess where they might have

#THE INDIAN MATCHLOCK



A gold mounted Sindh Jezail matchlock.

obtained cannon and guns and any such adoption was negligible and without military consequences. Very few were available in north India until later in the sixteenth century. The Mughal Hamza Nama from the 1560s depicts armies but very few guns. A Leviathan Attacks Hamza and His Men, painted circa 1567, shows two ships, one with a cannon barrel protruding from the forecastle, fighting off a sea monster. Among the passengers we see a crossbowman, three archers and two matchlock men. Their gunstocks have a pronounced step below the breech, a standard feature of Persian guns. The matchlock mechanism used in India until the twentieth century has been drawn showing a serpentine, the S-shaped trigger mechanism that guides the lighted match to the touch hole. From Abu'l Fazl, we learn that the Emperor Akbar ordered guns to be made with two lengths of wrought-iron barrels, banduk, the full-sized barrel of



Asia in the gunpowder revolution.

PART:1



'A Leviathan Attacks Hamza and His Men' painting.

A Rajput blunderbuss made for a chaukidar.

lar wound from a gun. The seventeenth-century Iranian traveller in India, Abdullah Sani, who attended Shah Jahan's court, expressed surprise at the large numbers of Rajputs and Afghans serving in the Mughal army. However, Jodhpur paintings rarely show Rajputs of status with guns until the second half of the eighteenth century. Hunting scenes show bows being used, though there are many literary references to Rajputs using guns.

The fame of Rani Durgavati (d.1564), queen of Gondwana, reached Akbar's court. She was a good shot with gun and arrow and continually hunting... It was her custom that whenever she heard that a tiger had made his appearance, she would not drink water till she had shot him.

In contrast to Rajput disdain, Akbar was very interested in guns. Abu'l Fazl tells us Akbar 'introduces all sorts of new methods and studies their applicability to practical purposes. Thus, a plated armour was brought before His Majesty, and set up as a target; but no bullet was so powerful as to make an impression on it.' More of these were ordered. Since rulers and generals were expected to direct battles from the vantage point of a howdah on the back of the largest elephant available, where they made excellent targets, one can see why this might



The First Battle of Panipat, 1526.

appeal to him. Abu'l Fazl acknowledges the importance to Akbar of guns, saying he is responsible for various gun inventions. "With the exception of Turkey there is perhaps no country which in its guns has more means of securing the government than this." He further says: "His Majesty looks upon the care bestowed on the efficiency of this branch as one of the higher objects of a king, and therefore devotes to it much of his time. Daroghas and clever clerks are appointed to keep the whole in proper order." The Padshahnama refers in 1636 to Bahadur Beg, supervisor of the Imperial matchlocks. Matchlocks are in particular favour with His Majesty, who stands unrivalled in their manufacture, and as a marksman. "Many masters are to be found among gunmakers at court" including Ustad Kabir and Husayn. "It is impossible to count every gun; besides clever workmen continually make new ones, especially gajnaals and narnals."

The Portuguese priest Francis Henriques, a member of the first Jesuit mission to Jalal-uddin Akbar, in 1580 wrote from Fatehpur Sikri: "Akbar knows a little of all trades, and sometimes loves to practise them before his people, either as a carpenter, or as a blacksmith, or as an armourer, flier." Henriques's companion, Father Monserrate, confirmed this in his Commentary: "Zeladinus (Latin for Jalal-ud-din) is so devoted to building that he sometimes quarries stone himself along with the other workmen. Nor

does he shrink from watching and even himself practising for the sake of amusement the craft of an ordinary artisan. For this purpose, he has built a workshop near the palace where also are studios and work rooms for the finer and more reputable arts, such as painting, goldsmith work, tapestry-making, carpet and curtain making, and the manufacture of arms. Hither, he very frequently comes and relaxes his mind with watching those who practise their arts.

Many early Turkish gun barrels were made of bronze but wrought iron gradually replaced these. In 1556, Janissaries sent to further Ottoman interests in Central Asia had their iron barrelled arquebuses seized by the Khan of Bukhara, who gave them inferior copper-barrel arquebuses in return. Early Indian gun barrels were made of sheet of iron rolled into a tube with the two edges brought together and braised. "They also take cylindrical pieces of iron, and pierce them when hot with an iron pin. Three or four such pieces make one gun." Joining three or four pieces of metal to make a gun barrel sounds particularly hazardous but it should be remembered that in Mughal India, as in Ottoman Turkey, it was common to make cannon in two parts, and since guns were seen as small cannon, the same practice applied. The powder chamber required much thicker walls than the rest of the barrel and was made separately. The two parts were then joined, the joint reinforced by an astragal.

Barrel-making in Hindustan improved when they were made by twisting a ribbon of iron round a mandrel. In the next stage, the metal was heated and the mandrel held vertically and hammered to weld the edges. "Numerous accidents" were caused by barrels exploding. Abu'l Fazl tells us that Akbar tested new guns personally and put the experience to good use. His Majesty has invented an excellent method of construction. They flatten iron, and twist it round obliquely in form of a roll, so that the folds get longer at every twist; they then join the folds, not edges to edge, but so as to allow them to lie one over the other, and heat them gradually in the fire.

The overlap described by Abu'l Fazl as Akbar's invention was already used for joining the cannon which were cast in two parts, the powder chamber (daru-khana) and the stone chamber (tash-awi). Ottoman cannon were made with a screw thread to join the parts but the Indians lacked the technical knowledge to make this. The result of Akbar's new gun-barrel-making technique was that: "Matchlocks are now made so strong that they do not burst, though let off when filled to the top." His system may have made barrels stronger but it also made them a great deal heavier, which was unimportant to him as he was extremely strong. There were still casualties however. Maharana Hamir Singh severely wounded his hand when his gun exploded during a hunt in 1778. He died from the infected wound six months later.

To be continued...

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#RAKSHAT HOOJA

'Gaslight'

True to this meaning, the play is both an intimate domestic drama and a potent social critique



Rajasthan International Center (RIC) continued its tradition of bringing world-class theater to Jaipur with its September 5 staging of Patrick Hamilton's *Gaslight*. The production, adapted and directed by Saurabh Shrivastava, was performed in Hindi, an inspired choice that brought the story closer to the audience.

Patrick Hamilton's *Gaslight* is a master class in psychological suspense and theatrical craftsmanship. First staged in 1938, the play feels startlingly contemporary, its themes of manipulation, control, and fragile perception as relevant as ever. What makes *Gaslight* endure is not only its chilling premise, a husband subtly undermining his wife's sanity for personal gain, but the precision with which the director builds tension. Scene by scene, like a light dimming on stage, the atmosphere tightens until the audience finds itself as uncertain and trapped as the heroine. By the time the truth is revealed, the room feels heavy with anticipation, the effect almost unbearable.

To contextualize the play's impact, consider the term, "gaslighting" that it inspired. Webster's Dictionary defines "gaslighting" as the psychological manipulation of a person, often over a prolonged period, that causes the victim to doubt the validity of their own thoughts, perceptions, or memories. This process typically leads to confusion, diminished self-confidence, and a growing dependency on the perpetrator.



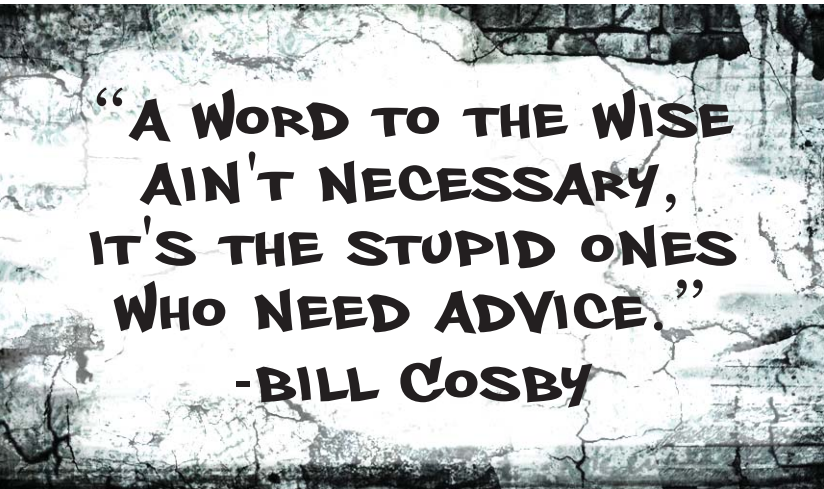
True to this meaning, the play is both an intimate domestic drama and a potent social critique. Long before the term "gaslighting" entered what we now, at times wryly, call the "woke" vocabulary, Hamilton's play exposed its insidious cruelty. Today, these themes resonate all the more deeply. Hamilton's insight into psychological abuse, veiled as care and concern, gives the play extraordinary contemporary relevance. The production's success owes much to its taut dialogue and meticulous pacing. Saurabh Shrivastava, who directed, and starred in the lead role, masterfully wields the sinister power of suggestion, leaving both characters and audience questioning reality. The atmosphere he crafts, enhanced by fading lights and a claustrophobic set, transforms the domestic space into a psychological prison, both suffocating and enthralling. Saurabh, who established Gandharva Theater Group after retiring from a distinguished career in the Indian

Police Service, wrote, directed, and played the role of Manjeet, the calculating antagonist. His performance is chilling: coolly manipulative, menacing without raising his voice, commanding attention through stillness as much as presence. His cruelty, understated yet devastating, is a study in emotional control. He was ably supported by Khushboo Kamal as Bela, the vulnerable heroine. Watching her resist a carefully orchestrated campaign of psychological torment is both harrowing and inspiring, her performance holding the audience in quiet solidarity. Vineeth Vishwanathan, as the CID Officer, provides a brief but electrifying turn, delivering some of the play's sharpest comic lines. Supporting roles were equally assured, anchoring the story's tension. The production values, lights, sound, and stage design, worked seamlessly, drawing no attention to themselves, but allowing the narrative to take full possession of the stage.

Few plays manage to weave suspense, social commentary, and emotional depth so cohesively. *Gaslight*, the play, balances sharp dialogue with moments of unbearable silence, allowing pauses and gestures to echo louder than words. The result is devastating. When the curtain finally fell, the applause carried not just appreciation but a trace of unease, audiences left the theater entertained, unsettled, and perhaps, a little more aware of the shadows flickering in their own lives.

Reviewed by: AJAY GOEL

THE WALL

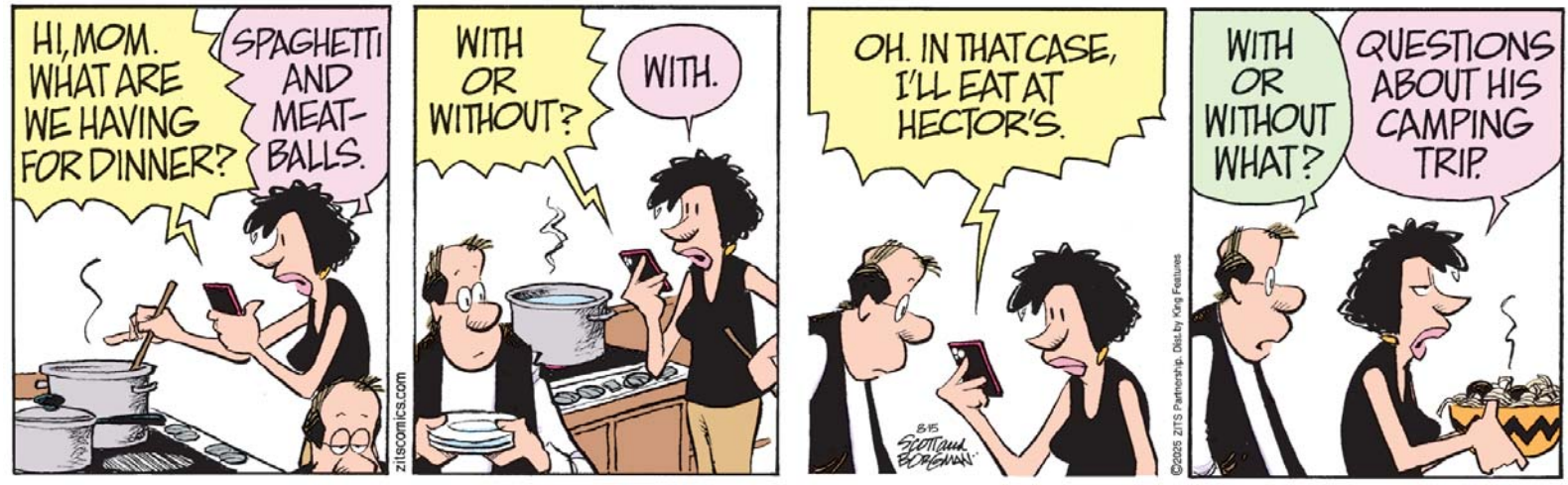


BABY BLUES



By Rick Kirkman & Jerry Scott

ZITS



By Jerry Scott & Jim Borgman