

Other countries could have made ‘Russian’ nerve agent

[By Debora MacKenzie, exclusive to *New Scientist*, March 20, 2018](#)

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British Prime Minister Theresa May says that because it was Russia that developed Novichok agents, it is “highly likely” that [Russia either attacked the Skripals itself, or lost control of its Novichok to someone else who did](#). But other countries legally created Novichok for testing purposes after its existence was revealed in 1992

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British Prime Minister Theresa May says that because it was Russia that developed Novichok agents, it is “highly likely” that [Russia either attacked the Skripals itself, or lost control of its Novichok to someone else who did](#). But other countries legally created Novichok for testing purposes after its existence was revealed in 1992, and a production method has even been published.

Science could reveal where the weapon came from, but it would require Russia to declare any Novichok stocks or production it has, and to give inspectors access to it, which it has never done.

This week, inspectors from the Organisation for the Prohibition of Chemical Weapons (OPCW) are in England investigating the chemical attack, on 4 March, on two Russians in Salisbury.

Sergei and Yulia Skripal, and a policeman who found them unconscious in a shopping centre, remain in critical condition due to what the British Defence Science and Technology Laboratory at Porton Down says was a [“Novichok” nerve agent](#).

Novichoks are a class of highly toxic chemicals developed in the 1980s in the then-Soviet Union. Peter Wilson, UK delegate to the OPCW, [said in a statement](#) that Russia was a suspect because it has produced Novichok and “probably still could”, and has a record of state-sponsored assassinations.

Russia does [have a history of using poison on enemies](#), but it is not the only conceivable source of Novichoks. And while using it this way contravenes the Chemical Weapons Convention (CWC), the treaty does not ban Novichoks by name, making verification difficult.

Undeclared chemicals

Vil Mirzayanov, a scientist with the Soviet chemical weapons programme, [revealed in 1992](#) that it had developed a new class of nerve agents that worked like the older agents VX or sarin, but had chemical differences that made them up to eight times more toxic.

Moreover, while the precursors used to make VX and sarin are themselves banned by the CWC, Novichoks can be made from chemicals permitted for other industrial uses, in normal chemical plants. They are also [binary](#), making them easier to handle: two harmless precursors can be mixed at the last minute to make the poison.

Mirzayanov's revelation came only weeks after the CWC negotiations ended. Treaty members feared that re-opening the treaty's list of banned chemicals to insert the Novichoks would just publicise them to the many countries that hadn't signed yet, says [Jean-Pascal Zanders](#), a chemical weapons consultant.

So Novichoks are not listed by the CWC, but they are illegal: the CWC makes any toxic chemical used to harm people illegal. But verification of what a country has by the OPCW depends on what it declares, and Russia insists only listed chemicals must be declared. It has rejected pressure to declare Novichoks.

[Alastair Hay](#), professor of environmental toxicology at the University of Leeds, says he hopes Novichoks will now be listed in the CWC.

“Novichoks were only produced in any sizeable quantities in the Soviet Union,” says Zanders. But after Mirzayanov's revelations, Western defence labs made small amounts – legal under the treaty, partly so the agents can be identified in situations like Salisbury. In 2016, Iranian chemists even [published a method for doing so](#).

Ralf Trapp, a chemical weapons consultant formerly with the OPCW, says the inspectors can tell where molecules sampled in Salisbury came from, if they have reference samples for the ingredients used by the factory. “I doubt they have reference chemicals for forensic analysis related to Russian CW agents,” says Trapp. “But if Russia has nothing to hide they may let inspectors in.”

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What are Novichok nerve agents and did Russia do it?

[By Alice Klein, New Scientist, March 13, 2018](#)

The poison used to target [ex-Russian spy Sergei Skripal and his daughter](#) in Salisbury was a Novichok nerve agent, UK prime minister Theresa May revealed yesterday.

The chemical was identified by the Defence Science and Technology Laboratory at Porton Down, May told the House of Commons.

Novichok nerve agents – also known as the “N-series” – were secretly developed by the former Soviet Union beginning in the 1970s. They followed the “G-series” of nerve agents made by

Germany in the 1930s and the “V-series” made by the UK in the 1950s. Novichok means “newbie” in Russian.

The small amount that we know about these agents is based on [reports from Russian chemist Vil Mirzayanov](#), who exposed the development programme in 1991.

Novichoks work in the same way as [other nerve agents](#), which disrupt nerve signals to the muscles by inhibiting an enzyme called acetylcholinesterase. The gaps between nerve cells become flooded with acetylcholine, causing continuous contraction of the muscles. Symptoms include convulsions and difficulty breathing.

According to Mirzayanov, some Novichoks can be eight times as deadly as VX, the V-series agent that was used to [kill North Korean exile Kim Jong-nam](#) last year. Just 10 milligrams of VX on the skin can be lethal.

There are no previous reports of Novichoks being used in battle or assassinations. However, Andrei Zheleznyakov, a Russian scientist involved in their development, reportedly died not long after being exposed to a small amount that leaked out of a rubber tube in the lab.

Secret structures

The most potent members of the N-series are reportedly Novichok-5 and 7. We know these are chemicals that contain carbon and phosphorus like the G-series – which includes sarin, tabun, soman, and cyclosarin, and the V-series – which includes VX, VR, VE, VG and VM. However, their exact structures are a mystery.

According to Mirzayanov, both are binary agents, meaning they are made from two precursor chemicals that are mixed together just before use. These precursors could be made at pesticide or fertiliser manufacturers without arousing suspicion, he says.

The use of a Novichok in the attack on the Skripals makes it highly likely that Russia was involved, because no one else knows how to make them, says [John Lamb](#) at Birmingham City University, UK. “The Novichok family was specifically created by Russia to be unknown in the West and as such it’ll be one of their most tightly guarded secrets,” he says.

But why would Russia employ such an incriminating nerve agent? “It could have been a demonstration of capability,” says Lamb. After allegedly poisoning ex-Russian spy Alexander Litvinenko with radioactive polonium-210 in 2006 without serious consequences, they may simply have felt that they could get away with it, he says. Novichok precursor chemicals are also safer to transport and handle than ready-made nerve agents, he says. However, Russia has denied any involvement.

Detective work

Identifying the Novichok agent would have been a painstaking process, says [Martin Boland](#) at Charles Darwin University in Australia.

If someone shows signs of nerve agent poisoning, the first thing to do is to check for decreased acetylcholinesterase activity. This reveals if a nerve agent has bound to the enzyme.

Next, the specific nerve agent must be identified. A telltale sign of poisoning with sarin, for example, is unnaturally high blood levels of fluoride, which is used to make the nerve agent.

Because no standard test exists for Novichoks, defence officials may have taken fluid from the Skripals' spinal cords, isolated the acetylcholinesterase enzyme, and analysed the structure of the nerve agent attached, says Boland. Western intelligence agencies probably have knowledge of the exact Novichok structures, allowing them to detect a match, he says.

The Skripals are probably receiving the same treatment that is given for other types of nerve agent exposure, says Boland. This includes atropine to block the effects of acetylcholine, pralidoxime to restore acetylcholinesterase activity, diazepam to stop convulsions, and ventilation to assist breathing.

Their survival so far suggests the Novichok poison was designed to be slow-acting or to be absorbed through the skin, because this route of administration takes longer to cause symptoms than inhalable nerve agents like sarin, says Lamb.

Parts of Salisbury – where the attack took place – are still cordoned off, and Public Health England has advised anyone who was close by to [wash their clothes](#). This precaution is necessary because we don't know how long Novichoks persist in the environment, says Boland.