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WORKING PAPER No. 23, November 2026

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Executive Summary

The 2026 Nobel Prize in Physiology or Medicine was awarded to three scientists who developed optogenetics - methods that allow light to be used to affect the activity of neurons-which is one of the key technologies that underpins the rapid development of civil neuroscience during this century. The medical use of such technological developments will lead to significant gains in our understanding and subsequent treatment of devastating and widespread psychiatric and neurological diseases, but such dual-use knowledge could also be exploited in the malign manipulation of the human central nervous system (CNS) and other core physiological systems. Responding to such concerns, this paper examines the contemporary and potential future risks of State-sanctioned malign application of neuroscience and related chemical and life sciences, particularly with regard to development of CNS-acting chemical agent (CNSAC) weapons and noting concerns relating to incapacitating chemical agent (ICA) weapons that attack other core physiological systems.

Section one introduces CNSAC weapons noting previous State development and use of these weapons, before examining the current regulation of CNSACs under the Chemical Weapons Convention (CWC), the prohibition on use of CNSAC weapons in armed conflict and the 2021 'Understanding' clarifying prohibition on use of aerosolised CNSAC weapons in law enforcement.

Section two examines ongoing advances in neuroscience that could have implications for the development of novel CNSAC weapons attacking specific targets in the CNS. By reviewing recent work on neuropeptides, psychedelic drugs, and autoimmune diseases it is clearly demonstrated that large numbers of potential specific targets have been and will be discovered, and, as recent disclosures have shown, this process will be accelerated by the use of new methods of Artificial Intelligence.

Section three summarises contemporary allegations made by CWC States of development, transfer and use of CNSAC weapons by other CWC States. Allegations made by the US of alleged Chinese research of CNSAC weapons, Iranian research and development of CNSAC weapons and Russian research and development, as well as confirmed use of CNSAC weapons, are described. The section also describes Russian allegations of 'Western' transfer of CNSAC weapons to Ukrainian forces.

Section four then makes a series of recommendations for CWC States Parties and the Organisation for the Prohibition of Chemical Weapons (OPCW) to prevent and address CNSAC (and broader ICA) weaponisation under the CWC. It recommends:

- Establishing a Scientific Advisory Board (SAB) Temporary Working Group (TWG) on CNSACs and broader ICAs. One immediate role of the TWG would be to provide technical assistance to the OPCW Technical Secretariat (TS) in its preparation of guidance to States to facilitate implementation of the CSP-26 'Understanding' on aerosolised law enforcement CNSAC weapons.
- Strengthening OPCW science and technology (S&T) monitoring and review capabilities with specific relevance to CNSACs and ICAs
- Addressing allegations of malign use of CNSACs and ICAs

1 The Regulation of CNSACs and ICAs Under the Chemical Weapons Convention

1.1 CNS-acting chemical agent weapons and incapacitating chemical agent weapons

This century's ongoing advances in neuroscience, and broader life and chemical sciences and associated technologies will likely yield significant gains in our understanding and subsequent treatment of currently devastating and widespread psychiatric and neurological illnesses.[1] However, given its multi-faceted applicability, such knowledge and capabilities could instead be exploited in the malign manipulation of the human central nervous system (CNS) and additional core human physiological systems.

In 2000, the distinguished scientist George Poste argued that 'as we begin to understand the exquisite molecular mechanisms that regulate this remarkable structure called the human body … the ability to understand those circuits means simultaneously we gain the capacity to scramble them'.[2] Responding to such concerns, in this paper we will examine the contemporary and potential future risks of State-sanctioned malign application of neuroscience and related chemical and life sciences, concentrating on development of incapacitating chemical agent (ICA) weapons, predominantly those employing CNS-acting chemical agents (CNSAC). For the purposes of this paper, an 'ICA weapon' will be considered to comprise an ICA and associated means of delivery developed with the purported intended purpose to cause prolonged but non-permanent disability or incapacitation of the human target. ICA weapons can potentially be developed to target a wide range of core physiological systems beyond the CNS such as the respiratory, circulatory or immune systems. For clarity where such weapons employ chemicals acting on the CNS – producing non-permanent loss of consciousness, sedation, hallucination, incoherence, paralysis, disorientation, or other such effects – they will be termed 'CNS-acting chemical agent (CNSAC) weapons'.[3] Many putative CNSAC and broader ICAs have low safety margins, and inappropriate doses cause serious, sometimes permanent, health effects and may result in death. Chemicals of biological origin – notably toxins and bioregulators – and their synthetic analogues have been amongst the substances explored as potential CNSAC or other types of ICA weapons.[4]

Previous analysis by the current authors has highlighted development and/or use of CNSAC weapons by State entities in China, Israel and Russia. To date there has been only one large scale use of such weapons by a State, namely the employment in 2002 by Russian security forces of an aerosolised CNSAC weapon to break the siege of the Dubrovka theatre in Moscow where a Chechen armed group held 900 people hostages. Although the siege was ended and hostages freed, over 120 hostages died from asphyxiation or other effects of the CNSAC weapon. Our research also uncovered how States including Czechia, India, Iran, UK and the US have conducted dual–use research since 1997 potentially applicable to study or development of such weapons.[5] Although the UK, US, and some other countries that previously conducted research in these areas have formally declared they are not developing and do not possess CNSAC weapons, some States known

1 Naddaf, M. and Callaway, E. (2026) Medicine Nobel awarded for Brain 'switch' that controls neurons with light. *Nature*, News, 5 October. https://doi.org/10.1038/d41586-026-03091-2.

2 Poste, G. Advances in biotechnology: promise and peril, Second National Symposium on Medical and Public Health Response to Bioterrorism, Center for Biosecurity, Washington, DC, 28–29 November, 2000. www.upmc-biosecurity.org/pages/events/2nd_symposia/transcripts/trans_post.html (no longer active).

3 Certain chemical agents like organophosphorus and carbamate nerve agents that act principally on the CNS, are not included, for ease of distinction, within the definition of CNSAC weapons because they are not intended to reversibly incapacitate their targets.

4 For further discussion see: Crowley, M. and Dando, M. Preventing Weaponization of CNS-acting Chemicals' Royal Society of Chemistry, London, 2025; Crowley, M. and Dando, M. Toxin and Bioregulator Weapons, Preventing the misuse of the chemical and life sciences. Palgrave Macmillan/Springer Nature, Cham, Switzerland, 2022; Crowley, M. and Dando, M. Down the Slippery Slope? A study of contemporary dual-use chemical and life science research potentially applicable to incapacitating chemical agent weapons. University of Bath and University of Bradford, 2014.

5 Crowley and Dando (2014) *op.cit*., pp. 20–37, 50–72; Crowley and Dando (2022) *op.cit.,* pp. 60–63, 100–103, 111–113, 124–128, 150–160, Crowley and Dando (2025) *op.cit.,* pp.29-67.

to have developed and/or employed such weapons – notably Russia, China and Israel – remain silent. As discussed in Section 3 of this paper, concerns about the ongoing attempts by certain countries to research and develop CNSAC weapons have been raised and are continuing to be raised by States Parties to the Chemical Weapons Convention (CWC).

The CWC is currently the most important legal instrument that can be utilised by the international community to prevent and address misuse of neuroscience and related chemical and life sciences in development of CNSAC and broader ICA weapons. Consequently, the remaining sections of Section 1 will review its objectives, key provisions and its application to CNSAC and ICA weapons.

1.2 Chemical Weapons Convention

The Chemical Weapons Convention (CWC) entered into force on 29 April 1997 and, at 1 November 2026, comprises 193 States Parties that have ratified, acceded or succeeded to it, representing 98% of the worldwide chemical industry.[6] The CWC is of unlimited duration and was intended by the negotiating States to be far more ambitious and comprehensive in scope and application than any prior international agreement on chemical weapons.

Article I, which established the basic overarching obligations of States Parties, explicitly prohibits development, production, stockpiling, transfer 'directly or indirectly' of 'chemical weapons to anyone'. It also expressly outlaws use of chemical weapons 'under any circumstances' and requires their destruction within a specified time period.[7]

The comprehensive nature of the CWC was further established under Article II.2 which defined a 'toxic chemical' as: 'any chemical which through its chemical action on life processes, can cause death, temporary incapacitation or permanent harm to humans or animals.'[8] Furthermore, this definition explicitly includes 'all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere'[9] Consequently, the CWC is not restricted to chemical warfare agents, but covers toxic industrial chemicals, pharmaceutical chemicals or any other human-synthesised chemicals. Furthermore, it would also cover naturally occurring chemicals, notably including toxic chemicals produced by living organisms (i.e., toxins and by extension bioregulators).

The attempts by the negotiators to ensure a comprehensive scope of the CWC are also apparent in the Article II.1 definition of 'chemical weapons' *inter alia* as: '(a) *toxic chemicals and their precursors, except when intended for purposes not prohibited under this Convention*, as long as the types and quantities are consistent with such purposes' (emphasis added).[10] This highlighted text is known as the General Purpose Criterion (GPC). In their Commentary to the Convention, Krutszch and Trapp highlighted the positive implications of the open–ended nature of the GPC

> Under this concept, *all* toxic or precursor chemicals are regarded as chemical weapons *unless* they have been developed, produced, stockpiled, or used for purposes not prohibited. The definition thus covers any toxic or precursor chemical if intended for chemical weapons purposes, irrespective of whether it has been listed in one of the Schedules [of restricted chemicals]. (Emphasis highlighted in original).[11]

6 For further information see the website of the Organisation for the Prohibition of Chemical Weapons (OPCW) https://www.opcw.org/ (accessed 1 November2026).

7 OPCW, Chemical Weapons Convention: Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (CWC). 1993, Article I.

8 OPCW, CWC, (1993) *op.cit.,* Article II.2.

9 Ibid.

10 OPCW, CWC, (1993) op.cit., Article II.1

11 Krutzsch, W., Herbach, J. and Trapp, R. (Eds.) *The Chemical Weapons Convention: A Commentary*. 1st. edition. Oxford Commentaries on International Law. Oxford: Oxford Univ. Press. 2014, p.77.

Because the GPC establishes a prohibition based on intent rather than on a limited list of toxic chemical agents, it allows the CWC to encompass developments in science and technology (S&T); consequently, as Meselson and Perry Robinson have highlighted, 'even toxic chemicals whose existence is not yet known are covered' by its provisions.[12] Meselson and Perry Robinson also noted that the GPC has a second important function; it 'protects legitimate uses of all toxic chemicals and chemicals from which they can be made'[13].

To determine whether the specific use of a toxic chemical would be in conformity with the Convention, the purpose for that use must be established. The range of 'purposes not prohibited' under the CWC has been defined under Article II.9 as including '(d) Law enforcement including domestic riot control purposes'.[14] Consequently, any toxic chemicals held (or used) for purposes not covered by Article II.9 are considered to be chemical weapons and prohibited under the Convention. However, the use of toxic chemicals for 'purposes not prohibited' would be acceptable only 'as long as the types and quantities [of toxic chemicals] are consistent with such purposes'.[15]

1.2.1 Application of the CWC to CNSAC weapons and ICA weapons

Neither CNSACs nor the broader category of ICAs are separately defined under the CWC, but are considered to be toxic chemicals and regulated accordingly. Development, acquisition, stockpiling, transfer or utilization of such toxic chemicals would be permissible only for 'purposes not prohibited', and only where the 'types and quantities' of such toxic chemicals were consistent with such purposes. Consequently, employment of CNSAC or ICA weapons in armed conflict is absolutely prohibited under the CWC. However, there have been differing interpretations if, and in what circumstances, such toxic chemicals could be employed for 'law enforcement' purposes.

In recent years, there have been concerted attempts by a growing number of States, led by Australia, Switzerland and the US, to encourage the Organisation for the Prohibition of Chemical Weapons (OPCW) to resolve the ambiguities concerning development and use of these weapons. Since 2019 discussions focused on whether use of aerosolised CNSACs for law enforcement purposes was permissible under the CWC.

On 1 December 2021, the 26th Conference of States Parties to the CWC (CSP–26) adopted an 'Understanding'––on the aerosolised use of CNSACs for law enforcement purposes, which 'Decided that the aerosolised use of CNS–acting chemicals is understood to be inconsistent with law enforcement purposes as a "purpose not prohibited" under the Convention'.[16] This CSP Decision did not introduce a new prohibition but rather clarified correct application of existing prohibitions and rules of the CWC. The Decision also noted that 'munitions and devices specifically designed to cause death or other harm' through the release of aerosolised CNS–acting chemicals would "constitute a 'chemical weapon"', and consequently should be declared and verifiably destroyed.

Whilst 85 States supported the Decision, 10 States—including China, Iran, and Russia—voted against it. On 29 November 2021, China, Iran, Russia, as well as the Assad Syrian regime issued a joint statement declaring their rejection of the Decision, which they considered to be 'an *ultra vires* act' that 'went beyond the powers and functions of the Policy–Making Organs of the OPCW', and 'so could not have any legal effect(s) on the States Parties' rights and obligations under the

[12] Meselson, M., and Robinson, J.P. eds. 1994. "Chemical Weapons Convention Bulletin: News, Background and Comment on Chemical and Biological Warfare Issues." *Quarterly Journal of the Harvard Sussex Program on CBW Armament and Arms Limitation,* no. 23, 2 March 1994, p.1.

[13] Meselson, M., and Robinson, J.P. (1994) op.cit., p.1.

[14] OPCW, CWC (1993) *op.cit.,* Article II.9 (d).

[15] OPCW, CWC (1993) *op.cit.* Article II.1 (a).

[16] OPCW, *Decision: Understanding Regarding the Aerosolised Use of Central Nervous System-Acting Chemicals for Law Enforcement Purposes*, 26th Conference of the States Parties, 1 December 2021 https://www.opcw.org/sites/default/files/documents/2021/12/c26dec10%28e%29.pdf (accessed 28 September 2026).

Convention'.[17] There are concerns that three of these States – China, Iran and Russia, and potentially others may still wish to develop and use such CNSAC weapons.

In addition to the contested nature of its adoption and legal status, aspects of the Decision are ambiguous. Although it addresses 'CNS acting chemicals', there is no definition of this phrase, nor an indication of the range of chemicals that would be covered by it. It is also limited in its scope—its prohibitions are specifically restricted to CNSACs. Consequently, any existing or future ICA law enforcement weapons that use ICAs that act on other core human physiological processes beyond the CNS would not be covered by this prohibition.

The Decision is further limited in the scope of the means of delivery addressed. It explicitly prohibits only aerosolised CNSAC weapons, excluding other delivery mechanisms such as CNSAC dart guns previously developed by Chinese companies and held by the Chinese military. The Decision further restricts application to 'munitions and devices specifically designed to cause death or other harm' and therefore the use of general–purpose munitions and delivery devices such as air blowers and aerosol delivery systems may not be covered. In summary, although this Decision is a significant advance in constraining weaponised use of CNSACs, its full implications will only become apparent as States Parties further clarify outstanding areas of ambiguity in the text and attempt to implement it. Consequently, the permissibility under the CWC of research, development, and use of law enforcement ICA weapons employing pharmaceutical chemicals, toxins, and bioregulators, is likely to remain unclear and contested.

2 Developments in Science and Technology

2.1 Assessing the Rate and Extent of Advances in the Life Sciences

In 2003 just when the first complete referenced sequence of human genome was declared, three analysts in the US published a paper titled *Biotechnology: Impact on Biowarfare and Biodefence*.[18] In this influential paper the authors argued that as the biotechnology revolution advanced those seeking novel biological weapons would be able to move from making modification of traditional agents to designing agents specifically targeted at critical points in physiological systems, and that the number of such potential targets would progressively increase as the biotechnology revolution progressed. Clearly, this argument would also apply to possible development of novel chemical weapons targeted at specific points in important physiological systems.

In 2008 Julian Perry Robinson illustrated the kinds of civil work that could be subject to such misuse arguing that 'if a new molecule is discovered that can exert novel disabling effect on the human body at low dosage, attempts at weaponization may well ensue. … Or if a hitherto unknown molecular pathway serving a process of life comes to be identified, chemical agents capable of interfering with that pathway might also be identifiable and then form the basis for a novel weapon.'[19]

[17] OPCW, Delegation of the Islamic Republic of Iran, Joint Statement on Behalf of 4 Delegations Delivered by the Delegation of the Islamic Republic of Iran at the 26th Session of the Conference of States Parties of the OPCW, December 2021. https://www.opcw.org/sites/default/files/documents/2021/11/Joint%20Statement%20on%20behalf%20of%204%20Delegations%20delivered%20by%20the%20Delegation%20of%20the%20Islamic%20Republic%20of%20Iran%20at%20the%2026th%20Session%20of%20the%20Conference%20of%20States%20Parties%20of%20the%20OPCW.pdf (accessed 28 September 2026).

[18] Petro, J.B. *et al* (2003) Biotechnology: Impact on Biological Warfare and Biodefence. *Biosecurity and Biodefense*, 1(3), 161 -168. https://doi.org/10.1089/153871303769201815

[19] Perry Robinson, J. (2008) Difficulties facing the Chemical Weapons Convention. *International Affairs*, 84(2), 223-239. P.227.

In 2025 we assessed how these kinds of developments were taking place in neuroscience and related sciences and technologies.[20] The rate of advances in neuroscience can be illustrated by the development of our understanding of the sleep/wake cycle and the cause of narcolepsy during this century.[21] Type 1 Narcolepsy is characterized by excessive daytime sleepiness and cataplexy - sudden weakness of muscles. The cause of the disease was not known until the discovery of the orexin neuropeptide just before the turn of the century. It quickly became clear that the loss of the group of neurons that produce orexin, almost certainly through a mistaken autoimmune action, caused the disease. A detailed report in 2025 stated. 'Therapeutically, the field is undergoing a fundamental shift. Traditional wake-promoting drugs and REM [Rapid Eye Movement] suppressants offered symptomatic relief without altering disease biology. Today, orexin receptor agonists such as danavorexton and ALKS 2680 show promise as mechanism-based therapies, restoring receptor function independent of endogenous orexin production'.[22]

Recent research has shown that it is possible to separate the neuronal circuits that cause sleepiness from those that cause cataplexy,[23] and it is clear that the orexin system is linked to many other systems in the brain which may open up possibilities for treatment of other diseases.[24] Yet we know that malign manipulation of such processes produced what Leitenberg and Zilinskas, in their monumental study, characterised as the 'most advances and frightening research' of the later stages of the 20th Century Soviet bioweapons programme.[25] In this work it was demonstrated that genetic modification of a bacteria to produce myelin (that acts as a sheath for nerve axons) could cause an autoimmune attack in an infected mammal's nervous system – 'an artificial version of multiple sclerosis'. The question then is how can the rate of developments in neuroscience that might potentially be subject to misuse be assessed? One set of estimates about what might be understood within various time periods was made by a prominent neuroscientist in 2015.[26] His estimate for what might be possible within 50 years included '[W]hat causes psychiatric and neurological illnesses?' and '[H]ow do learning and memory work?'

Clearly, some of such knowledge might possibly be subject to misuse, and now it is probable that some of these developments might be achieved sooner than it appeared likely a decade ago. For example, given the application of modern technologies by medical scientists investigating the biological basis of mental illnesses, the causes of certain diseases are likely to become much better clarified.[27] However, what struck us most in the literature we have seen since 2025 is the sheer number of novel neuropeptides, psychedelics and potential autoimmune diseases being discussed in the open literature. It is to these issues and their potential implications that we turn.

[20] Crowley, M. and Dando, M. (2025)op. cit., (Chapter 3, pp. 87 – 120; Chapter 4, pp. 121 – 157; and Chapter 5, pp. 158 - 224).

[21] Crowley, M. and Dando, M. (2025) *op. cit.* (Pp 105 -109).

[22] Rauf, R, *et al* (2025) Orexin Deficiency in Narcolepsy: Molecular Mechanisms, Clinical Phenotypes, and Emerging Therapeutic Frontiers. *Brain Behav*.15(10):e70984 (page 13) https://doi.org/10.1002/brb3.70984.; See also Kingwell,K. (2026) Orexin receptor agonist secures landmark narcolepsy approval: Takeda's overporexton (Orezeyful) becomes the first-in-class treatment for narcolepsy type 1, industry eyes broader indications for orexin receptor agonists. *Nature Reviews Drug Discovery*, 10 August. https://www.nature.com/articles/d41573-026-00135-0.

[23] Ishikawa,T. *et al* (2025) An orexin agonist promotes wakefulness and inhibits cataplexy through distinct brain regions. *Curr Biol*. 35, 2088-2099. https://doi.org/10.1016/j.cub.2025.03.040.

[24] Thannickal, T. C. et al (2026) Human narcolepsy is linked to degeneration of both locus coeruleus and hypocretin neurons. *Nature Communications*,17:4978. https://doi.org/10.1038/s41467-026-70899-x.

[25] Leitenberg, M and Zilinskas, R. (2012) *The Soviet Biological Weapons Program: A History*. Harvard University Press, Cambridge, Mass. (P. 194).

[26] Adolphs, R. (2015) The unsolved problems of neuroscience. *Trends Cogn Sci.,* 19(4), 173 - 175. https://doi.org/10.1016/j.tics.2015.01.007.

[27] Hyman, S. (2023) The Biology of Mental Disorders: Progress at Last. *Daedalus*, 152(4), 186-211. https://doi.org/10.1162/daed_a_02038; Yoon, J. H. *et al* (2024) Paradigm shift required for translational research on the brain. *Experimental and Molecular Medicine*, 56:1043 – 1054. https://doi.org/10.1038/s12276-024-01218-x.

2.2 Neuropeptides

A peptide is defined as[28] 'a chemical compound consisting of two or more linked amino acids', and a neuropeptide is a peptide produced by a neuron. Although neuropeptides can be co-released at synapses with classical neurotransmitters (such as acetyl choline) they are formed and released in a different process in which they are derived from precursor proteins.[29] These precursors can be subject to processing in the neuron to different neuropeptides and fractions of specific neuropeptides (such as CCK-4[30]) that have different functions. Moreover, similar peptides can be produced by non-neural cells in the body and act as hormones.Peptides are important elements in the control of physiology and behaviour. They differ from classical neurotransmitters as they are not taken up by reuptake pumps and therefore can drift into the extracellular space, remaining active for longer and over greater areas than just within the synapse. So, they are capable of major bioregulatory functions through modulating of entire networks of neurons.[31]

In 2025 we compared what was known about neuropeptides and the available investigative technologies in 2000 with what was known in 2025.[32] The essential point was made, for example, in a 2017 review that stated that:[33] *'[*A] little appreciated fact is that over the past several decades, *the number of known neuropeptides in the human brain has grown to over 100 distinct molecules*' (emphasis added). And it continued '[A]n internet resource of data on all known neuropeptides expressed in the human brain has been compiled by the Human Genome Organisation Gene Nomenclature Committee… which has been further annotated by another database [NeuroPep].' The review went on to note that the functions of many peptides (including neuropeptides) in human health and disease 'remains to be uncovered [but] the strong evolutionary conservation of peptides and their receptors, argues that this cast… may play important undiscovered roles.'

It is important now to consider the number of neuropeptides listed in the NeuroPep database.[34] NeuroPep 2.0 was reviewed in an article published in 2024.[35] This review noted that '[*C]urrently, NeuroPep has been updated to version 2.0. It now holds 11,417 unique neuropeptide entries, which is nearly double the first version of NeuoPep.* When available, we collected information about the receptor for each neuropeptide entry and predicted the 3D structures of those neuropeptides without known experimental structure using AlphaFold2 or APPTEST according to the peptide sequence length' (emphasis added). Neuropeptides are found in many species, including humans. But as the review points out '[D]espite the fact that neuropeptides are found in five phyla… the majority (94.7%) are found in Chordata. *It is to be noted that neuropeptides of human are distributed in 49 families [of neuropeptide types], among which 37 have receptor annotation information. There are 462 neuropeptide-receptor pairs between 225 neuropeptides and 108 receptors in human'* (emphasis added).

Not surprisingly, the review points out that in 2024 there were 'over 80 FDA approved peptide drugs… among which near 75% were developed based on different neuropeptides', and ends with an extensive discussion of clinical applications of current neuropeptide-based drug development.

[28] Soanes, C. and Hawker, S. (2008) *Compact Oxford English Dictionary*, Oxford University Press, Oxford.

[29] Russo, A.F. (2017) Overview of neuropeptides: awakening the senses? *Headache*, 57 (Suppl 2), 37 – 46. https://doi.org/10.1111/head.13084. (Page 3).

[30] For a discussion of CCK-4 and panic attacks see Crowley, M. and Dando, M. (2025) *op. cit.* (Pp. 43 and 111-112).

[31] Guillaimin, M. C. C. and Burdakov, D. (2021) Neuropeptides as Primary Mediators of Brain Circuit Connectivity. *Frontiers in Neuroscience*. 15:644313. https://doi.org/10.3389/fnins.2021.644313.

[32] Crowley, M. and Dando, M. (2025) *op. cit.* (Pp. 93 -103).

[33] Russo, A.F. (2017) *op. cit.* (P.2).

[34] Wang, Y. et al (2015) NeuroPep: a comprehensive resource of neuropeptides. *Database: The Journal of Biological Databases and Curation*, 2015, 1- 9. Doi: 1093/database/bav038.

[35] Wang, M. *et al* (2024) NeuroPep 2.0: an Updated Database Dedicated to Neuropeptide and its Receptor annotations. *Journal of Molecular Biology* 436:168416. Doi: 10.1016/j.jmb.2023.168416. (P.1, 2, 1-2).

It seems highly likely that such developments will continue apace as the roles of different neuropeptides are elucidated.

2.3 Psychedelics

There has been a major resurgence of research on psychedelic drugs during this century.[36] This kind of research had basically come to a halt decades ago when an attempt was made to ban the use of these drugs for leisure and social purposes by imposing strict legal restrictions. This did not stop illegal social use but did bring medical research to a grinding halt. In the meantime, a great deal had been learnt about the operations of the CNS and, in particular, about the large-scale neuronal networks that could be detected using modern techniques such as magnetic resonance imaging (MRI). The psychedelics have been found to directly and indirectly affect Serotonin (5-hydroxytryptamine) 2A receptors in the brain and thus to significantly disrupt the operations of the large-scale networks of the brain and particularly the Default Mode Network (DMN) which is characteristic of the resting state. The disruption of these networks appears to help reset the brain when it is, for example in a depressed state, and may also facilitate the growth of new neurons. Clearly this impact and its potential use to help people suffering from mental illnesses is of great interest to medical scientists and practitioners in countries around the world, for example in Russia[37] and China[38] and India[39] as well as in Western Europe[40] and the USA.[41]

However, these studies have been carried out by different groups in different countries and inevitably there is some variation in the results achieved. A mega-analysis of such studies was published in *Nature Medicine* in April 2026. The authors investigated[42] '11 independent resting-state functional magnetic resonance imaging datasets across five psychedelic drugs (psilocybin, lysergic acid diethylamide, mescaline, *N*,*N*-dimethyltryptamine and ayahuasca) from research groups spanning three continents and five countries'. They concluded that there were similar patterns of effects in these studies: '[M]ost prominently, we identified a core signature of increased functional connectivity between transmodal (default, frontoparietal and limbic) and unimodal networks (visual and somatomotor), with subnetwork specificity. Furthermore, key subcortical regions (thalamus, caudate and putamen) and the cerebellum exhibited altered coupling with sensorimotor networks.'

The scientific analysis of such changes was also reviewed in *Nature Medicine* in early 2026.[43] The authors argued that study of psychedelics has been transformed 'from a niche curiosity into a prominent frontier in translational neuroscience'.

[36] Crowley, M. and Dando, M. (2025) *op.cit.* (Pp.121 – 127).

[37] Asadullin, A.R. *et al* (2026) New Psychoactive Substances (Designer Drugs): An Approach to Classification. *Neurology Bulletin*, 58(1), 94 – 108. DOI:10.17816/nb689708 END: VGTQDK.

[38] Xu, Z. *et al* (2026) Psychedelics elicit their effects by 5-HT_{2A} receptor-mediated G_i signalling. *Nature*, 651, 829 – 837. https://doi.org/10.1038/s4158/6-025-10061-7.

[39] Tiwari, P. *et al* (2024) Ventral hippocampal parvalbumin interneurons gate the acute anxiolytic action of the serotonergic psychedelic DOI. *Neuron*, 112, 3697 – 3714. https://doi.org/10.1016/j.neuron.2024.08.016.

[40] Vollebregt, R. *et al* (2026) Psychedelic experiences elicited by serotonin psychedelics; Molecular mechanisms and functional changes in the brain. *Neuroscience and Biobehavioural Reviews*, 181, 106529. https://doi.org/10.1016/j.neubiorev.2025.106529.

[41] Hatzipantelis, C. J. and Olson, D. E. (2024) The effects of psychedelics on neuronal physiology. *Annu Rev Physiol*, 86, 27 – 47. https://doi.org/10.1146/annurev-physiol-042022-020923.

[42] Grin, M. *et al* (2026) An international mega-analysis of psychedelic drug effects on brain circuit function. *Nature Medicine*, 32, 1543 – 1554. (p.1543). https://doi.org/10.1038/s41591-026-04287-9.

[43] Siegel, J. S. *et al* (2026) The science of psychedelic medicine. *Nature Medicine*, **32**, 449 – 462. (p.449). https://doi.org/10.1038/s41591-025-04194-5.

Partly this has resulted, in their view, from the numerous positive clinical trials and a developing international infrastructure, but crucially, from our point of view, also from 'investment from both established pharmaceutical companies and a new generation of biotech innovators [that] has accelerated discovery of novel analogues, formulations and digital tools for psychedelic-assisted therapy'. They went on to give some startling numbers related to the growth of novel psychedelic compounds, stating that[44] '[T]here are at least six naturally occurring serotonergic psychedelic compounds, more than 100 psychedelic compounds currently under development by pharmaceutical companies and many additional synthetic compounds with documented psychedelic or hallucinogenic effects in humans'. Furthermore, 'AI-based tools for drug discovery (i.e., AlphaFold2) suggest that *the number of unique molecules with psychedelic 5-HT$_{2A}$ agonism could be over 100,000. These compounds may differ not only in the profile of receptors that are co-activated, but also in the ways in which the 5-HT$_{2A}$ itself is engaged and activated'* (emphasis added). They conclude: '[T]he number of possible combinations between drug, dosing protocol and medical indication are limitless'.

What is of particular importance to stress is the growing involvement of commercial interests in the discovery and production of novel psychedelic chemicals,[45] in short, the rapid development of a psychedelic industry. In summary, a 2023 review noted that[46] '[H]undreds of psychedelic-focused pharmaceutical and biotech companies have formed in the past 5 years, and psychedelics are now considered a multibillion-dollar industry with exceptional growth projections over the next decade'. In 2021, 'venture capital investment in psychedelic startups reached $2 billion'. More recently, major pharmaceutical companies, for example in Denmark and Japan became involved, and the review notes that '[A]s of May 4 2023, there were 49 publicly traded psychedelic biotech companies and 44 private companies.'

A probable indicator of future developments came in an announcement by Eli Lilly, the world's largest pharmaceutical company, that it was to acquire AtaiBeckley, a developer of 5-MeO-DMT, for up to $3.8 billion.[47] 5- MeO-DMT (5-methoxy-N,N-dimethyltryptamine) is described as[48] 'a fast-acting tryptamine that can induce an immediate (within seconds) and intense psychedelic experience of short duration (10–20 min)'. It has 'high binding affinities for the 5-HT1A and 5-HT2A receptors but appears to be more selective for 5-HT1A'. And, importantly '*[O]bservational studies and surveys have suggested that single administrations of 5-MeO-DMT, like other tryptamines, could be employed to induce durable treatment of mental health disorders such as depression, anxiety, PTSD, and substance misuse*'(emphasis added). Eli Lilly is not the only company interested in bringing this psychedelic to market for medical purposes, and there is also intense interest in the effects of the drug by research scientists analysing the nature of consciousness.[49] So, we can confidently expect much further work on just this one psychedelic drug and its effects.

[44] Siegel, J. S. *et al* (2026) *op. cit.* (P.455).

[45] Yoo, M. and Sakopoulos, S. (2024) The Birth of the Psychedelic Industry; Capitalisation on the Psychedelic Renaissance. *Future Humanities*, 2025; 3:e70004. https://doi.org/10.1002/fhu2.70004.

[46] Aday, J. S. *et al* (2023) Psychedelic Commercialization: A Wide-Spanning Overview of the Emerging Psychedelic Industry. *Psychedelic Medicine*, 1(3), 150 – 165. https://doi.org/10.1089/psymed.2023.0013. (Pp. 151, 152, 153).

[47] See, Breaking News: World's Largest Pharmaceutical Company, Eli Lilly, Acquires 5-MeO-DMT Developer AtaiBeckley for up to $3.8 billion. *Psychedelic Alpha Insights*, 16 July 2026; Eli Lilly (2026) Lilly to acquire AtaiBeckley to advance therapies for treatment-resistant depression and other mental health conditions. *Eli Lilly News*, July 16, 06:45ET.

[48] Reckweg, J.T., *et al* (2022) The clinical pharmacology and potential therapeutical applications of 5-methoxy-N,N-dimethyltryptamine (5-MeO-DMT). *Journal of Neurochemistry*, 162, 128 – 146. https://doi.org/10.1111/jnc.15587. (P.140).

[49] Timmermann, C. *et al* (2025) Exploring 5-MeO-DMT as a pharmacological model for deconstructed consciousness. Neuroscience of Consciousness, 1, miaf007. https://doi.org/10.1093/nc/niaf007.

2.4 Autoimmune Diseases

An autoimmune disease can be understood as a condition where the immune system mistakenly attacks the healthy body cells instead of protecting them from attack by foreign entities. By 2025 there were thought to be at least 80 autoimmune diseases of humans, and that these affect different physiological systems including many that affect the nervous system.[50] For example, three autoimmune diseases of the nervous system have a prevalence of between 1 in 1,000 to 1 in 10,000 people: multiple sclerosis, narcolepsy and *myasthenia gravis*. Multiple sclerosis involves intermittent debilitating attacks by autoimmune antibodies on the myelin sheaths of the nerves, narcolepsy involves an autoimmune destruction of the orexin producing neurons of the CNS, and *myasthenia gravis* involves an autoimmune disruption of the acetyl choline receptors at the junction of the motor neurons and the muscles of the body.

There are indications in the literature of an increasing medical interest in immunopsychiatry - notably regarding disruptions of complex higher order functions of the CNS through malfunctions of the immune system,[51] such as autoimmune encephalitis and, in particular, anti-N-methyl-D-aspartate (NMDA) receptor encephalitis in which an ovarian teratoma can contain neural tissue that provokes an autoimmune immune response and mistaken attacks on the cells of the CNS. If this response is not treated it can then lead to complex psychiatric disorders as the operations of the CNS are progressively disrupted, and it is suggested that it is likely that such causes could underly other complex mental diseases and degenerations. It is difficult to assess the overall societal impact of autoimmune disease because, for example, there is no consensus about the definitions of some of these diseases, individually they are rare and diverse in their presentation, and methodologies for their assay are rapidly evolving. Nevertheless, a major review in 2023 concluded that[52] '[A]utoimmune diseases have a major impact… on our society and healthcare costs, and *current projections suggest that they many soon take their place amongst the predominant medical disorders*' (emphasis added).

In such circumstances there will likely be an increasing amount of research on autoimmune disease that affect the CNS. Thus, the US National Institutes of Health announced in June 2026 that there would be funding opportunities until February 2028 for research on *Advancing Autoimmune Disease Research; Integrating Genetic, Environmental, and Immunological Factors to Improve Diagnosis and Treatment.* Under this topic the National Institute of Mental Health (NIMH) stated[53] that it was 'interested in supporting research aimed at advancing the understanding of the relationship between autoimmune processes and mental disorders' and specifically in 'research of the targets and downstream process in the CNS impacted by autoantibodies and … co-occurrence of autoimmune and mental disorders.'

From our point of view, it is most important to get an insight into where this ongoing research might lead to in regard to the potential targets that might be revealed for malign misuse in the future. A review in 2024 suggested that the research on antibodies in neurological disease could best be understood by dividing it into three categories: established, emerging and explorative.[54]

[50] Crowley, M. and Dando, M. (2025) *op.cit.* (Pp.128 – 146).

[51] Teixeira, A. I. and Bauer, M. E. (Eds.) (2019) *Immunopsychiatry: A Clinician's introduction to the Immune Basis of Mental Disorders.* Oxford University Press, Oxford; Khandaker, G. et al (Eds.) (2021) *Textbook of Immunopsychiatry*. Cambridge University, Cambridge.

[52] Miller, F. W. (2022) The increasing prevalence of autoimmunity and autoimmune diseases: an urgent call to action for improved understanding, diagnosis, treatment and prevention. *Current Opinion in Immunology*, 80:102266. https://doi.org/10.1016/j.coi.2022.102266. (P.1).

[53] United States National Institutes of Health (2026) Advancing Autoimmune Disease Research; Integrating Genetic, Environmental, and Immunological Factors to Improve Diagnosis and Treatment. Grants and Funding. Website (accessed 29 August, 2026). National Institute of Mental Health (NIMH) section p.12.

[54] Li, L. Y. *et al* (2024) Antibodies in neurological diseases: Established, Emerging, Explorative. Invited Review, *Immunological Reviews*, 2024:328:283-299. https://doi.org/10.1111/imr.13405. (Pp. 283 – 284 and 294).

In regard to the *established group* of diseases (such as NMDR encephalitis) they state that '[F]or this group… it has become clear that they cause disease directly'. Then, they note that '[T]he current focus of the field has been shifting towards the group of *emerging* neurological autoantibodies. In some patients of this group with autoimmune dementia or autoimmune psychosis, autoantibodies were associated with clinical improvement after immunotherapy; however, the detailed mechanisms and underlying antigenic targets await experimental confirmation.' Finally, in regard to the third group they state that '[Most] interestingly, evidence has been emerging that autoantibodies could even play a role in clinical constellations not previously thought to be autoimmune-mediated. Autoantibodies in this third *explorative* group of patients with stroke, neurodegenerative diseases, or cancer-associated cognitive impairment, but also in normal brain aging, may play an important additive, modulating role on brain function' (emphases added).These authors draw an important conclusion on the number of potential elements involved: '[F]uture concepts will likely shift the focus from individual autoantibodies to the "brain antibody-ome", where the composition of *thousands of anti-neuronal autoantibodies* shapes neuronal function and homeostasis, neurodegeneration, but also healthy aging' (emphasis added). That may be the direction of travel and eventual result of such research. However, even if we are cautious about such conclusions, what we can be sure about is that medical scientists and clinicians seeking biologically-based explanations are finding ways of using advances in neuroscience to determine the role of autoimmune processes in complex mental disorders.[55]

2.5 The Impact of AI on Advances in Neuroscience

Advances in artificial intelligence (AI) and machine learning (ML) are transforming neuroscience,[56] while raising concerns about misuse in agent discovery and development.[57] Anthropic's report, *Detecting and countering misuse of AI: September 2026,* describes operations involving attempted malicious use of Claude that the company disrupted between December 2025 and August 2026.[58] Covering seven harm areas, the report identifies suspected state-sponsored groups and politically motivated individuals among the actors involved. Anthropic presents these disclosures as a means of helping developers recognise misuse, informing governments and civil society, and strengthening collective defences.

Two of the cases described under "Biological misuse" concern work on toxins and therefore come under the purview of the Chemical Weapons Convention, as well as the Biological and Toxin Weapons Convention. In the authors' fourth case study *'a researcher used Claude to develop an atlas of venom toxin peptides from multiple venomous animal lineages. They then further developed this into a generative pipeline that optimized toxin characteristics'* (emphasis added). Moreover, 'the atlas contained scaffolds for both analgesic and *paralytic* targets: it could, therefore, be used to generate both novel therapeutic or harmful compounds. The latter are derived from toxins that are export-controlled under the Australia Group common control list due to their *dual-use potential as incapacitating agents*. The researchers themselves showed awareness of the dual-use nature of their work, citing journal articles that referred to the dual-use nature of protein design' (emphasis added). Finally, the authors note that 'In this case, we learned from information shared with Claude that the researcher's outputs also were part of a state-supported research program'. The company therefore closed the account.

[55] See, for example, Sforzini, L. and Pariante, C. M. (2025) The Clinical Relevance of Immunopsychiatric Treatment: Lessons from a Transdiagnostic Case Series on Young People. *Biological Psychiatry: Global Open Science* November 2025; 5:100600, https://doi.org/10.1016/j.bpsgos.2025.100600 ; Chen, X. and Li, H-F (2023) A narrative review of identifying the culprit antibody in neuroimmune diseases: concept and clinical significance. *Ann Transl Med* 2023;11(7):279 https://dx.doi.org/10.21037/atm-21-1627.

[56] Onciul, R. *et al* (2025) Artificial Intelligence and Neuroscience: Transformative synergies in Brain Research and Clinical Applications. *J. Clin. Med*.14, 550. https://doi.org/10.3390/jcm14020550.

[57] Crowley, M. and Dando, M. (2025) *op. cit.* (P.158 -173).

[58] Anthropic (2026) *Detecting and countering misuse of AI: September 2026*. Published 10th September. (Pp. 3, 136 -137).

In the fifth case study 'a researcher *used Claude in several research projects that involved the computational redesign of a diverse set of toxins.* With analogies to the prior case, the research projects used many of the same technical tools, framed targets in a largely therapeutic context, and described state priority research under a national public research program' (emphasis added). However, '[A]s a part of this research assignment, the work covered a bacterial toxin subunit and a protein of the hemorrhagic-fever virus that is on the World Health Organization R&D Blueprint priority list of diseases with the greatest epidemic and pandemic threat'. And the report states also that: '[T]he researcher co-wrote quarterly progress reports with Claude. *Notably, the identity of the bacterial toxin and viral proteins were intentionally obscured, and the researcher specifically directed Claude to keep these descriptions deliberately low fidelity*' (emphasis added). Consequently, the accounts were also closed.

Of course, it is necessary to stress that building an effective weapon is many steps away from the discovery or development of an agent,[59] but these examples again demonstrate the large numbers of possibilities for malign misuse that could come from mechanistic understanding of the mode of operation of toxins and venoms.[60] Moreover, in line with the developments described above there are many more different types of relevant toxins being discovered and developed.[61]

3 Allegations Made by CWC States of Development, Transfer and Use of CNSAC Weapons Undertaken by Another CWC State Party

3.1 Introduction

Since the CWC came into force certain CWC States Parties have alleged that other CWC States Parties had undertaken research and development, transfer and/or use of CNSAC or other types of ICA weapons. These State allegations can be differentiated into two broad categories: Firstly, there are allegations, principally by the US, that China, Iran and Russia have conducted such activities. As summarised below, such allegations are normally documented in annual US assessment reports of State compliance with the CWC, and have also been included in high-level US statements to the UN and/or to meetings of the OPCW. In addition to the allegations themselves, US CWC Compliance Reports document actions the US has taken to address its concerns, including attempted bilateral engagement with States concerned. The second series of allegations has been made by Russia against the US and other 'Western' countries. The allegations are normally broad in nature and contain little supporting evidence, that if present, is of a dubious nature.

3.2 Allegations by the US

3.2.1 Alleged Chinese Research of CNS-acting Chemical Agent Weapons

In its 2019–2022 US CWC Compliance Reports, the US stated that: '[S]cientists at a Chinese military institute have expressed interest in military applications of PBAs [Pharmaceutical Based Agents] and are engaged in research involving the synthesis, characterization, and testing of PBAs with potential dual-use applications'.[62]

[59] Ben Ouagrham-Gormley, S. (2026) Rethinking the De-skilling Narrative in AI and Biological Weapons Policy. *Georgetown Journal of International Affairs*, Georgetown University, Washington D.C., August 27.

[60] Chapter 2 Dual-Use Chemical and Life Science Research of Potential Concern in Crowley, M. and Dando, M. (2022) op. cit. (Pp. 25 -46).

[61] See, for example, the great increase in our understanding of botulinum toxins in recent years as described in Chapter 2 "Dual-Use Chemical and Life Science Research of Potential Concern" in Crowley, M. and Dando, M. (2022) op. cit. (Pp. 32 - 35).

[62] See for example, United States, Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and on Their Destruction, April 2022, pp. 10–11.

In its 2022 CWC Compliance Report the US further stated: '[R]einforcing these concerns, during the November 2021 CSP, the [People's Republic of China] PRC submitted a joint statement with Iran, Russia, and Syria making clear its objections to the decision adopted by the Conference on the aerosolized use of CNS-acting chemicals. In the statement, the co-signatories stated that, '[A]rticle II, paragraphs 1(a) and 9(d) of the Convention permits the use of toxic chemicals for law enforcement including domestic riot control purposes' as long as types and quantities are consistent with such purposes. Therefore, the Convention allows States Parties to choose their own method of law enforcement in full conformity with the provisions of the Convention including the General Purpose Criterion (GPC).'[63]

In its 2024 CWC Compliance Report the US stated that '[D]uring the November 2023 CSP, in bilateral discussions with the PRC, the United States reiterated its concerns about the PRC's potential development of aerosolized fentanyl. In response to U.S. concerns, the PRC reiterated that it does not use fentanyl for law enforcement purposes'.[64] To date, it appears that the US has not attempted to initiate the formal multilateral consultation, cooperation, and fact-finding mechanisms under the CWC to raise and resolve these issues.

3.2.2 Alleged Iranian Research and Development of CNSAC Weapons

In its 2019–2023 CWC Compliance Reports, the US stated that since 2005, some of Iran's military-controlled facilities, notably Imam Hossein University (IHU) and Malek Ashtar University (MUT), have researched chemicals that have a wide range of sedation, dissociation, and amnestic incapacitating effects. According to the US, published Iranian papers cited the potential weapons applications of the PBAs; one specifically referenced the use of fentanyl during the 2002 Dubrovka theatre hostage crisis. According to the US, in 2014, the IHU chemistry department sought 'kilogram quantities of medetomidine—a sedative it has researched as an incapacitant—from Chinese exporters'.[65] According to the US, the IHU chemistry department has 'little history of veterinary or even medical research', and the quantities sought (over 10 000 effective doses) were 'inconsistent with the reported end use of research'.[66]

In its 2024 CWC Compliance Report, the US stated

> Most recently on September 23, 2023, an X (formerly Twitter) account representing Lab Dookhtegan – whose members claim to be a hacker organization in opposition to Iranian state-sponsored cyber actors — posted confidential documents detailing an Iranian military university's development of grenades meant to disseminate medetomidine, an anesthetic that is a central nervous system-acting chemical. According to the documents, this development included information on the production and testing of prototype weapons.[67]

On 3 December 2020, the US introduced sanctions against the Iranian company, Shahid Meisami Group (SMG) and its director, under Executive Order 13382 [Blocking Property of Weapons of Mass Destruction Proliferators and Their Supporters].[68]

63 United States (April 2022) op.cit., p. 11.

64 United States, Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and on Their Destruction, April 2024

65 See for example: US, *CWC Compliance Report*, (April 2022) op.cit., p. 15.

66 Ibid..

67 United States, (April 2024).op.cit.

68 United States, (April 2022) op.cit., p. 15; See also: G. Bush, US Executive Order 13382, *Blocking Property of Weapons of Mass Destruction Proliferators and Their Supporters*, 28 June 2005.

The US accused SMG of responsibility for projects 'involving the testing and production of chemical agents for use as so-called incapacitation agents'.[69] The US further highlighted that it was 'concerned about the [Iranian] regime's true intent with regard to the testing and production of these so-called chemical incapacitation agents, which could be used either to further oppress Iranian citizens or for offensive purposes'.[70] And stated in its 2023 Compliance Report that it 'will continue to work to shed light on Iran's activities, including by highlighting the recently adopted CSP decision [on aerosolization of CNS-acting chemicals]'. It further noted that '[T]he last CWC compliance-related bilateral exchanges occurred in 2001 and 2004, on the margins of OPCW EC [Executive Council] meetings, but discussions did not resolve any of the issues raised by the United States'.[71]

The US has raised these concerns during meetings of the OPCW, including at the 105th Session of the Executive Council in March 2024 when it stated that Iran had developed and filled weapons with pharmaceutical-based agents after acceding to the CWC, in violation of its obligations. It cited documents published by a hacker organisation in September 2023 describing medetomidine weaponisation, which it considered corroboration of its earlier concerns, and called on Iran to end its chemical weapons programme.[72] To date, it appears the US has not attempted to initiate the formal multilateral consultation, investigation, and fact-finding mechanisms under the CWC to raise and resolve these issues.

3.2.3 Russia: Acknowledged Use of CNSAC Weapons and Alleged Research and Development

Russian and international media documented extensively the Russian security force's use of a CNSAC weapon to end the Moscow theatre siege. On 30th October 2002 the Russian Health Minister, Yuri Shevchenko, identified the incapacitating agent as 'a mixture of derivative substances of the fast action opiate Fentanyl'.[73] Mr Shevchenko further stated that: '[I] officially declare: chemical substances which might have fallen under the jurisdiction of the international convention on banning chemical weapons were not used during the special operation'.[74]

Although Russia refused to fully identify the CNSACs employed, analysis by the UK's Defence Science and Technology Laboratory (DSTL) indicated that the weapon comprised two analgesic-anaesthetics, carfentanil and remifentanil.[75] The DSTL authors also highlighted Russian research, asserting that '[S]cientific papers published by Russian military officers indicate an interest in

[69] United States, Sanctions on Iranian Entities Involved in Chemical Weapons Activities of Concern, press statement, US Department of State, 3 December 2020.

[70] US, US Department of State (2020) op.cit.

[71] United States, Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and on Their Destruction, April 2023, p.12.

[72] United States, *Statement by Ms. Laura Gross, US Representative to the OPCW*. 105th Session of the Executive Council, OPCW, The Hague, 1 March 2024.

[73] ITAR-TASS, from Moscow in English, 2112 hrs GMT 30th October 2002, as in FBIS-SOV-2002-1030; 'Russian experts discuss use of Fentanyl in hostage crisis,' as cited by Perry Robinson, J. (2007) *Non lethal warfare and the Chemical Weapons Convention*, Further HSP submission to the OPCW Open-Ended Working Group on Preparations for the Second CWC Review Conference, 24th October 2002.

[74] Alison, S. [from Moscow for Reuters], 1257 hrs ET 30th October 2002, 'Russian confirms siege gas based on opiate fentanyl', as cited in Perry Robinson, J. (2007) *Disabling Chemical Weapons, A Documented Chronology of Events 1945-2011*, 20th November 2012 (copy circulated to author).

[75] Riches, J. *et al.* (2012) Analysis of Clothing and Urine from Moscow Theatre Siege Casualties Reveals Carfentanil and Remifentanil Use', *J. Anal. Toxicol.,* 36(9), 647–656.

fentanyls extending back 12 years: opioid receptor studies,[76,77] fentanyl analysis[78] and synthesis of fentanyl precursors'.[79,80] To date, Russia has provided no public information as to whether stockpiles of weaponised CNSACs are currently held by Russian authorities, nor whether research into development and employment of such weapons is taking place, and if so, for what purposes.

The US has repeatedly raised its concerns with Russian CNSAC activities including in its CWC Compliance Reports from 2018–2024. In its 2022 CWC Compliance Report, the US stated:

> [T]he United States is … concerned that Russia has a pharmaceutical based agent (PBA) program intended for purposes inconsistent with the CWC. Russian Health Minister Shevchenko acknowledged to the press that Russian special operations employed 'derivatives of fentanyl' to resolve the October 2002 Dubrovka theater hostage crisis. The United States is concerned that Russia is pursuing these types of agents for offensive purposes, which would be a violation of Article I. According to a non-paper Russia published at the OPCW in November 2018, entitled, *Aerosolisation of Central Nervous System-Acting Chemicals for Law Enforcement Purposes*, Russia believes use of these agents 'is not regulated under the [Chemical Weapons] Convention.'[81]

In its 2022 CWC Compliance Report, the US described its attempts to address these issues including its leadership of:

> a successful effort at the OPCW that in 2021 resulted in the adoption of a CSP decision affirming the understanding that 'the aerosolized use of CNS-acting chemicals is understood to be inconsistent with law enforcement purposes' as a 'purpose not prohibited' under the Convention'. The United States has long had concerns about Russia's activities related to PBAs and will continue to work to shed light on these activities, including through highlighting the CSP decision.[82]

To date, it appears that no States, including the US, that have publicly voiced concerns regarding Russian CNSAC weapons, have attempted to initiate formal multilateral consultation, investigation, and fact-finding mechanisms under the CWC to raise and resolve these issues.

3.3 Russian allegations of 'Western' Transfer of CNSAC to Ukrainian Forces

Russian defence and security officials have repeatedly alleged that Ukraine has been supplied with CNSAC weapons by the US or other Western States and that Ukraine had used such weapons.

On 4 March 2024 the Russian News Agency (TASS) reported a statement by the Russian Security Service that 'a terrorist attack plotted by Ukrainian security services involving the use of an analogue of the BZ chemical warfare agent in Zaporozhye Region had been prevented. Criminal proceedings were launched and three Ukrainian citizens detained. The seized chemicals are used to create weapons of mass destruction. All were developed in the United States'.[83]

[76] Kuzmina, N. and Kuzmin, V. (2011) Development of concepts on the interaction of drugs with opioid receptors, *Russ. Chem. Rev*., 80, 145–169.

[77] Dukhovich, F., *et al.* (2005) The agonist paradox: Agonists and antagonists of acetylcholine receptors and opioid receptors, *Chem. Biodiversity*, 2, 354–366.

[78] Zlobin, V. *et al.* (2000) Analysis of opiates by HPLC with indirect spectrophotometric detection, *Pharm. Chem. J.,* 34, 279–280.

[79] Panfilov, A. *et al*. (2000) Sodium borohydride in reductive amination reactions, *Pharm. Chem. J*., 34, 76–78.

[80] Panfilov, A. (2000) Reactions of sodium borohydride in acetic acid: Reductive amination of carbonyl compounds, *Pharm. Chem. J*., 34, 371–373.

[81] US (April 2022) op.cit., p. 17.

[82] US (April 2022) op.cit., p. 22.

[83] TASS, Components of chemical agent close to BZ found in Zaporozhye Region — Russian military, 4 March 2024, https://tass.com/politics/1755117 (accessed 5 October 2026).

The TASS report cites and clips an interview by Lieutenant General Igor Kirillov, then-chief of Russia's radiation, chemical and biological protection forces, for Russian TV channel Rossiya-24, in which he claimed that '[W]hat has now been discovered is a substance close to BZ, a poisonous blacklisted substance. Some precursors that are used in its manufacture were seized, too. This poison was created at Edgewood Arsenal in the United States'.[84]

According to TASS, on 19 February 2024, Kirillov said that 'a toxic chemical similar to BZ, included in Schedule 2 of the Chemical Weapons Convention, had been used against Russian servicemen on August 19, 2022. A similar substance, he said, was found on January 28, 2024 during a detection and search operation in a cache in Melitopol'.[85] On 8 July 2024 TASS further reported that Kirillov claimed '[W]ith the connivance of Western countries, Ukraine does not limit itself to using non-lethal chemical agents, and actively employs listed chemicals such as BZ, prussic acid [hydrogen cyanide], and chlorine cyanide [cyanogen chloride]'.[86]

On 8 July 2024, Russia requested circulation to CWC States Parties of materials alleging Ukrainian chemical weapons activities.[87] These included Kirillov's briefing of 23 February 2023, which alleged the clandestine transfer of BZ to Ukrainian forces, implicitly attributing responsibility to the US. Kirillov claimed that a train arriving in Kramatorsk on 10 February 2023 carried 16 sealed metal containers, eight labelled as containing BZ. He alleged that the cargo was unloaded at the Kuibyshev metallurgical plant under Ukrainian security service and military supervision, then transported towards the front on US-manufactured armoured vehicles. These were Russian allegations, rather than independently established findings. He also described accompanying foreign nationals and chemical hazard markings with two red bands on the eight labelled containers.[88]

According to Kirilov 'The facts of the simultaneous delivery of toxic chemicals and means of protection against them testify to an attempt to carry out large-scale provocations using the BZ military incapacitating agent during the conflict'.[89] Kirilov continued '[I] recall that under the Chemical Weapons Convention, BZ agent is a controlled and a Schedule 2 chemical, and its use is prohibited under Article 1 of the CWC. This chemical causes acute phrenoplegia, disorientation, hallucinations, and memory impairment. BZ is a standard toxic agent of the US Army and was widely used during the Vietnam War. … The United States declared the complete elimination of stocks of BZ back in 1990, when about 50 tons of the substance were disposed of, while samples were kept. In addition, the synthesis of BZ precursors at pharmaceutical production facilities in the amount of up to several tens of tons per year is still possible.'[90]

Despite the circulation of information to all CWC States Parties, Russia has not sought to initiate formal CWC consultation, clarification and factfinding mechanisms to resolve such matters. Considering the nature of the Russian allegations and the lack of credible publicly available information that Russia has provided to justify their claims, the Russian activities appear to be part of a disinformation campaign against the US, 'Western States' and Ukraine rather than an attempt at raising legitimate concerns over CNSAC weapons.

84 Ibid.

85 Ibid.

86 TASS, Russian *Defense Ministry: First Ukrainian chemical lab found during special operation*, 8 July 2024. https://tass.com/defense/1814199 (accessed 27 September 2026).

87 Russian Federation, *Correspondence to the OPCW Technical Secretariat from Permanent Representation of the Russian Federation to the OPCW*, 8 July 2024, https://www.opcw.org/sites/default/files/documents/2022/Compendium%20of%20correspondence%20shared%20by%20States%20Parties%20on%20Ukraine.pdf.

88 Kirillov, I. Chief NBC Protection Troops of the RF Armed Forces, Briefing on large-scale provocations using toxic chemicals in Ukraine prepared by the West, 23 February 2023, pp. 1–2.

89 Kirillov, I. (23 February 2023) op.cit., p. 2.

90 Kirillov, I. (23 February 2023) op.cit., pp. 2–3.

4 Recommendations

With adoption by CSP-26 of the 'Understanding' on aerosolised CNS-acting agents, CWC States Parties took an important step acknowledging the threats of, and seeking to prevent, weaponization of such agents for law enforcement. However more needs to be done to prevent and, if identified, halt CNS-acting and ICA weapons and the broader misuse of neuroscience in this period of rapid S&T advance. Despite the difficulties that are evident in this context, we suggest, in our following recommendations, further steps that could realistically be undertaken at this time.

4.1 Establish a SAB Temporary Working Group on CNSACs and ICAs

In its S&T Report to the 5th CWC Review Conference, the SAB recommended that the Director General consider establishing an SAB Temporary Working Group to 'to study current developments concerning CNS-acting chemicals' and that it 'include the participation and expertise of other relevant international institutions (e.g., the United Nations Commission on Narcotic Drugs)'. Although this was supported by certain States, notably the US, this TWG has yet to be established. We believe this should be a priority for the Organisation and such a body established at the earliest opportunity. If OPCW funding is constrained, the Organisation might still be able to undertake this process through voluntary financial contributions from concerned States Parties. The TWG would necessarily need to take a broad view of the advances in neuroscience and associated technologies such as AI and synthetic biology. However, based on the evidence we have reviewed here, we suggest that the TWG should pay particular attention to the implications of: the ongoing elucidation of neuronal circuits, neuropeptides and neuroreceptors of the brain that underly behaviours; the growing understanding of the impact of psychedelics on the functions of the higher CNS; and the impact of the immune system malfunctions on the operations of the higher CNS.

Depending on when it is formed and its mandate, the SAB TWG should firstly provide technical assistance to the Technical Secretariat in its preparation of guidance to States to facilitate implementation of the CSP-26 'Understanding'. We also recommend that the SAB TWG, while concentrating upon CNSACs, should have a more extensive mandate encompassing the broader category of ICAs. This would enable the SAB TWG to undertake a wide-ranging survey and analysis of developments in chemical, life and associated sciences relevant to the weaponization or other malign use of ICAs (including CNSACs) that undermine the object and purpose of the Convention.

Beyond the CSP-26 'Understanding', the SAB TWG could be tasked with making further recommendations:

- As to which if any CNSACs or other ICAs that could be readily weaponized, pose a significant risk to the CWC, and therefore merit inclusion into one of the existing CWC Schedules of chemicals. At present only one pharmaceutical chemical (BZ) and two of its precursors are listed in Schedule 2. This is despite the fact that certain States previously weaponized or attempted to weaponize a range of pharmaceutical chemicals, toxins and bioregulators attacking the CNS or other core physiological systems.
- On how to adapt the routine verification measures to cover appropriate sites of CNSAC /ICA production. One area requiring particular attention is how to appropriately regulate bioregulator production. One potential route proposed by Tucker would be to modify the provisions in the CWC Verification Annex that cover other chemical production facilities (OCPFs) which produce by synthesis more than 200 metric tons per year of organic chemicals not listed by name in the CWC. Tucker proposed developing a subcategory for those facilities that manufacture peptides with a production threshold of between 50 and 100 kilograms per year, thereby capturing OCPFs that could support State-level bioregulator weapons production.[91]

[91] Tucker J. (2008) The body's own bioweapons. *Bulletin of Atomic Scientists*, 64 (1),16–22 & 56–57.

- On adaptations and improvements to the Technical Secretariat's ability to conduct challenge inspections and inspections of alleged use where CNSACs/ICAs may be present, including its and the OPCW designated laboratories' combined capabilities to detect and identify CNSACs /ICAs, and provision of appropriate personal protective equipment.
- To inform development of guidance material on the range of ICAs and associated delivery mechanisms that could be encompassed under a second 'Understanding' prohibiting use of ICAs for law enforcement purposes.

4.2 Strengthen OPCW Science and Technology Monitoring and Review Capabilities

Advances in science and technology (S&T) can significantly alter the implementation environment of the CWC, and are likely to continually and significantly expand the range of substances to which the Convention's prohibitions apply. Consequently, it is crucial that the OPCW conduct in-depth, systematic, and holistic analysis of relevant S&T advances, including those related to toxins and bioregulators, as part of the activities of the five-yearly Review Conferences. To facilitate such activity, it is essential that independent technical advice is provided to the States Parties concerning developments in relevant S&T and their potential impacts upon the operation of the Convention. While such technical expertise is provided to CWC States Parties through the SAB and the OPCW Technical Secretariat with the long-standing cooperation of the International Union of Pure and Applied Chemistry (IUPAC), measures for ensuring greater involvement of independent chemical and life scientists, including neuroscientists and neuropharmacologists, as well as experts in related and converging disciplines notably AI and nanotechnology, should be developed.

CWC States Parties should further enhance the Technical Secretariat's inhouse capability to monitor S&T advances of potential concern to the Organisation; suitable mechanisms should also be established to allow the Technical Secretariat to bring relevant concerns proactively to the attention of the Executive Council and the States Parties, in a timely manner, and not be restricted to only responding to their requests.

4.3 Address Allegations of Malign Use

If a CWC State Party has information indicating that another State has been developing, acquiring, stockpiling or using CNSAC /ICA weapons they should bring this information to the attention of the CWC States Parties through the appropriate institutional mechanisms. Following the CSP-26 'Understanding', this would include any use of aerosolised CNSACs for law enforcement. We would argue that States should also bring information concerning malign use of CNSAC and ICAs for torture, other ill-treatment and other violations of International Human Rights Law and breaches of International Humanitarian Law, to the attention of CWC States Parties, as such use would not be consistent with 'law enforcement' or any other 'purposes not prohibited' as covered by the CWC, and consequently would breach the Convention.

In the first instance, States can seek to resolve such concerns through bilateral consultation. If these consultations are successful and relevant States Parties agree, in order to dispel misperceptions, the results of such consultations should be made known to all States Parties and, if appropriate, to the public. If bilateral consultations with relevant States Parties do not prove fruitful, concerned States Parties should initiate formal multilateral consultation, investigation and fact-finding mechanisms, under CWC Article IX. These include on-site challenge inspections of any facility or location in the territory or in any other place under the jurisdiction or control of the State Party of potential concern. States should avoid making allegations without being prepared to fully substantiate them and allow them to be investigated through the relevant institutional mechanisms. Where appropriate such information should be placed in the public domain.

The CBW network for the comprehensive strengthening of norms against chemical and biological weapons (CBWNet)

The research project CBWNet is carried out jointly by the Berlin office of the Institute for Peace Research and Security Policy at the University of Hamburg (IFSH), the Chair for Public Law and International Law at the University of Gießen, the Peace Research Institute Frankfurt (PRIF) and the Carl Friedrich Weizsäcker-Centre for Science and Peace Research (ZNF) at the University of Hamburg. The joint project aims to identify options to comprehensively strengthen the norms against chemical and biological weapons (CBW).

These norms have increasingly been challenged in recent years, *inter alia* by the repeated use of chemical weapons in Syria. The project scrutinizes the forms and consequences of norm contestations within the CBW prohibition regimes from an interdisciplinary perspective. This includes a comprehensive analysis of the normative order of the regimes as well as an investigation of the possible consequences which technological developments, international security dynamics or terrorist threats might yield for the CBW prohibition regimes. Wherever research results point to challenges for or a weakening of CBW norms, the project partners will develop options and proposals to uphold or strengthen these norms and to enhance their resilience.

The joint research project is being funded by the Federal Ministry of Research, Technology and Space for six years (April 2022 until March 2028).

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ISSN (Online): 2751-4501

With funding from the:

UNIVERSITY of BRADFORD

Federal Ministry of Research, Technology and Space