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ATTACKS ON GHOUTA

Analysis of Alleged Use of Chemical Weapons in Syria

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ANALYSIS OF ALLEGED USE OF CHEMICAL WEAPONS IN SYRIA

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Projected launch zone of the 140 mm rocket identified near the Rawda Mosque, based on a minimum fire range of 3.8 km and a maximum range of 9.8 km.

Government military bases

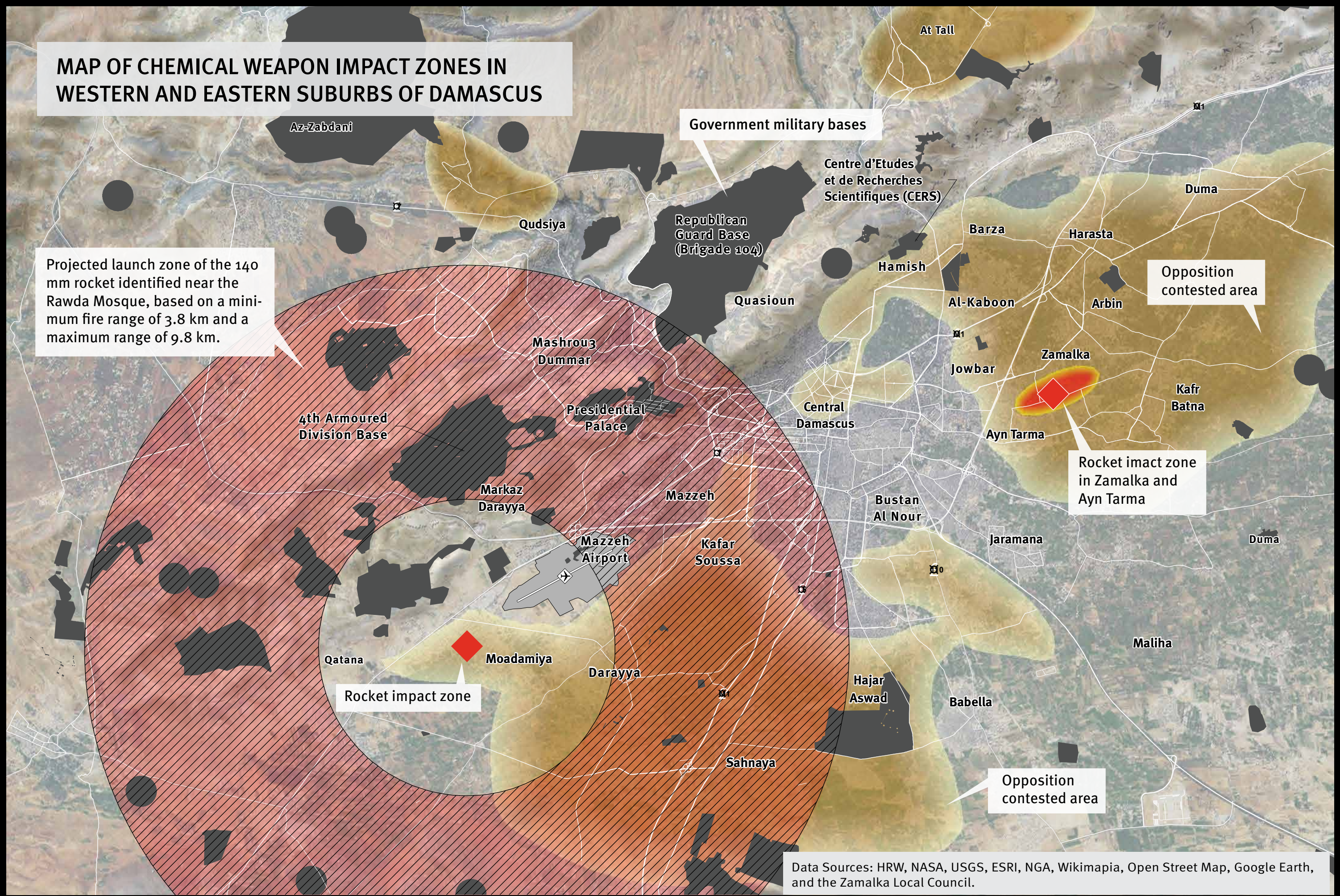
Opposition contested area

Rocket impact zone in Zamalka and Ayn Tarma

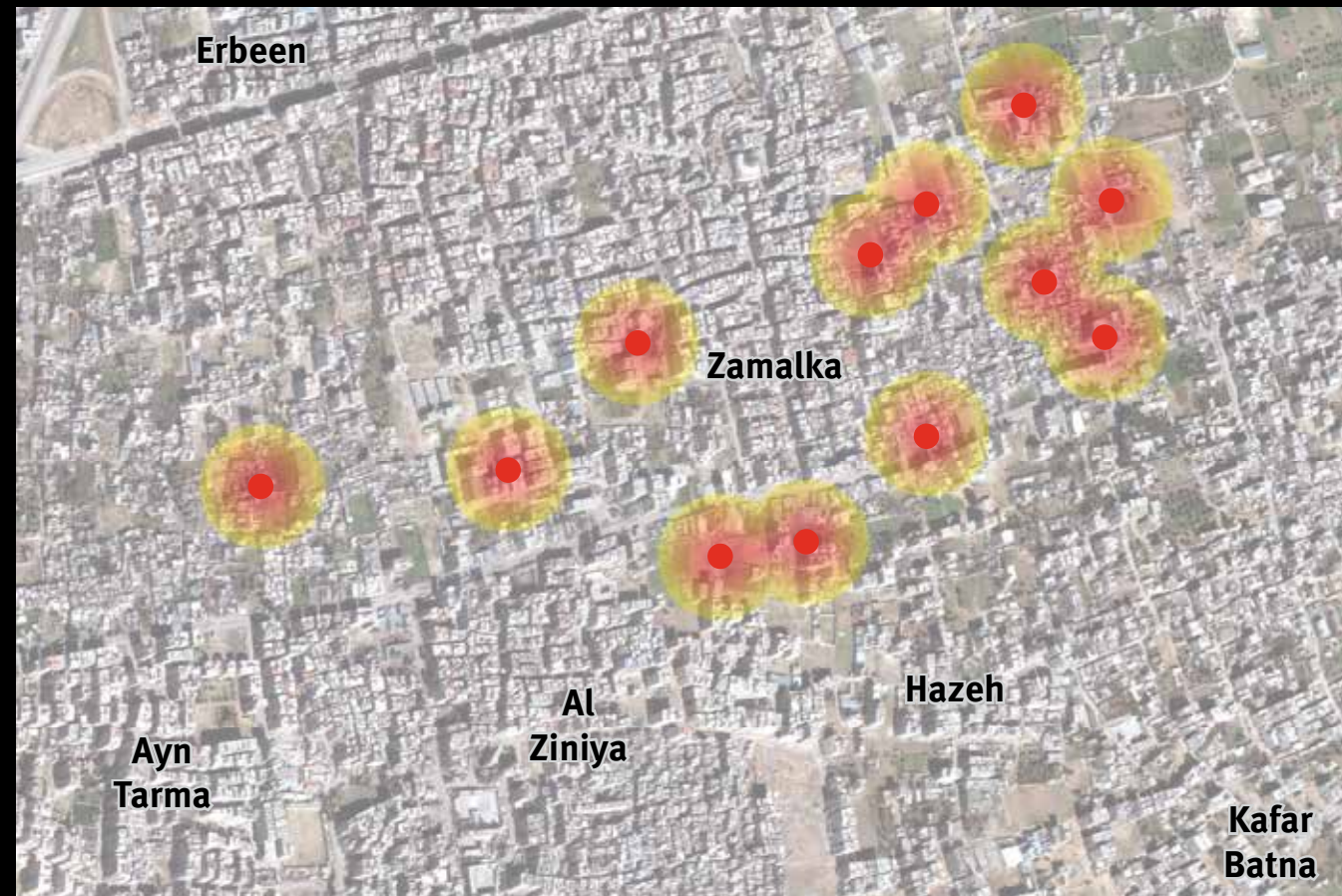
Rocket impact zone

Opposition contested area

Data Sources: HRW, NASA, USGS, ESRI, NGA, Wikimapia, Open Street Map, Google Earth, and the Zamalka Local Council.



MAP OF THE 330MM CHEMICAL ROCKET IMPACT LOCATIONS IN ZAMALKA NEIGHBORHOOD



SUMMARY

This report details two alleged chemical weapons attacks in Syria on the opposition-controlled Damascus suburbs of Eastern and Western Ghouta, located 16 kilometers apart, on the morning of August 21, 2013. The attacks killed hundreds of civilians, including large numbers of children. Human Rights Watch analyzed witness accounts of the rocket attacks, information on the likely source of the attacks, the physical remnants of the weapon systems used, and the medical symptoms exhibited by the victims of the attack as documented by medical staff.

Our investigation finds that the August 21 attacks were likely chemical weapons attacks using a surface-to-surface rocket system of approximately 330mm in diameter—likely Syrian-produced—and a Soviet-era 140mm surface-to-surface rocket system to deliver a nerve agent. Evidence suggests the agent was most likely Sarin or a similar weapons-grade nerve agent. Three local doctors told Human Rights Watch that victims of the attacks showed symptoms which are consistent with exposure to nerve gas, including suffocation; constricted, irregular, and infrequent breathing; involuntary muscle spasms; nausea; frothing at the mouth; fluid coming out of noses and eyes; convulsing; dizziness; blurred vision; and red and irritated eyes, and pin-point pupils.

The evidence concerning the type of rockets and launchers used in these attacks strongly suggests that these are weapon systems known and documented to be only in the possession of, and used by, Syrian government armed forces. Human Rights Watch and arms experts monitoring the use of weaponry in Syria have not documented Syrian opposition forces to be in the possession of the 140mm and 330mm rockets used in the attack, or their associated launchers.

The Syrian government has denied its responsibility for the attack, and has blamed opposition groups, but has presented no evidence to back up its claims. Based on the available evidence, Human Rights Watch finds that Syrian government forces were almost certainly responsible for the August 21 attacks, and that a weapons-grade nerve agent was delivered during the attack using specially de-

signed rocket delivery systems. The scale and coordinated nature of the two attacks; against opposition-held areas; the presence of government-controlled potential launching sites within range of the targets; the pattern of other recent alleged chemical weapon attacks against opposition-held areas using the same 330mm rocket delivery system; and the documented possession of the 140mm and 330mm rocket systems able to deliver chemical weapons in the government arsenal—all point towards Syrian government responsibility for the attacks.

Human Rights Watch has investigated alternative claims that opposition forces themselves were responsible for the August 21 attacks, and has found such claims lacking in credibility and inconsistent with the evidence found at the scene. Claims that the August 21 deaths were caused by an accidental explosion by opposition forces mishandling chemical weapons in their possession are inconsistent with large numbers of deaths at two locations 16 kilometers apart, and documentation of rocket attacks on the sites that morning, as evidenced by witness accounts, the damage visible on the rockets themselves, and their impact craters.

METHODOLOGY

Without physical access to Eastern and Western Ghouta, Human Rights Watch interviewed by Skype from August 22 to September 6 more than 10 witnesses and survivors of the August 21 attacks, and 3 doctors who responded to the attacks. Human Rights Watch also reviewed available video and photo footage from the scene of the attacks, including high-resolution images obtained directly from a source who photographed and measured the rocket components found in the Eastern Ghouta attack, and conducted a detailed analysis of the weapon remnants captured in such footage.

Human Rights Watch asked Keith B. Ward, Ph.D., an expert on the detection and effects of chemical warfare agents, to review the clinical signs revealed by videos of hospitalized victims of the attacks, the victims' symptoms described by medical workers on the scene, and the re-

ported clinical signs and symptoms exhibited by medical workers after working with the victims.

Human Rights Watch also used GPS data and satellite imagery analysis to map the precise locations where the attacks took place, and the exact positions where eight of the 330mm rockets impacted in Eastern Ghouta.

In researching this report, Human Rights Watch also used the extensive expertise of its Arms Division in the monitoring and identification of weapons, including chemical weapons. Human Rights Watch previously issued detailed reports and analysis on the last known chemical weapon attacks, conducted by Saddam Hussein's military in Iraq against the Iraqi Kurds, culminating in the Halabja massacre, which killed thousands of civilians 25 years ago, on March 16, 1998.¹

In its investigation, Human Rights Watch was assisted by arms experts including Nic Jenzen-Jones, author of "The Rogue Adventurer",² as well as the independent investigation conducted by Eliot Higgins of the "Brown Moses" blog, who collected and analyzed photos and videos from the attacks.³



¹ Human Rights Watch, *Genocide in Iraq: The Anfal Campaign Against the Kurds* (Human Rights Watch, 1993), <http://www.hrw.org/reports/1993/iraqanfal/>.

² Nic Jenzen-Jones, "The Rogue Adventurer" (blog), <http://rogueadventurer.com/> (accessed September 6, 2013).

³ Brown Moses, "Brown Moses" (blog), <http://brown-moses.blogspot.ch> (accessed September 6, 2013).

I. THE AUGUST 21 ATTACKS ON GHOUTA

On the morning of August 21, 2013, dozens of videos began appearing on YouTube channels associated with the Syrian opposition showing large numbers of dead people, the victims of what the opposition claimed was a chemical weapons attack. The footage also showed many hospitalized victims who seemed to be suffering from symptoms from such an attack. Large numbers of dead animals, including sheep, dogs, cats, and wild birds, were also visible in the videos uploaded by the activists.

As more details became available, it became clear that the attack had affected two separate opposition-controlled districts in Damascus Suburbs governorate, located 16 kilometers apart. According to local residents, the Zamalka neighborhood in Eastern Ghouta was struck by rockets at some time between 2 and 3 a.m., and the Moadamiya neighborhood in Western Ghouta was struck by rockets at about 5 a.m., shortly after the completion of the Muslim morning prayer.

Victims consistently showed symptoms including suffocation; constricted, irregular, and infrequent breathing; involuntary muscle spasms; nausea; frothing at the mouth; fluid coming out of noses and eyes; convulsing; dizziness; blurred vision; and red and irritated eyes, and pin-point pupils. According to an expert review of the available evidence, the symptoms exhibited by the victims are consistent with exposure to a nerve agent such as Sarin. As discussed in part III. below, Sarin has been used in at least one previous chemical attack in the Syrian conflict.

Moadamiya, Western Ghouta

In Moadamiya in Western Ghouta, a witness who arrived on the scene shortly after rockets struck an apartment building next to the Rawda Mosque, told Human Rights Watch what followed after the rocket struck. His account directly linked the rocket strike to deaths associated with the alleged chemical attack in the area:

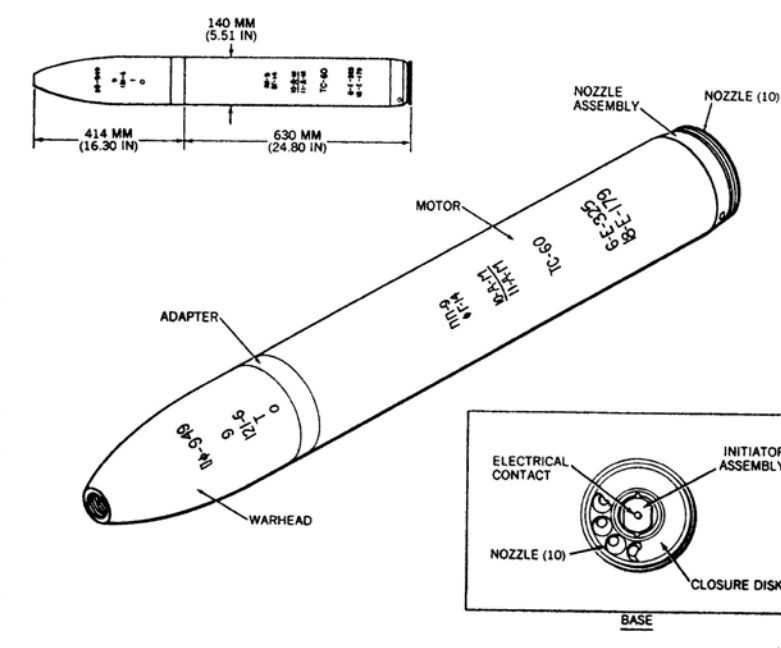
One rocket hit around 5 a.m. We were praying in the mosque near the turbi area 400 meters

away [from the strike site]. We heard the strike and went to the site to help the wounded. We thought it was a regular rocket but when we got there someone was screaming “Chemical! Chemical!” The rocket fell in the first floor of a four-story apartment building. Everyone in the building died in their sleep. It didn’t cause a lot of destruction... It made an opening in the wall. After the person was screaming, people covered their faces, with shirts dunked in water. We didn’t smell anything,⁴ but people were fainting. I covered my face with a shirt dunked in water and was rescuing people and taking them to the medical center...If anyone entered the building where the rocket fell they would faint.⁵

The witness identified a rocket as the weapon he saw on the scene after the strike.⁶ He told Human Rights Watch that in the days following the strike, the United Nations Mission to Investigate Allegations of the Use of Chemical Weapons in the Syrian Arab Republic (the UN Mission) visited the site, examined the remnant, and took it with them, presumably for further analysis.

A second witness who works for the Moadamiya media center told Human Rights Watch that he counted seven rockets that fell in two areas of Moadamiya during the early morning of August 21.⁷ He told Human Rights Watch that four rockets impacted next to the Rawda Mosque, and the other three in the area between Qahweh Street and Zeytouneh Street, which he identified as being approximately 500 meters to the east of the Rawda Mosque. According to the witness, all of the rockets were of the same type, identified by Human Rights Watch as a Soviet-produced 140mm rocket (see opposite page).

A declassified reference drawing from Ordata of the Soviet-produced 140mm rocket, which can carry a warhead containing 2.2 kg of Sarin.



From a review of a video of an expended rocket motor found on the street next to the Rawda Mosque in Moadamiya, Human Rights Watch has identified one of the rockets found in the Moadamiya attack as a Soviet-era surface-to-surface 140mm rocket, known as the M-14.⁸ A separate video shot on August 27 shows UN inspectors measuring and photographing this rocket motor, which confirmed the remnant’s length and width correspond with the dimensions of the Soviet 140mm rocket motor.⁹ The first video clearly shows the 10 venturi (exhaust nozzles) and electric contact plate of the rocket, which is a unique identification characteristic of the Soviet-made 140mm rocket, as well as the factory markings on the casing of the rocket, making the identification definitive. The 179 factory markings on the rocket refer to the soviet-era “Factory 179” in Novosibirsk, one of the largest producers of artillery and rockets during the Soviet period, and a known manufacturer of the 140mm M-14 rocket.

The expended rocket motor visible in the videos represents only part of the delivery system and not the weapon’s payload. To date, no visual evidence of any type of intact or expended 140mm rocket warhead has been identified in videos shot in the areas of the August 21 attack.

The 140mm rocket is documented in standard reference materials as being present in the Syrian government’s weapons arsenal. Designed in the 1950s, the Soviet Union transferred 200 BM-14 launchers,¹⁰ the most common launcher for 140mm rockets made by the Soviet Union, to Syria in 1967-1969, presumably along with stockpiles of

ammunition including 140mm rockets, according to the database on arms transfers maintained by the Stockholm International Peace Research Institute (SIPRI).¹¹

According to a declassified US munitions catalogue¹² and standard international reference materials published by Jane’s,¹³ only three warheads were produced for 140mm rockets:

- M-14-OF high explosive-fragmentation;
- M-14-D smoke containing white phosphorus;
- A chemical warhead containing 2.2 kilograms of Sarin.

Based on witness statements describing the impact of the rockets and the absence of rocket remnants or reported types of injuries consistent with an attack using high

⁴ In its pure form, Sarin is a clear, colorless, tasteless and odorless liquid. See Centers for Disease Control and Prevention, “Emergency Preparedness and Response: Facts about Sarin,” at <http://www.bt.cdc.gov/agent/sarin/basics/facts.asp>.

⁵ Human Rights Watch Skype interview with witness in Moadamiya, August 22, 2013.

⁶ The rocket is visible in the following YouTube video: <http://www.youtube.com/watch?v=nymy8roKcag> (accessed September 9, 2013).

⁷ Human Rights Watch Skype interview with member of Moadamiya media center, August 22, 2013.

⁸ The rocket is visible in the following YouTube video: <http://www.youtube.com/watch?v=nymy8roKcag> (accessed September 9, 2013).

⁹ “[UN examines the remains of a missile in the area of chemical Gota],” August 27, 2013, video clip, YouTube, [http://www.youtube.com/watch?v=6mOLULcrcVs\\$](http://www.youtube.com/watch?v=6mOLULcrcVs$) (accessed September 9, 2013).

¹⁰ The BM-14 launcher is the most common for 140mm rockets that were made by the Soviet Union. Other types of launchers exist as does the possibility of improvising field expedient launchers, as Vietcong forces did during the Vietnam War.

¹¹ Stockholm International Peace Research Institute, “Arms Transfers Database,” www.sipri.org/databases/armstransfers. Recipient report for Syria for the period 1950–2012, generated on August 27, 2013.

¹² US Defense Intelligence Agency and US Army Intelligence Agency, “Ammunition Data and Terminal Effects Guide -- Eurasian Communist Countries,” DST-1160Z-126-92, March 5, 1992, partially declassified and released to Human Rights Watch via FOIA request.

¹³ Leland S. Ness and Anthony G. Williams, eds., Jane’s Ammunition Handbook 1997-1998 (Surrey, UK: Jane’s Information Group Limited, 2008), pp. 544-45.



The 140mm Soviet-produced rocket motor found at the site of the Moadamiya alleged chemical weapons attack. The rocket is capable of carrying a 2.2kg Sarin warhead.
Source <http://www.youtube.com/watch?v=nymy8roKcag>

explosive or incendiary payloads, Human Rights Watch believes there is little possibility that the rocket could have been carrying high explosive or incendiary payloads. Given the large number of casualties, this leaves a chemical agent warhead as a strong remaining possibility, which would be consistent with the symptoms displayed by the victims.

According to declassified reference guides, the 140mm artillery rocket has a minimum range of 3.8 kilometers and a maximum range of 9.8 kilometers.¹⁴ Two witnesses told Human Rights Watch that the August 21 rocket attack on their area came from the direction of the Mezzeh Military Airport and the nearby Syrian 4th Armored Division base, which are located respectively four kilometers and five to seven kilometers from the site of the attack, and thus within the range of possible launching sites. The projected

¹⁴ US Defense Intelligence Agency and US Army Intelligence Agency, "Ammunition Data and Terminal Effects Guide -- Eurasian Communist Countries," DST-1160Z-126-92, March 5, 1992, partially declassified and released to Human Rights Watch via FOIA request.

likely launch zone for the 140mm rocket impact near the Rawda Mosque encompasses multiple Syrian government military bases, training facilities, surface-to-air missile sites, the 4th Armored Division base, as well as the eastern section of the Mezzeh Military Airport.

Human Rights Watch has closely monitored the types of munitions and weapons used in the Syrian conflict, and has extensively reported on unlawful use of weapons by Syrian government forces, including heavy 240mm mortars against populated areas, antipersonnel mines, indiscriminate air-dropped bombs, at least six types of cluster munitions, incendiary weapons against civilians, and indiscriminate tactical ballistic missiles.¹⁵ However, the

¹⁵ See for example: "Cluster Munitions: Syria Use Persists," Human Rights Watch news release, September 4, 2013, <http://www.hrw.org/news/2013/09/04/cluster-munitions-syria-use-persists>; "Syria: Ballistic Missiles Killing Civilians, Many Children," Human Rights Watch news release, August 5, 2013, <http://www.hrw.org/news/2013/08/04/syria-ballistic-missiles-killing-civilians-many-children>; Human Rights Watch, Death from the Skies, April 10, 2013, <http://www.hrw.org/reports/2013/04/10/death-skies>; "Syria: Army Using New Type of Cluster Munition," Human Rights Watch news release, January 14, 2013, <http://www.hrw.org/news/2013/01/14/syria-army-using-new-type-cluster-munition>; "Syria: Incendiary Weapons Used in Populated Areas," Human Rights Watch news release, December 12, 2012, <http://www.hrw.org/news/2012/12/12/>



attack on Moadadiya on August 21 represents the first known appearance of the 140mm rocket, which has not been documented in use in the current Syrian conflict. Human Rights Watch is not aware of any information indicating that opposition forces are in possession of the 140mm rocket, and its associated launching system.

Zamalka, Eastern Ghouta

Human Rights Watch documented the use of apparent surface-to-surface 330mm rockets in Zamalka, Eastern Ghouta on August 21. We found no evidence of any use of the 140mm rocket system used in the Moadamiya attack in Eastern Ghouta.

syria-incendiary-weapons-used-populated-areas; "Syria: Evidence Shows Cluster Bombs Killed Children," Human Rights Watch news release, November 27, 2012, <http://www.hrw.org/news/2012/11/27/syria-evidence-shows-cluster-bombs-killed-children-o>; "Friends of Syria: Push to End Indiscriminate Shelling," Human Rights Watch news release, February 24, 2012, <http://www.hrw.org/news/2012/02/24/friends-syria-push-end-indiscriminate-shelling>; "ICBL publicly condemns reports of Syrian forces laying mines," Human Rights Watch news release, November 2, 2011, <http://www.hrw.org/news/2011/11/02/icbl-publicly-condemns-reports-syrian-forces-laying-mines>.

A Member of the UN Mission measuring and photographing the 140mm Soviet rocket motor found at the site of the Moadamiya alleged chemical weapons attack. The 140mm rocket is capable of carrying a 2.2kg Sarin warhead.
Source: <http://www.youtube.com/watch?v=6mOLULcrcVs>

Witness statements and information including GPS locations of rockets found in the area provided by local activists, as well as satellite imagery locations that match the location in the videos, have allowed Human Rights Watch to confirm at least four strike sites in Zamalka where at least eight 330mm rockets struck on August 21. This is unlikely to be a complete account of the number of rockets used in the attack.¹⁶

- Two rockets struck al-Mahariq Street, one on the Ghazal building and the other on Mehdi al-Deen building;
- One rocket struck the Bostan neighborhood on Naher al-Tahoun street;

¹⁶ Human Rights Watch Skype interview with a member of the local civilian council, September 4, 2013.



A Member of the UN inspection team photographing a 330mm rocket found at the al-Mahariq strike site.
Source: <http://youtu.be/MmP6wPdTIUM>

- Two rockets struck next to the Hamza mosque, one just next to the mosque and the other close to the nearby al-Kamal banquet hall;
- Three rockets struck the al-Mazraat neighborhood next to the al-Tawfiq mosque and next to the elementary school.

None of the witness accounts describing the impact of the rockets, and none of the images of the rocket remnants or the reported injuries sustained at the scene are consistent with an attack using high explosive or incendiary payloads, as there are no visible traumatic injuries on any of the victims or large impact craters visible at the scene of the rocket impacts. High-explosive payloads would have caused severe physical injuries to the victims and leave large impact craters, while incendiary weapons cause severe burns on the victims, and leave behind a distinctive burn scar where they strike. Based on the lack of evidence of a high-explosive or incendiary attack, and symptoms of victims that are consistent with a chemical attack, Human

Rights Watch believes that the 330mm rockets found at the sites were used in the alleged chemical attack.

A member of the Zamalka media center told Human Rights Watch that he visited the scene of one strike in the al-Mazraat area of Zamalka just after the attack.¹⁷ He said:

On August 21, I was in the media office when around 2 to 3 a.m. my friends called to say that rockets had hit Zamalka. When I heard that, I went to the field hospital in al-Mazraat neighborhood... After around 30 minutes rockets hit the al-Mazraat area. When the explosion hit I heard a very low sound, it was like the sound of a helicopter buzzing, and not the sound of explosion... I went outside the field hospital and started running towards the explosion site. I didn't reach the explosion site because I saw injured people on the ground and people screaming and running in all directions... I remember I went into one house and saw a man with his wife on the ground. The house was not destroyed. It was not where the rocket

¹⁷ Human Rights Watch Skype interview with member of media center, September 4, 2013.

fell or had an impact but they were dead on the ground. After around 40 minutes rescuing people, I started feeling my body aching. I was feeling weak and unable to move. Then my eyes started hurting me and headache started. There was no smoke but there was a smell... I told my friend that I have to go to the hospital. He put me in a car and drove away... I remember very well when we left al-Mazraat in my friend's car, I saw a dog crossing the street. I shouted to my friend to be careful not to hit him but before I finished my sentence the dog by itself collapsed on the ground.

The same witness also confirmed to Human Rights Watch that he had videotaped and uploaded a large number of videos taken at the hospital of the wounded and dead.¹⁸

A second witness shared with Human Rights Watch several videos of remnants of the weapons used in the al-Mazraat area on August 21. The videos show the same 330mm rocket type.

The member of the Zamalka media center also shared with Human Rights Watch videos and pictures he took of rockets in the al-Mahariq strike site affected during the August 21 attack. The remnants in these videos are also 330mm rockets. On August 29 he visited the al-Mahariq strike site and photographed a 330mm rocket he found there and which he believes had been used during the August 21 attack. In the proceeding days, when the UN chemical weapons inspection team visited Zamalka, he took several videos of other 330mm rockets found at the al-Mahariq site, as they were being examined by the UN weapon inspectors.

The 330mm surface-to-surface rocket that appears to be associated with the August 21 attack on Eastern Ghouta is of a type not listed in standard, specialized, international or declassified reference materials. It is a rocket type that has not been documented before the outbreak of the current Syrian conflict, although it has been documented in a num-

¹⁸ The witness confirmed to Human Rights Watch that he videotaped and uploaded the following videos: <http://youtu.be/R6nazUF-HN9Y>; <http://youtu.be/6qLj3ixwvr8>; <http://youtu.be/xB2spWf5Jpl>; <http://youtu.be/rldBJJecBnM>; <http://youtu.be/WHU-KAoiP3k>; and <http://www.youtube.com/watch?v=WHU-KAoiP3k> (accessed September 9, 2013).

ber of other attacks on opposition held areas in the months prior to the Eastern Ghouta attack, including at least one attack in which opposition activists claimed the government had carried out an alleged chemical attack (see next page).

Human Rights Watch has obtained precise measurements for the dimensions of the warhead from a local activist in Eastern Ghouta, and these measurements determine that the estimated volume of nerve agent inside the warheads would be approximately 50 to 60 liters, compared to 2.2 liters for the warheads designed for the 140mm rockets. Prior to each attack, the warhead of the 330mm rocket would have to be filled with the 50 to 60 liters of nerve agent, a dangerous process that is normally conducted by specialized teams wearing protective gear to prevent exposure to the chemical agents. Human Rights Watch is not aware of any information that the opposition forces have ever possessed the amounts of chemical weapon agent necessary to deploy such rockets, or that they possess the expertise needed to fill the warheads without accidental exposure to the deadly nerve agent.

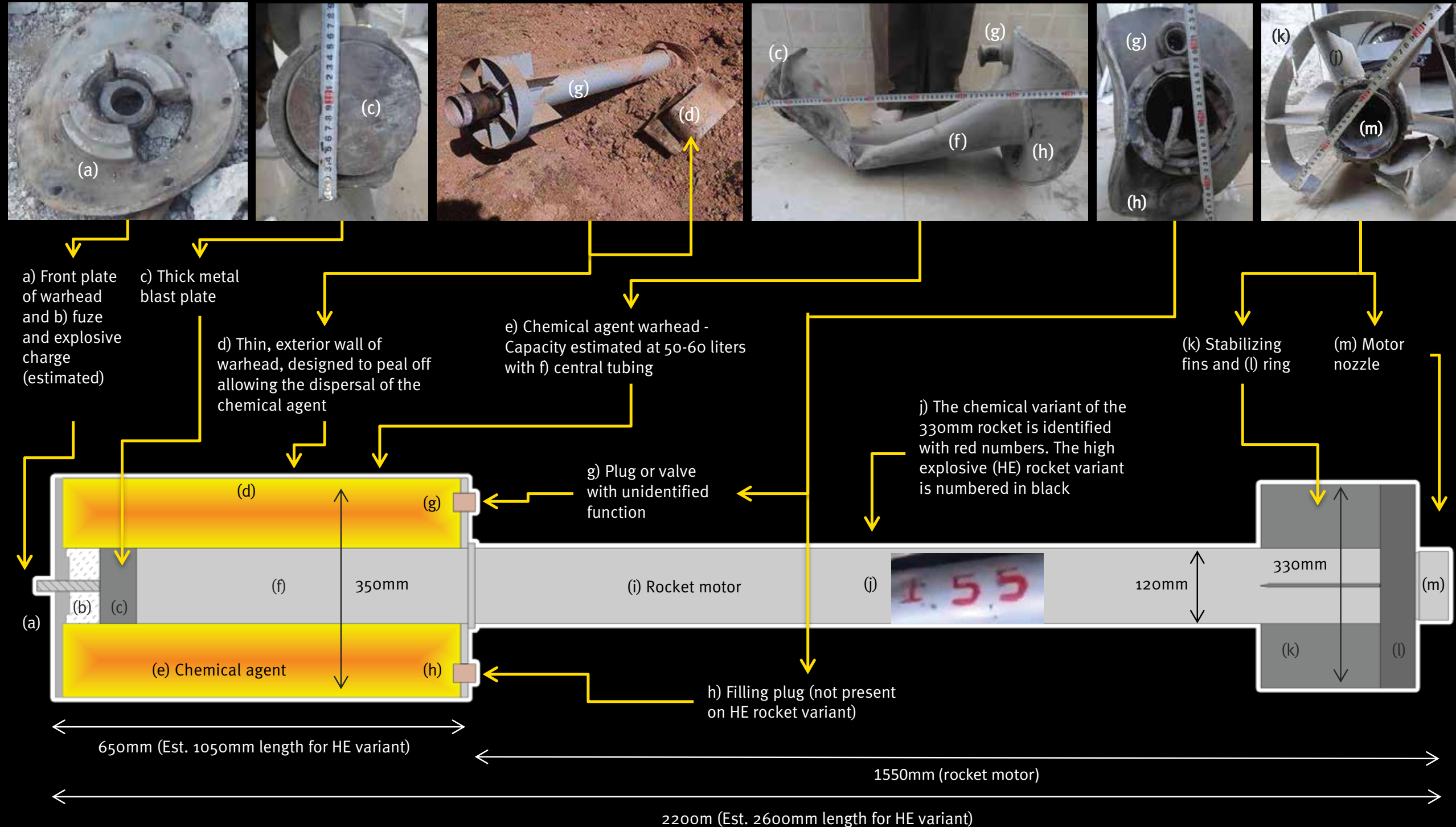
Using the measurements and high-resolution images provided by the Eastern Ghouta activist, Human Rights Watch has been able to reconstruct the characteristics of the 330mm rocket. Detailed measurements and high-resolution photographs provided directly by an activist in Eastern Ghouta allowed Human Rights Watch to define the diameter of the rocket as approximately 330mm; this is significant because these dimensions are compatible with the Iranian-produced 333mm Falaq-2 launcher, or close copies and derivatives thereof.¹⁹ Iran is believed to be the only country in the world to produce rocket launchers in the 333mm category. Videos have appeared showing Syrian forces using the Falaq-2 launching system to launch what appears to be versions of the 330mm rockets, although the launches seen in the video occurred during daytime and are thus unrelated to the August 21 nighttime attack.²⁰

¹⁹ See the brochure extract from Iran's Defense Industries Organization on the Falaq-2 launcher and its FL2-A rocket, available at: Nic Jenzen-Jones, "Alleged CW Munitions in Syria Fired From Iranian Falaq-2 Type Launchers," post to "The Rogue Adventurer" (blog), August 29, 2013, <http://rogueadventurer.com/2013/08/29/alleged-cw-munitions-in-syria-fired-from-iranian-falaq-2-type-launchers/> (accessed September 6, 2013).

²⁰ Nic Jenzen-Jones, "Alleged CW Munitions in Syria Fired From Iranian Falaq-2 Type Launchers," <http://rogueadventurer.com>

DIAGRAM OF 330 MM CHEMICAL ROCKET VARIANT

THIS DIAGRAM OF THE 330MM CHEMICAL ROCKET VARIANT IS DRAWN TO SCALE, BASED ON IN-FIELD MEASUREMENTS OF SURVIVING ROCKET COMPONENTS COLLECTED FROM IMPACT SITES IN THE ZAMALKA NEIGHBORHOOD OF DAMASCUS FOLLOWING THE ATTACKS ON THE MORNING OF AUGUST 21, 2013.



Photographs courtesy of Eliot Higgins of "Brown Moses" blog <http://brown-moses.blogspot.ch>

The rocket is of a non-aerodynamic design and possesses a novel spin stabilization mechanism located just above the nozzle. The non-aerodynamic design of the rocket indicates that the rocket would be relatively short ranged and not capable of accurate targeting.

The consistency in the design of these rockets suggests that they were locally but industrially produced, and apparently designed to be deployed with the Iranian 333mm launchers or derivatives thereof. While Human Rights Watch cannot establish where the rockets were manufactured, their basic design and unique size matching the Iranian rocket launching system suggest a Syrian industrial origin. The production of a weapon specifically designed to deliver chemical weapons would be a violation of the 1993 Convention on Chemical Weapons, of which only five countries, including Syria, are not parties.

While a separate, high-explosive warhead version of the rocket appears to exist based on attacks in other areas, three design differences appear to distinguish the suspected chemical weapon type from the suspected high-explosive type: videos and photos of the weapons from attacks in Syria show that the chemical weapons variant has an additional plug or aperture on the payload (used to fill the container with chemical agent prior to firing); the high-explosive type measures at least 400mm longer; and the chemical weapons variant appears to be numbered in red numbers (with one documented rocket numbered 900, suggesting a significant number of the rockets were produced), while images of the high-explosive variant consistently show that it has black numbering, perhaps for ease of identification. All of the 330mm rocket remnants identified by Human Rights Watch in the Eastern Ghouta Zamalka attack are of the suspected chemical weapons variant, with red numbering, a shorter-sized warhead, and an additional fill plug.

Most significantly, the design of the payload of the rockets found at the scene of the Eastern Ghouta August 21 attack strongly indicates that it is compatible, and perhaps specifically designed, for the delivery of chemical agents. The payload of the rocket consists of a large, thin-walled

container, capable of holding 50 to 60 liters of chemical agent which is loaded into the payload via a plughole, and a small central tube with a suspected bursting charge at the front, rupturing the thin-walled container and distributing the vaporized chemical agent.

The 330mm rocket has appeared in its high-explosive form in previous attacks around Damascus. The high-explosive version of the 330mm surface-to-surface rocket appears to have been used in the Daraya suburb of Damascus on January 4, 2013²¹ and in Khalidiya, in Homs governorate, on August 2, 2013. Opposition forces blamed both attacks on the Syrian government, although Human Rights Watch could not independently confirm this allegation.²²

On August 5, 2013, opposition activists filmed what appears to be the remnants of the chemical weapons-carrying variant (with the extra fill plug visible²³ as well as the red numbering system)²⁴ of the 330mm rocket in the `Adra suburb of Damascus, in what they alleged was a chemical weapons attack by Syrian government forces.²⁵ While Human Rights Watch could not independently confirm the allegations that Syrian government forces were responsible for the August 5 `Adra attack, the videos do show the remnants of suspected chemical weapons-delivery variant of the 330mm rocket, as well as dead and dying

²¹ “[Flash important one of the rockets that fell tonight aya],” January 4, 2013, video clip, YouTube, <http://www.youtube.com/watch?v=5DznRyIq1js> (accessed September 6, 2013).

²² “Unidentified Rocket or Missile in Khalidiya, Homs August 2nd 2013,” August 6, 2013, video clip, YouTube, <http://youtu.be/oelrXubJAgE> (accessed September 6, 2013).

²³ “[Rocket, which was carrying chemical materials and shows around the dead animals after chemical attack],” August 5, 2013, video clip, YouTube, https://www.youtube.com/watch?v=YLcqi_dE-9SU (accessed September 6, 2013).

²⁴ “Unidentified Munitions Linked To August 5th Adra Chemical Attack,” August 22, 2013, video clip, YouTube, <https://www.youtube.com/watch?v=EolzUvozF1c> (accessed September 6, 2013).

²⁵ “[Rocket, which was carrying chemical materials and shows around the dead animals after chemical attack],” August 5, 2013, video clip, YouTube, https://www.youtube.com/watch?v=YLcqi_dE-9SU (accessed September 6, 2013); Brown Moses, “Unidentified Munitions Linked To August 5th Adra Chemical Attack,” August 22, 2013, video clip, YouTube, <https://www.youtube.com/watch?v=EolzUvozF1c> (accessed September 6, 2013); Brown Moses, “Unidentified Muniton Linked To August 5th Adra Chemical Attack [2],” August 22, 2013, video clip, YouTube, <https://www.youtube.com/watch?v=Tzhhhv3uHio> (accessed September 6, 2013).

[com/2013/08/29/alleged-cw-munitions-in-syria-fired-from-iranian-falaq-2-type-launchers/](http://www.hrw.org/news/2013/08/29/alleged-cw-munitions-in-syria-fired-from-iranian-falaq-2-type-launchers/).



animals nearby, otherwise uninjured and showing signs of exposure to a nerve agent.

This handout photo provided by Shaam News Network shows bodies of victims of an alleged chemical weapons attack on Ghouta, Syria, on August 21, 2013. © 2013 Associated Press

No evidence has been produced that opposition forces are in possession of the 330mm surface-to-surface rockets and their associated launchers. The only documented attacks using this weapon system in Syria have been against opposition-held areas and targets. The Syrian government is known to possess the Iranian Falaq-2 333mm rocket launching system, as several videos have emerged on social media allegedly showing Syrian government forces firing the 330mm rockets from truck-mounted 333mm launchers, although no videos have emerged from the nighttime August 21 attack.²⁶

²⁶ Nic Jenzen-Jones, “Alleged CW Munitions in Syria Fired From Iranian Falaq-2 Type Launchers,” <http://rogueadventurer.com/2013/08/29/alleged-cw-munitions-in-syria-fired-from-iranian-falaq-2-type-launchers/>.

Death Toll

Because the August 21 attacks took place in two separate areas of Ghouta, and owing to the chaos resulting from the large number of casualties, it is difficult to establish a precise death toll. The areas affected do not have any large hospitals, and rely on several small, badly supplied underground clinics to provide medical assistance. According to the doctors interviewed by Human Rights Watch, these small medical clinics were overwhelmed by the number of victims, and many of the dead were never brought to the clinics and thus not registered. According to Médecins Sans Frontières, at least 3,600 persons were treated for symptoms consistent with exposure to neurotoxic agents at three hospitals it supports in the area in the first three hours following the attacks.²⁷

²⁷ Médecins Sans Frontières, “Syria: Thousands Suffering from



This handout photo provided by Shaam News Network shows bodies of a baby and two children, victims of an alleged chemical weapons attack on Ghouta, Syria, on August 21, 2013. © 2013 Associated Press

the same day, that the local council in Zamalka had registered the full names of 734 persons who were killed during the attack in Zamalka neighborhood.²⁹

Human Rights Watch has collected the names of 80 individuals believed to have been killed in the August 21 strikes in Moadamiya in Western Ghouta. Two sources told Human Rights Watch that 103 people were killed in the Moadamiya attack.²⁸

Because the attack on Eastern Ghouta involved a much larger affected area, and several small clinics where victims were brought, a total death toll is more difficult to establish. A member of the Zamalka media center, stated during an interview with Human Rights Watch on September 4, and in a separate interview with local journalists on

Neurotoxic Symptoms Treated in Hospitals Supported by MSF,” August 24, 2013.

²⁸ “Syria: Witnesses Describe Alleged Chemical Attacks,” Human Rights Watch news release, August 21, 2013, <http://www.hrw.org/news/2013/08/21/syria-witnesses-describe-alleged-chemical-attacks>.

²⁹ Human Rights Watch Skype interview with member of Zamalka media center, September 4, 2013; “[Chairman of the local council in the port Zamalka in Ghouta campaign will not die],” September 3, 2013, video clip, YouTube, <http://www.youtube.com/watch?v=IT4R14LHNZM&feature=youtu.be> (accessed September 6, 2013).

II. IDENTIFICATION OF THE WEAPONS USED IN THE ATTACKS

Human Rights Watch analyzed publicly posted YouTube videos from the attacked areas as well as higher-resolution images of weapon remnants provided by a local activist in Eastern Ghouta, and identified and analyzed two separate surface-to-surface rocket systems that are believed to be associated with the delivery of chemical agents.

By directly contacting the activists who videotaped and uploaded the videos of the attack available on YouTube, Human Rights Watch has been able to verify the reliability of the videos, and confirmed that they were filmed in the affected area. In the case of Eastern Ghouta, a local activist provided Human Rights Watch with high-resolution photographs and measurements of the 330mm rocket components. UN inspectors were also videotaped inspecting some of the same rocket remnants during their on-site visit, further confirming that the rockets are located at the scene of the attacks.

The first type of rocket, found at the site of the Eastern Ghouta attacks, is a 330mm rocket that appears to have a warhead designed to be loaded with and deliver a large payload of liquid chemical agent. The second type, found in the Western Ghouta attack, is a Soviet-produced 140mm rocket which according to reference guides has the ability to be armed with one of three possible warheads including a warhead that was specifically designed to carry and deliver 2.2 kilograms of Sarin.³⁰

Our analysis does not exclude the possibility that additional weapons delivery systems were used in the Eastern and Western Ghouta attacks that have not yet been identified and analyzed. However, the two analyzed by Human Rights Watch are the only known rocket systems identified as associated with the attacks, according to local activists who have closely inspected both the affected areas.

³⁰ Leland S. Ness and Anthony G. Williams, eds., *Jane's Ammunition Handbook 1997-1998* (Surrey, UK: Jane's Information Group Limited, 2008), pp. 544-45.

In the hours after the August 21 attacks, local activists uploaded several videos of the remnants of rockets they said were collected from some of the sites of the attacks, including some showing remnants apparently filmed where they struck on the ground.³¹ In addition, photographs taken by local activists including some taken at the scenes of the attack, appear to show the remnants of rockets used in the attacks.³² By directly contacting the activists responsible for uploading the videos, Human Rights Watch has been able to obtain precise GPS locations where some rocket remnants were found, and has used satellite imagery to match the locations seen in other videos to precise map locations.

Because the areas in Ghouta where the alleged chemical attacks occurred were shelled by Syrian government forces prior to and after August 21, it is difficult to conclusively determine if the two types of rockets identified, the Soviet 140mm rocket and the 330mm rocket of unknown origin, were the ones used in the attacks. However, local activists say that they only found the remnants of these rockets in the hours after the attacks of August 21 and not before.

In addition, none of the rocket remnants reviewed appeared to contain high explosive or incendiary (flammable substances such as white phosphorus) payloads. According to local activists and doctors as well as publicly available videos of the dead and wounded, none of the injuries

³¹ “[Serious one rocket, which was carrying toxic gases that caused the massacre in Medmah Sham]” August 25, 2013, video clip, YouTube, <http://youtu.be/nymy8roKcag>, (accessed September 6, 2013); “[A chemical rocket that did not explode in a location that was targeted with chemotherapy in the Eastern Ghouta],” August 22, 2013, video clip, YouTube, <http://youtu.be/klhsgFrgNo> (accessed September 6, 2013); “[Chemical rocket that landed on East Ghouta and witness testimonies of the survivors],” August 22, 2013, video clip, YouTube, <http://youtu.be/Pc6xL-N6f5M>, (accessed September 6, 2013); “[The truth of what happened - an eyewitness of the massacre of the chemical in East Ghouta],” August 22, 2013, video clip, YouTube, <http://youtu.be/h2uBpDxAoJA>, (accessed September 6, 2013); “[One of the rockets dropped on chemical Zamalka area and Ghouta],” August 21, 2013, video clip, YouTube, <http://youtu.be/16qFgAfM5jg> (accessed September 6, 2013).

³² See: Brown Moses, “August 21st Chemical Attack,” gallery of photographs, August 24, 2013, <http://imgur.com/a/1nziC> (collection of photographs collated by Brown Moses accessed September 6, 2013);, “Images of rockets which ‘delivered poison’ to Damascus,” ITV, August 25, 2013, <http://www.itv.com/news/2013-08-23/images-of-rockets-which-delivered-poison-to-damascus/> (accessed September 6, 2013).(ITV).



A still image from a YouTube video uploaded by opposition activists following the August 21 alleged chemical attack shows a victim of the attack frothing from the nose and mouth, a medical condition associated with exposure to nerve agents such as Sarin.
Source: https://www.youtube.com/watch?v=AqCDSq_BXKo

III. IDENTIFICATION OF THE NERVE AGENT USED IN THE ATTACKS

sustained by the dead and injured from the attacks appear to be the result of high explosive or incendiary weapons. In both the Eastern and Western Ghouta attacks, witnesses interviewed by Human Rights Watch described how large numbers of persons died without any type of traumatic injury in the immediate vicinity of the strikes involving the identified rockets.

The precise identification of the specific chemical agent used in the August 21 attack requires the collection of samples from weapon remnants, environmental samples, and physiological samples from those directly or indirectly exposed to the chemical agent. Subsequent specialized analyses of these samples can reveal the specific agent itself or the reaction or degradation products characteristic of a specific agent. The UN investigative team has collected such samples, and will issue its findings after the completion of its investigation. In the absence of such testing, Human Rights Watch can only make a preliminary, indirect, circumstantial identification of the chemical that was likely used in the Ghouta attacks.

Human Rights Watch has sought technical advice from Dr. Keith B. Ward, a respected expert on the detection and effects of chemical warfare agents, who has reviewed first-hand and second-hand reports from local residents, the clinical signs and symptoms described by doctors, and



the large number of videos that were taken of the victims of the August 21 attack.

The videos showed that several of the younger victims exhibited cyanosis, a bluish coloring on their face, especially around their eyes and mouth, which is consistent with suffocation or asphyxiation. The suffocation was likely either caused by excessive secretion of mucus and fluids in the lungs and air passages, or damage to the part of the nervous system that supports breathing, or both. A majority of adult victims in these videos also show signs of excessive secretions of fluids or mucus from the mouth and nose. Several of the patients shown in the videos were experiencing involuntary muscle spasms or convulsions. It is significant that there was no obvious indication of bodily trauma or excessive blood loss.

These observations are consistent with reports from witnesses, doctors, and the international aid organization Médecins Sans Frontières (MSF).³³ For example, three local doctors told Human Rights Watch that residents af-

³³ Médecins Sans Frontières, "Syria: Thousands Suffering from Neurotoxic Symptoms Treated in Hospitals Supported by MSF," August 24, 2013, <http://www.doctorswithoutborders.org/press/release.cfm?id=7029> (accessed September 7, 2013).

A still image from a YouTube video uploaded by opposition activists following the August 21 alleged chemical attack shows medical staff attempting to restrain a victim who appears to be undergoing fasciculations (involuntary muscle spasms or convulsions), a medical condition associated with exposure to nerve agents such as Sarin.
Source: <https://www.youtube.com/watch?v=5iSZ1bBnksc>

fectured by the attacks consistently showed clinical signs including suffocation; constricted, irregular, and infrequent breathing; involuntary muscle spasms; frothing at the mouth; fluid coming out of noses and eyes; convulsions; red and irritated eyes and pin-point pupils (myosis). In addition, they report that victims complained of nausea, dizziness, and blurred vision.

The clinical signs we observed on the videos and the signs and symptoms of the victims commonly reported by others are not consistent with injuries due to explosive concussions, fragmentation, or incendiary devices. Nor are they consistent with exposure to choking/pulmonary, lachrymatory, incapacitating, vesicant/blister, or asphyxiant/blood agents. Rather they are a strong indication that the victims were exposed to a toxic organophosphate chemical agent (a "nerve agent") which acts by inhibiting enzymes necessary to the proper functioning of the nervous system. This class of chemicals includes the less toxic



A still image from a YouTube video uploaded by opposition activists following the August 21 alleged chemical attack shows sheep allegedly killed during the attack. The presence of dead animals, including birds, dogs, cats, and livestock, is further evidence of a chemical attack.
Source: http://www.youtube.com/watch?v=eF4GF1ysNm8&feature=share&list=UUdqyoMJox2GUa_9R_ILNbGQ

common pesticide Malathion, but the severity and extent of the clinical signs and symptoms coupled with the large death toll that resulted from the attack strongly suggests that a much more toxic chemical warfare nerve agent was used in the attack.

Syria is believed to possess at least two nerve agents, Sarin and VX, in significant quantities.³⁴ Sarin is a toxic but non-persistent nerve agent. Exposure is usually due to inhalation, and the agent rather quickly degrades and disperses into atmosphere. The agent VX is both more persistent and 5 to 10 times more toxic than Sarin. Exposure and death by VX is caused by inhalation or by skin,

³⁴ See, for example: David E. Sanger, Andrew W. Lehern, and Rick Gladstone, "With the World Watching, Syria Amassed Nerve Gas," September 7, 2013, New York Times, <http://www.nytimes.com/2013/09/08/world/middleeast/with-the-world-watching-syria-amassed-nerve-gas.html?pagewanted=all> (accessed September 7, 2013).

conjunctival, and mucosal absorption. There are reports that people were able to visit the sites of the attacks a few hours post attack and to handle remnants of rockets associated with the attacks without suffering signs and symptoms of exposure to nerve agent. This suggests that the nerve agent involved is more likely to be the less persistent and less toxic agent, Sarin, rather than VX.

Thus while our findings cannot be conclusive without laboratory analyses of environmental and physiological samples, the large number of victims of the attack, the clinical signs and symptoms that characterized both the victims and, later, the medical workers who treated the victims, and the fact that areas near attack sites were apparently safe to enter soon after the attack, all strongly suggest that the attack involved an organophosphate chemical more toxic than the pesticide Malathion, and was most likely a toxic but non-persistent chemical warfare nerve agent, such as Sarin, which Syria is believed to possess.

The use of Sarin in these latest attacks would be consistent with its apparent use earlier in Syria. There is laboratory evidence that Sarin gas has been used in previous attacks allegedly carried out by Syrian government forces, including an earlier attack in Ghouta. A photographer for



Le Monde newspaper, Laurent Van der Stockt, was exposed to what he believed was a chemical weapon attack while in Jobar in April 2013.³⁵ In laboratory tests conducted upon his return to France, he tested positive for exposure to Sarin. Sarin was thus a likely agent to have been used in the Jobar attack, and is consistent with the symptoms experienced by those exposed to the agent during the August 21 attacks on Ghouta.³⁶

Other samples collected by the Le Monde team from sites of suspected chemical attacks in the Jobar and Ghouta areas also tested positive for Sarin in June 2013.³⁷ During the same April trip, the Le Monde journalists also collected 21 hair, blood, urine, and clothes samples from victims of suspected chemical weapon attacks in Jobar and Ghouta

³⁵ Kareem Fahim, "Still More Questions Than Answers on Nerve Gas in Syria," June 10, 2013, New York Times, http://www.nytimes.com/2013/06/11/world/middleeast/still-more-questions-than-answers-on-nerve-gas-in-syria.html?pagewanted=all&_r=0 (accessed September 9, 2013).

³⁶ Jean-Philippe Rémy, "Des analyses confirment l'ampleur de l'usage de sarin en Syrie," Le Monde, June 28, 2013, http://www.lemonde.fr/proche-orient/article/2013/06/28/des-analyses-confirment-l-ampleur-de-l-usage-de-sarin-en-syrie_3438187_3218.html (accessed September 6, 2013).

³⁷ Ibid.

A still image from a YouTube video uploaded by opposition activists following the August 21 alleged chemical attack shows a child victim of the attack frothing from the mouth and cyanosis (bluish coloring of the face, especially around the lips, caused by suffocation or asphyxiation due to the build-up of mucus and fluids in the lungs), a medical condition associated with exposure to nerve agents such as Sarin.
Source: <https://www.youtube.com/watch?v=xfTKTlf4-Dg>

neighborhoods of Damascus and had the samples tested by the Centre D'Études du Bouchet, a French laboratory specializing in the analysis of samples of nuclear, chemical, and biological agents. Thirteen of the samples tested positive for exposure to Sarin gas, while the other samples tested inconclusive.³⁸

³⁸ Ibid.



This handout photo provided by Shaam News Network shows a young victim of an alleged chemical weapons attack on Ghouta, Syria, recuperating in a hospital on August 22, 2013. © 2013 Associated Press

IV. RESPONSIBILITY FOR THE AUGUST 21 ATTACKS

Syrian Government Forces Responsibility for the Attacks

The evidence examined by Human Rights Watch strongly suggests that the August 21 chemical weapon attacks on Eastern and Western Ghouta were carried out by government forces. Our basis for this finding is:

- The large-scale nature of the attacks, involving at least a dozen surface-to-surface rockets affecting two different neighborhoods in Damascus countryside situated 16 kilometers apart, and surrounded by major Syrian government military positions.

- One of the types of rockets used in the attack, the 330mm rocket system – likely Syrian produced, which appear to have been used in a number of alleged chemical weapon attacks, has been filmed in at least two instances in the hands of government forces. The second type of rocket, the Soviet-produced 140mm rocket, which can carry Sarin, is listed as a weapon known to be in Syrian government weapon stocks. Both rockets have never been reported to be in the possession of the opposition. Nor is there any footage or other evidence that the armed opposition has the vehicle-mounted launchers needed to fire these rockets.
- The August 21 attacks were a sophisticated military attack, requiring large amounts of nerve agent (each 330mm warhead is estimated to contain between 50 and 60 liters of agent), specialized procedures to load the warheads with the nerve agent, and specialized launchers to launch the rockets.

V. SYRIA AND CHEMICAL WEAPONS UNDER INTERNATIONAL LAW

Syria is not among the 189 countries that are party to the 1993 Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and on their Destruction.³⁹ However, Syria is a party to the 1925 Geneva Gas protocol, which bans the use in war of asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices.⁴⁰ The use of chemical weapons is also prohibited as a matter of customary international humanitarian law, or the laws of war.⁴¹

The prohibition on the use of chemical weapons applies to all armed conflicts, including so-called non-international armed conflicts such as the current fighting in Syria. The International Criminal Tribunal for the former Yugoslavia, in the Tadic case, stated “there undisputedly emerged a general consensus in the international community on the principle that the use of [chemical] weapons is also prohibited in internal armed conflicts.”⁴² In 1977, during a debate in the First Committee of the United Nations General Assembly, Syria supported a complete ban on chemical weapons.⁴³

³⁹ Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and on their Destruction, Paris, January 13, 1993, Doc. CD/CW/WP.400/Rev. 1, <http://www.icrc.org/applic/ihl/ihl.nsf/Treaty.xsp?action=openDocument&documentId=9D3CCA7B40638EF5C12563F6005F63C5> (access September 7, 2013).

⁴⁰ Protocol for the Prohibition of the Use of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, Geneva (Geneva Gas Protocol), June 17, 1925, <http://www.icrc.org/applic/ihl/ihl.nsf/Article.xsp?action=openDocument&documentId=58A096110540867AC12563CD005187B9>. Syria ratified the Geneva Gas Protocol in 1968.

⁴¹ International Committee of the Red Cross, Henckaerts, Doswald-Beck, eds., Customary International Humanitarian Law (Cambridge: Cambridge University Press, 2005), rule 74.

⁴² International Criminal Court for the former Yugoslavia, Tadic case, Interlocutory Appeal, October 2, 1995, sec. 120.

⁴³ Syria, Statement before the First Committee of the UN General Assembly, UN Doc 1/C.1/32PV.15, Sept. 30, 1977, pp. 11 and 16.

(cover photo) Bodies of victims of a suspected chemical attack on Ghouta, Syria on Wednesday, August 21, 2013.

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