

THE THREAT OF THEATRE BALLISTIC MISSILES



Myth or reality?
A study on the use
of ground-to-ground
short-range missiles
and theatre ballistic
missiles in warfare
operations

1944 -2001



A special 24-page issue of TTU, in colour, and devoted to a single topic! A surprise for our readers.

The reason is simple: the subject is exceptional. How to explain the difference between the abundance of articles, conferences and meetings devoted to the protection against theatre ballistic missiles and the scarcity of studies dedicated to the offensive use of these missiles and the evolution of their threat? Is it because military specialists think that since this threat exists, discussing it is useless? At the risk of raising doubts about the reality of a threat which has, in a way, become mythical. Unless it would be "politically incorrect" to evoke the use of weapons that are by nature offensive, and which states considered potentially aggressive have at their disposal.

Let us recall some facts:

- The total number of ballistic missiles fired in operations is around 6,000! This includes 3,000 V2s in 1944-45 and, in particular, 3,000 Scuds and derivatives since 1973.

- V2s and Scuds have the same advantages and disadvantages: no warning before impact, no effective defence before 2005, low vulnerability of the launch vehicles. With regards to limitations in range, load, precision, and rate of fire, the next generation of Super-Scuds will obviously improve upon them.

- Regarding the concept of use, it is identical to that of 1944. Used in lieu of an air force, it can be an "instrument of terror" over cities. In addition, in a lesser known use, these missiles have been used as a "super long-range heavy-artillery."

In others words: what was valid in 1944-45 still holds today! And could be even more relevant confronted with an owner of theatre ballistic missile, no matter who.

I hope this supplement will be useful as a participant in the current discussions on strategic and tactical questions, and that it will provide a true complement to our bimonthly newsletter.

Guy Perrimond

Cover page: Firing of a Russian SS-21 Scarab in Chechnya, in November 1999, to bombard Separatist Chechens supplying routes. (AFP)

Page 2 : Successful firing of a Pakistani Ghauri 2, on 14 April 1999 from Jhelum, 120 km south of Islamabad. (AFP)



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The Wehrmacht's secret weapon...

In 1942, Nazi Germany realised it was too late to launch long-range bombers capable of wreaking the same damage as the growing numbers of American four-engine B-17 Flying Fortresses and British Lancasters in the combat zone. Hence, the A4 ballistic rocket programme (V-2), led by Heer (German army) since 1934, seemed one of the only possible solutions in the absence of strategic bombers.

FROM THE INSTRUMENT OF TERROR...

Between 8 September 1944 and 27 March 1945, 1,115 V-2 impacts were recorded on British territory, primarily in the London area. This campaign of terror left 2,700 dead and 6,500 severely wounded, and forced the evacuation of 1,450,000 people.

The attack on London was a terrible blow because of its unstoppable aspect.

The V-2 reached its target without any alarm or defence. The Allied air forces, although in control of the skies, appeared unable to locate and destroy even one V-2 field launching unit.

This attack on London shifted the focus from the offensive launched against the vast harbour complex of Antwerp in Belgium, whose military significance was very different.

... TO THE "SUPER-ARTILLERY"

Antwerp's harbour, a strategic position of prime importance, was shelled by V-2s upon its reopening to allied traffic on 28 November 1944. Tonnage unloaded there was indeed more significant than that of all the harbours in Europe opened to allies.

1,712 V-2s were fired on Antwerp, with 1,474 impacts recorded, in addition to the 4,244 V-1 impacts, killing 3,772 persons and severely wounding 6,074.

V-2s also attacked Liege, Diest, Hasselt, Mons and Tournai in Belgium (146 impacts), as well as Lille, Arras, Tourcoing and Cambrai in France (55 impacts), these cities representing significant rail junctions on the allied rear.

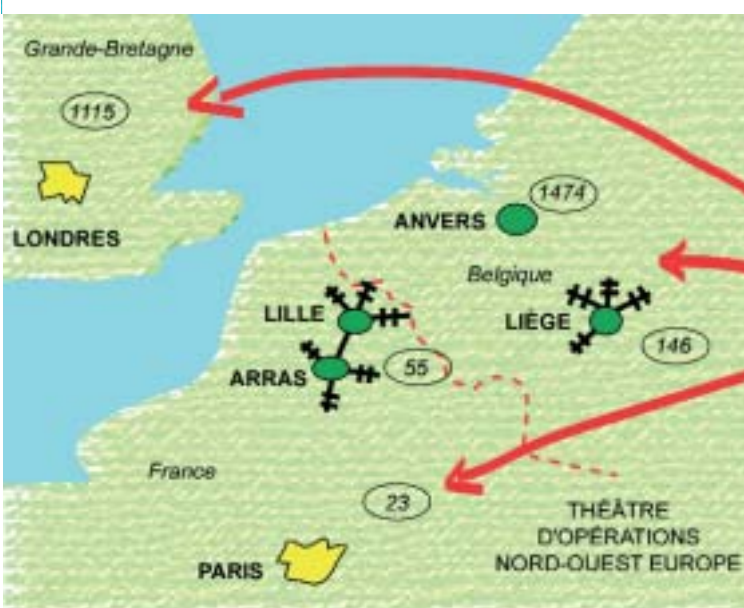
This offensive thus sought to disorganise allied logistical efforts by attempting to neutralise communication centres in the rear area of the enemy.

During the crossing of the Rhine, the Remagen bridge was also the target of V-2s. If these neutralisation missions were, in the allied camp, entrusted to the air forces, the Luftwaffe, for its part, was no longer in a position to carry them out.

This use of V-2s as a heavy "super-artillery" with long-range capabilities was certainly not unrelated to the fact that the V-2 fields launchers had been carried out by battalions of the German Army artillery.



A German A-4 ballistic missile, known as V-2, on its firing range. (Keystone)



V-2 impacts recorded circled on the European north west theatre of operations, in 1944-45.



Since 1973,
nearly 3,000 Scuds
have been fired
during ten conflicts
or crises...

Warfare oper since

Developed between 1955 and 1960, exported and used in combat since 1973, the Soviet Scud B missile is, along with its North Korean, Iraqi and Iranian derivatives, incontestably at the origin of the worldwide proliferation of theatre ballistic missiles of the 300- to 500-km range.

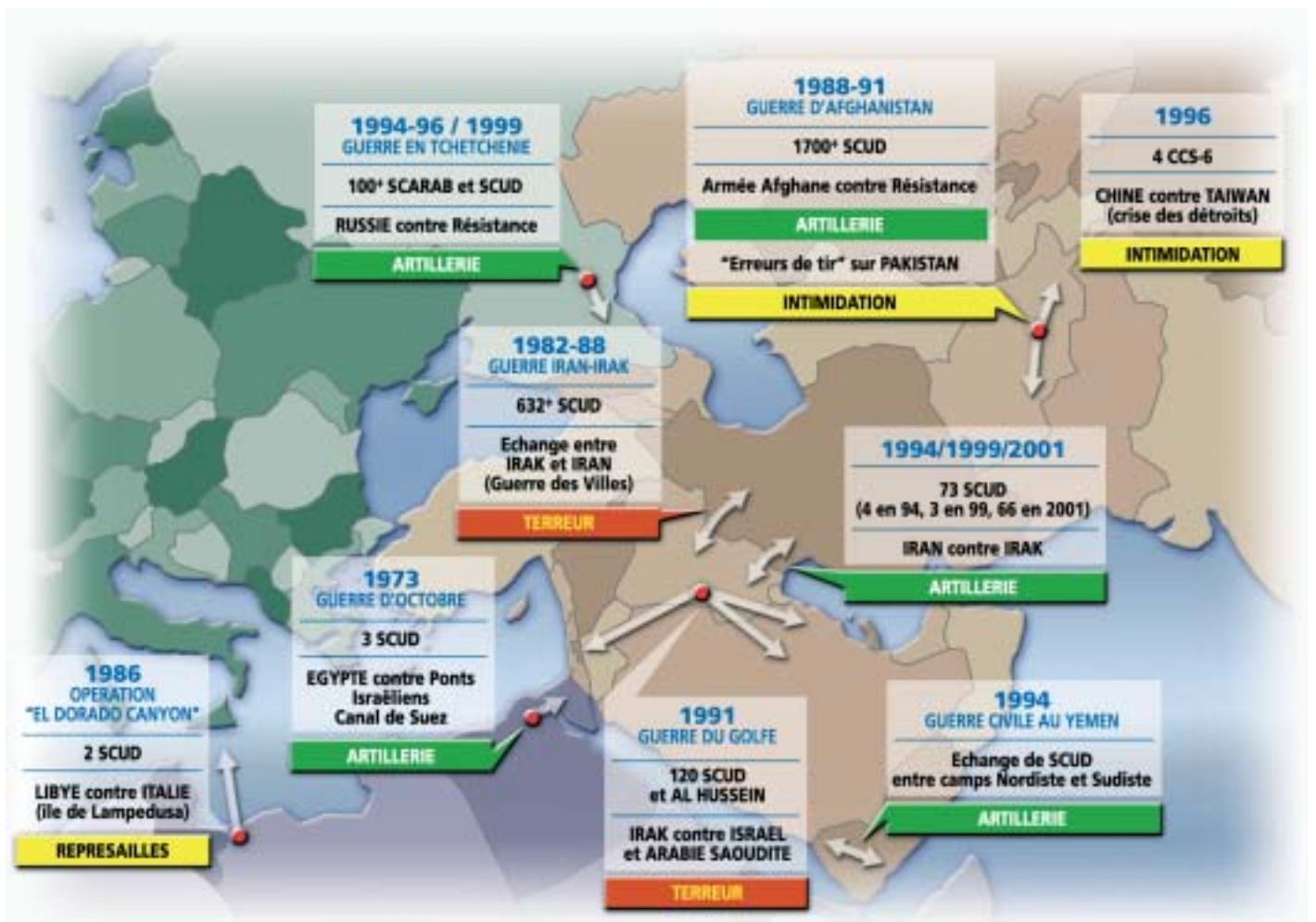
With 5,000 specimens produced in the USSR, the Scud was manufactured in greater number than all other ballistic missiles combined.

A closer look at the operational use of the Scud

reveals that this missile was a continuation of the very same features as the operational concept initiated by the V-2.

Like the V-2, the Scud was employed everywhere as a palliative to combat planes. Again, like the V-2, the Scud gained its reputation as an instrument of terror by indiscriminately attacking cities and villages, causing tens of thousands of civilian victims. This form of use received wide media coverage and to this day remains an issue.

Map on the use in warfare operations of theatre missile since 1973



ations 1973



Des soldats russes préparent pour son lancement un missile SS-1 Scud-B quelque part en Tchétchénie en décembre 1999. La charge militaire n'est pas encore installée sur le vecteur. (AFP)

Still like the V-2, the Scud had been used, as much if not more, as a "super-artillery" with long range capabilities, this latter use remaining relatively unknown.

However it is in this form of use that Scud has shown on several occasions, in particular during the Gulf War, that theatre ballistic missiles could be a serious threat to the control of allied forces operations in overseas interventions.

Map of the theatre missile distribution since 1973 ; divided in "Terror over cities" and "In-depth strike".

POLITIQUE DE TERREUR(*)

1973

1982-1988

1986

1988-1991

1991

1994

1994

1994-1996

1996

1999

1999

2001

Total

- Guerre des Villes, Iran-Irak
- *Scud* libyens sur Lampedusa
- *Scud* afghans vers Pakistan
- *Scud* afghans sur villes et villages
- *Al Hussein* sur Ryād, Tel Aviv...
- CSS-6 chinois vers Taïwan
- **6 utilisations**

ARTILLERIE À LONGUE PORTÉE

• *Frog* et *Scud* égyptiens et syriens

• *Scud* sur zones et itinéraires de la résistance afghane

• *Al Hussein* sur Dhahran, Al Jubayl

• Guerre civile au Yémen

• *Scud* iraniens sur camps du MEK

• *Scud* russes sur Tchétchénie

• *Scud* et *Scarab* russes sur Tchétchénie

• *Scud* iraniens sur camps du MEK

• *Scud* iraniens sur camps du MEK

• **9 utilisations**

(*) ou d'intimidation



from some intimidation firings... to a massive exchange of missiles

Iraq used ground-to-ground artillery missile Frog-7 against Iranian cities from the very start of the conflict. Thus the first three Frog-7s hit the town of Dezful on 8 October 1980. In 1981, a total of 54 Frogs were aimed primarily at Dezful and Ahmaz, in Iran.

Iranians could not compete with the Iraqi units with respect to the volume of fire, but benefited from the proximity of large Iraqi cities, in particular the capital, Baghdad. The first Iranian Scud missiles were thus aimed at Baghdad and Kirkouk on 12 and 14 March 1985.

The First Iraqi Scud was only fired on 27 October 1982, on the town of Dezful, killing 21 people and wounding more than 100 other civilians. Two other Scuds aimed Dezful on 19 December 1982 resulted in 349 civilian victims. In 1985, the Iraqi army intensified its Scud firings on Iranian cities—firing one hundred missiles in the year—diversifying the targets to reach more distant cities, like Masjed-e-Soleyman and Ramhormoz.

The attack on Baghdad angered the Iraqi leader. From then on, he tried relentlessly to acquire the capacity to strike Tehran, the enemy capital, in reprisals. After the Soviet refusal to provide SS-12 Scaleboards, the Iraqis turned toward the development of a local Scud derivative with a lengthened range, baptised Al Hussein.

In 1985, Iran finally succeeded in getting some launchers and a limited stock of missiles from Libya, which constituted the basis of the Khatam Al-Anbya Force, attached to the Islamic Revolutionary Guards Corps (Pasdaran). The

In 1986, the two countries had almost exhausted their initial stocks, which triggered a vigorous competition to acquire more Scuds from foreign countries. In 1986, the USSR provided around 300 additional Scuds, i.e. a year's worth of production.

beginning in 1988, both countries launched a vast terror campaign over cities

The Teheran population's morale had been severely hit by the brutality and regularity of the Iraqi strikes ; and the fear of chemical attacks. Cities were emptied by the thousands.

"Cities Warfare" was the name given to the ultimate offensive between Iran and Iraq, which used ground-to-ground missiles to spread terror in enemy cities.

This battle lasted 52 days, from 29 February to 20 April 1988, resulting in thousands of civilian victims. It began on 29 February with the firing on Teheran of the first seven Al Hussein missiles, Scuds with a lengthened range, specially developed by the Iraqis in order to reach across the 500 km which separated the Iranian capital from the first Iraqi positions. Al Hussein is a modified Scud whose warhead was scaled down to be able to carry more propellant and to increase the range from 300 km to 500 km. In spite of the considerable reduction in the explosive load, the Al Hussein's impact at more than Mach 1.5, caused considerable damage in urban zones.



Impacts of an Iraqi Al-Hussein on Teheran. (D.R.)

The Iraqis fired 189 Scuds and Al Husseins (more than 90 per cent were Al Hussein) against six Iranian cities: Teheran (135 missiles, i.e. 70 per cent of the total Qom, the Iranian Holy City (23 missiles), Ispahan (22), Tabriz (4), Chiraz (3) and Karaj (2).



An Iranian Shahab-3 is shown on 21 September 2000 to celebrate the 20th Iran-Iraq war anniversary, on which the war memorial can be seen. (AFP)

As a reprisal, the Iranians initially used the locally manufactured short-range ground-to-ground missile, the Oghab, of the Frog-7-class. The Oghab entered service in 1986 and had been aimed at Bassora in December 1986. From January to May 1988, Iran fired 260 short-range missiles on Iraq, including 104 Oghab.

The Iranians answered by firing 75 to 77 Hwasong-5, of North Korean origin, a lengthened range version of the Soviet Scud, most of them aimed at Baghdad. They had just acquired them from North Korea with Iranian financing. The delivery of 90 to 100 missiles, for an amount of 500 million dollars, had been carried out between July 1987 and February 1988. At that time North Korea also provided technical assistance to Iran to establish a manufacturing site for the Hwasong-5 and later -6.

Over a seven-year period lasting from 1982 to 1988, 632 Scud missiles and derived missiles were fired during the conflict, including 361 by the Iraqis and 271 by the Iranians

A first, low-profile use, the Arab-Israeli war of 1973

At the end of 1967, the Egyptians obtained from the Soviet Union the delivery of Frog-7 ground-to-ground missiles.

It was the first export of this kind out of the Warsaw Pact countries. Then, in April 1973 the Soviets delivered, two Scud brigades with 12 TEL each.

In the first hours of the October 1973 war, between 60 and 70 Frog-7s targeted command centres, air bases and Israeli electronic listening posts, in Romani, Tasa, Bir Gafgafa, Oum Margan and Oum Khisheid. These firings caused damage, albeit limited, and unquestionable disorganisation within the Israeli command.

After the Israelis crossed the Suez Canal during the night of 15-16 October, Frog-7s tried to reach Israeli bridges, without success. The number of Frog-7s fired by the Egyptians during the conflict is estimated at 100 to 120 (of a stock of 180 to 190 missiles). Although the Frog-7 is a non-ballistic ground-to-ground artillery missile of short range (< 70 km) which cannot be put in the category of the ballistic missiles to which Scud belongs, its use in combat would turn out to be doctrinally inseparable from the employment of the Scud. The war in Afghanistan demonstrated this com-

binated use beginning in 1985. After having used their Frogs, the Egyptians fired three Scud Bs from the Cairo area toward the Israeli bridges on Suez Canal on 22 October 1973, shortly before the cease-fire issued by the United Nations. The missiles crashed in the desert.

The Syrians, for their part, fired between 70 and 90 Frog-7s, primarily targeting air bases in the north of Israel. The Israelis responded with a vast shelling campaign over Syria, striking staff headquarters in Damascus, as well as petroleum industry installations and power stations, resulting in the acquisition of Scud Bs by the Syrians in 1974, as a mean of dissuasion or reprisal.



Egyptian Frog-7 were the first ground-to-ground missiles fired during the October war of 1973. The three Egyptian Scud-B's launched on the 22 October 1973 were the first ballistics missiles fired in operation since 1945. Above, a Libyan Frog-7 in Tripoli in September 1999. (AFP)



1986 - Lampedusa : first firing on the European continent since 1945



15 April 1986, in the afternoon. Members of the U.S. Coast Guard in charge of the broadcasting station of the of aerial navigation system LORAN (Long Range Aid to Navigation) and personnel at the Electronic Warfare centre of the U.S. National Security Agency (NSA), on the Italian island of Lampedusa, were surprised to hear several violent explosions in the area surrounding the island. First, they thought they were being subjected to an air attack or a naval shelling. But the sky and the horizon were empty of planes and ships. Libya had, in fact, just responded to the American air raids on its territory (Operation

El Dorado Canyon) by firing several Scuds from the Zuwarah area, on the Libyan-Tunisian border, 270 km from Lampedusa. The missiles, which were not aimed far enough, crashed into the sea.

Still, this attack on Italian territory by a theatre ballistic missile constituted the first attack on European territory since the German V-2s. The Lampedusa episode was a determining factor in Italy's decision, in 1989, to join France in the development of the Aster family of anti-missile missiles.

1988-1991 - The Afghan war : more than 1,700 Scuds fired !



A Frog-7, ground-to-ground artillery rocket, of 65 km range, in the streets of Kabul, Afghanistan. (AFP)

The figure may appear unbelievable. It has, however, been confirmed by all sources of information. From November 1988 until the end of 1991, the Afghan government's army, supported by the Soviet Union, fired between 1,700 and 2,000 Scud missiles against resistance forces, marking a first un-

expected use of a theatre ballistic missiles in counter-insurgency missions.

Delivered by the Soviets beginning in October 1988 and triumphantly showed off during a procession on 1 November 1988 in the streets of Kabul, the first Scuds were fired the same evening. As early as 3 November, between six and eight missiles struck the outskirts of Jalalabad, encircled by the Afghan resistance.

During the first months of their use, the Scud attacks were concentrated on the east of the country, near the border with Pakistan. The distance between Kabul, from where Scuds were fired, and Kandahar being 450 km, indicates that in addition to the 300 km-range

Scud Bs, the government army also had Scud Cs with a 500-km range.

The study of this offensive led analysts to say that the campaign was not only aimed at tactically prohibiting the supply routes of the resistance, which had its rear bases in Pakistani territory, but also to politically dissuade Pakistan from continuing to support the guerrillas and harbouring their bases.

Several missiles were lost "by mistake" crashing on Pakistani territory, in order to intimidate the government.

In total, ten Scuds crashed in Pakistan, one of which landed 40 kilometres from Islamabad, the capital, killing 26 people and wounding 63. The rate of firing increased considerably in March 1989, with the beginning of the battle of Jalalabad. It lasted almost one year. From March to December 1989, 1,128 Scud firings were thus reported, i.e. an average of six to eight firings per day. A record was reached on 6 July 1989 with eleven Scuds fired on Jalalabad.

In July alone, 229 Scuds struck the outskirts of the city.

From August 1989 onwards, the Afghan government army used Frog-7s in the area.

Soon, all the battles zones, such as the city of Kandahar in the south of the country or the Salang mountain pass north of Kabul, were subjected to bombardment by Scuds.

Devastating psychological effects on Afghan guerrillas...

After the fall of Khost, in March 1991, the Scud attacks were greatly reduced for logistical reasons. The yearly consumption of Scuds in Afghanistan (between 600 and 700 missiles) largely exceeded the annual Soviet production. As the delivery of missiles, fuel and spare parts to maintain the intensively used equipment were exclusively made by air, it represented a logistical effort and cost which the Soviets could probably no longer afford.

Following two political decisions, Scud firings ceased almost entirely: the signature in September 1991 of a Soviet-American agreement providing for a stop to all weapons deliveries by the two countries in Afghanistan, beginning 1 January 1992; and President Mikhail Gorbachev's decision to recall the Soviet military advisers who looked after the operational control of the Scuds. The withdrawal of this support consequently prevented the Afghans from using these weapons.

The Scuds unleashed a certain terror on the resistance. While the militia without military experience often refused to be impressed by the firings and faced the threat with scorn, the more experienced soldiers recognised that Scuds could have, in the case of intensive bombardments, a devastating psychological effect because of the terror provoked by the total absence of warning before impact and by the feeling of powerlessness in face of a great number of missiles. The Stinger's uselessness when confronted with this threat, and the absence of any form of defence reinforced this feeling.

Nevertheless, the Scud attacks had little impact on guerrilla operations. The feeling of defencelessness in face of the Scud quickly faded with experience and the discovery that the use of the tactics inherent to guerrillas largely decreased the risks: dispersion, mobility and camouflage. Besides, the Soviets had encountered the same difficulties when using their Frogs against the guerrillas.

However, massive attacks on cities and villages between 1988 and 1991 killed a great number of civilians and undoubtedly some resistance fighters as well, resulting in several thousand victims.

Summary of counter-insurgency missions

- An effective ban of the resistance's means of communication, in a long-range artillery mission.
- Bombardments of cities and villages used as supply bases for the guerrillas, forcing the resistance to evacuate its strongholds. On 20 April 1991, two Scuds struck the bazaar of Asadabad on a busy day, killing 300 people and wounding 500. This city was used as a rear base by the resistance for the attack on Jalalabad, 80 km to the south-west.
- Harassment of the groups of resistance forces encircling the cities, with intense firings during the battles of Jalalabad and Khost.
- Immediate reprisal firings on cities that had just fallen into the hands of the resistance, in order to push both the population and resistance to evacuate. The town of Khost was the target of an attack the very same day it fell into the hands of the resistance, in March 1991.
- Forced evacuation of entire zones, through attempts to depopulate them by spreading terror.
- Preventive strikes on ambush zones used by the resistance such as the Salang mountain pass. These blocking fires were often followed by an infantry attack.

An original, use, the anti-coup d'Etat !

On 6 March 1989, the Afghan minister of defence, General Shah Nawaz Tanai attempted a coup de force against President Najibullah, from his headquarters established on the air base of Bagram, north of Kabul. In their counter-attack on Bagram, recaptured the following day, the loyalist forces used the Scuds from their Darulaman base, south of Kabul. General Tanai recognised that the shelling by Scuds was one of the main reasons for the failure of his coup d'Etat.



1991 : The Scud is Saddam Hussein's last



number of failed firings. By aiming at Israel, Saddam Hussein hoped to provoke an uncontrolled reaction from the Israelis and secretly hoped to succeed in dividing the allied anti-Iraqi coalition, causing the departure and even a change of position of Arab countries like Egypt or Syria.

By striking the Arabian Peninsula, Iraq showed that it could punish the "treacherous" countries which had welcomed the American forces on their territory. The deployment of Patriots, in spite of their operational inefficiency (later revealed), reassured the population of the Saudis cities that were targeted. Feeling protected one way or another, Israel stayed out of the conflict.

Iraqi military parade, Victory Square in Baghdad, on 31 December 2000. (AFP)

Iraqi ballistic missile attacks against Saudi Arabia and Israel had a major influence on the way this war was perceived. The psychological impact was, in fact, much more significant than the actual number of explosives launched. Given the images of large cities such as Riyadh, Dhahran, Tel Aviv or Haifa being shelled night after night, military commanders and the public could have thought it was 47 years earlier, at the time of the V-2s and the second London Blitz.

The political usefulness of having an anti-ballistic missile fighting capacity, even with poor operational effectiveness, was thus demonstrated. The Iraqi use of ballistic missiles must be understood from a purely psychological and political point of view, independent of the true level of damage it caused. By this demonstration of force, Saddam Hussein could show the world that he was still able to strike his enemies, despite the loss of his air force. Thus, he increased his prestige in the Arab and Muslim world, as well as among his own people, who were subjected to allied shelling.

Scuds were the only weapon in the entire Iraqi arsenal which could be used, night after night, and until the last day of the war, as a reprisal against allied air raids.

Reliable sources estimate that Iraq launched approximately 120 Scud B or Al Hussein missiles starting 18 January 1991, with a certain



Although the 30 fixed Scud launching units were quickly located and destroyed by allied aircraft, the field launching units appeared much more difficult to locate during the 15 to 30 minutes of firing preparation time, during which they are vulnerable.

In spite of thousands of aerial flights, almost none of the 40 to 60 launcher vehicles had been destroyed. It is widely suspected that the successes recorded, and announced in the allies' official statements, in fact only destroyed decoys, obligingly exposed by the Iraqis.

An American soldier and Saudi policemen are inspecting the wrecks of an Iraqi missile Al-Hussein, which landed on Riyadh on 22 January 1991. It must be one the various missiles which collapsed while descending upon the atmosphere and whose wrecks landed without exploding and without being intercepted by the Patriots. (AFP)



1994 : War in Yémen

From the Middle East to Asia, through the Caucasus, the use of theatre ballistic missiles became common in crises...

Following the surprise union in May 1990 between Northern Yemen and the Marxist People's Republic of Southern Yemen, political party friction led to a civil war beginning in May 1994. Following 15 days of indecisive combat, Northerners succeeded in making a breakthrough and approaching the large Southern air base of

Al Anad, 60 km north of Aden, which was the object of tough clashes. By mid-June 1994, Aden was surrounded by Northerners, and fell into their hands in early July. The rival factions, which had Scud and Frog 7 missiles, did not hesitate to use them in great numbers.

1994-1999 : Russians against Chechens



Rear view of a Russian Scud B, with details of the deflectors (silver coloured graphite) which are used for missile piloting ; the drift (in green) are fixed.
(AFP)

At the end of 1994, Chechnya was invaded by Russian armed forces. Fighting culminated in January 1995 with the first battle of Grozny. Until its withdrawal in 1996, the Russian army used ground-to-ground missiles as long range artillery. An unspecified number of Scuds were fired, in the hopes of rendering certain zones and routes inaccessible to the separatist Chechen guerrilla forces. Faithful to its practice of the "a power hammer to hunt mosquitoes," the Russian army did not hesitate, in 1999, to use its most recent ground-to-ground missile, the SS-21 Scarab, successor of the Frog-7, to support its second intervention. In November 1999, the Scarab was used to bombard Chechen transportation routes in the narrow, hemmed-in valleys in the south of the country, which were the only supply routes for the rear bases in Georgia.

1994, 1999 et 2001 : Iranian fires of intimidation

In 1994, Iran inaugurated a new use of Scuds as stand-off intimidation strikes when it fired four Scuds against a base of the Mujahideen-e-Khalq (MEK) organisation, an Iranian armed movement opposed to Teheran's regime, headed by Massoud Radjavi, and established in Iraq.

In June 1999, Iran repeated the move by firing three Scud Bs on an MEK camp in Ashraf, 80 km from the border.

A large-scale use in 2001

On 18 April 2001, Iran launched against the

MEK camp in Iraq one of the most massive barrages of theatre ballistic missile fire ever seen since World War II. In three hours, between 4:15 AM and 7:30 AM, a total of 66 Scud missiles were launched by the Islamic Revolutionary Guards Corps (Pasdaran), from 17 launching vehicles.

Iraq reported considerable damage caused to the areas of Jalula, Al Mansuriyah, Al Khalis, Baghdad, Kut, Amara and Bassora, resulting in numerous civilian deaths.



The Chinese missile CSS-6, in NATO nomenclature, is baptised DF-15 by the Chinese "Second Artillery"; and an M-9 for exportation. During its development, four CSS-6 have been fired in July 1995 on the vicinity of Taiwan. (XINHUA)

1996 : Tensions between Taiwan and China

In March 1996, while it was carrying out naval army manoeuvres, the People's Republic of China fired four type CSS-6 600-km range ballistic missiles in the direction of Taiwan.

The missiles crashed at sea, in the waters of the strait bordering the island. These firings were clearly identified as a means of intimidation while general elections were being held in Taiwan.

The concept of use developed by Hitler is still relevant...

The Eastern users of ballistic missiles seem to have realised the perfect synthesis of the qualities and defects of these weapons. Whether the V-2 shelling London in 1944-1945 or the Iraqi Al Hussein striking Riyadh or Tel Aviv, Hitler and Saddam Hussein, separated by a span of fifty years, were in the same situation: confronted with the crushing allied air superiority and with their own air power deficiency, the theatre ballistic missile was the only capability they had with which to counteract the strategic shelling of their cities and industries by the allies.

A modern fighter-bomber is undoubtedly capable of carrying a much greater warhead at the same distance and with much greater precision -about 10 meters with traditional bombs and about one meter with laser guided bombs- than a theatre ballistic missile. But an air force is extremely expensive to acquire, maintain and train, and only a limited number of countries can afford one. For instance, no Arab country has succeeded in carrying out in-depth strikes against Israel during the various Arab-Israeli conflicts, in spite of the small size of this territory. During the Lebanese war in 1982, the Syrian air force experienced a rate of loss during aerial combat of 30 per cent (82 aircraft shot down for 266 sorties). During the Gulf War in 1991, the Iraqi air force was quickly destroyed by allied shelling. Under these conditions, the ballistic missile appears as the main alternative in the absence of an air force, for in-depth strikes of enemy territory defended by Western means.

TYPES D'OBJECTIFS	CRISES ou CONFLITS
<ul style="list-style-type: none"> • Bases Aériennes et Aéroports 	<ul style="list-style-type: none"> - Sinaï et Galilée (1973) - Dhahran (1991) - Al Anad, Yémen (1994)
<ul style="list-style-type: none"> • Complexes Portuaires 	<ul style="list-style-type: none"> - Anvers (1944-1945) - Al Jubayl (1991)
<ul style="list-style-type: none"> • Installations Militaires Étendues - Bases logistiques, - Casernements, dépôts, - Points de ravitaillement 	<ul style="list-style-type: none"> - Sinaï (1973) - Afghanistan (1985-1991) - Guerre du Golfe (1991)
<ul style="list-style-type: none"> • Sites Fixes - Postes de commandement, station radar, d'écoute ou de télécommunications 	<ul style="list-style-type: none"> - Sinaï (1973) - Lampedusa (1986)
<ul style="list-style-type: none"> • Voies et Nœuds de Communication - Itinéraires, - Passages obligés (ponts, cols ...) 	<ul style="list-style-type: none"> - Liège, Lille, Arras (1944-1945) - Canal de Suez (1973) - Afghanistan (1985-1991) - Tchéchénie (1994-96)-(1999)
<ul style="list-style-type: none"> • Concentration de Troupes - Tête de pont - Zones de transit, d'attente ... - Camps d'un mouvement d'opposition 	<ul style="list-style-type: none"> - Remagen (1945) - Afghanistan (1985-1991) - Yémen (1994) - Crises Iran-Irak (1944)-(1999)-(2001)
<ul style="list-style-type: none"> • Emprises Industrielles - Production et stockage d'énergie (centrales thermiques, raffineries, dépôts pétroliers ...) 	<ul style="list-style-type: none"> - Guerre Iran-Irak (1980-1988)

Type of objectives hit by theatre ballistic missiles corresponding to the banning mission and shelling entrusted to the West by aerial forces.



The thread

Outline of the various launchers in

The proliferation of the Scud's improved derivatives as "pseudo-strategic" weapons for Third World countries, is accompanied everywhere by a systematic search for an increased ballistic missile range closer to the medium range (1,000 to 3,000 km). The proliferation of destructive and terrorist effects through the use of massive destructive warheads (chemical...), is now possible. In the end, the increase in impact precision of theatre ballistic missiles also appears inevitable.

	RANGE (km)	WARHEAD (kg)	CEP (m)	REMARKS
CHINA				
• CSS-8	150	190	--	In service (1992)
• CSS-7	280	800	600	In service (1982)
• CSS-6	600	500	300	In service (1990)
• CSS-5	2 500	500	700	In service (1987)
• CSS-2	2 400	2 500	1 000	In service (1988)
NORTH KOREA				
• HWASONG-5	325	985	450	In service (1988)
• HWASONG-6	550	770	700	In service (1992)
• NODONG	1 300	770	3 000	In service (1994)
• TAEPO DONG-1	2 000	750	3 000	1st flight in 1998
• TAEPO DONG-2	6 000	--	--	Under développement
INDIA				
• PRITHVI-1	150	800	150	In service (1994)
• PRITHVI-2	250	500	250	In service (1998)
• PRITHVI-3	350	--	25	Under développement
• AGNI 1	1 200	800	40	1st flight in 1989
• AGNI 2	2 500	700	45	In service (2000)
• AGNI 3	3 500	--	--	Under développement
IRAN				
• SHAHAB-3	1 300	800	2 500	Under production
• SHAHAB-4	2 000	--	--	Under développement
IRAQ				
• AL HUSSEIN	600	500	1 000	In service (1988)
ISRAEL				
• JERICO-2	1 500	800	--	In service (1990)
PAKISTAN				
• HATF-1	80	500	--	In service (1992)
• SHAHEEN-1	700	750	--	Under production
• GHOURI-1	1 300	800	--	In service (1999)
• GHOURI-2	2 000	750	--	1st flight in 1999
• SHAHEEN-2	2 300	--	--	Under développement

today

service today worldwide



AGNI

India derived from its technology demonstrator Agni-1, which has flown in 1989, 1992 and 1994, a new version with a shorter range (700 km instead of 1,200 km). Pictured here on its firing range in Chandipur, Orissa, on 25 January 2002. (AFP)

AGNI 2

This Indian ballistic missile with an intermediate range (2,500 km) Agni-2 is presented in the yearly parade of Republic Day. (AFP)



PRITHVI

The Indian ground-to-ground missile Prithvi is in service in the Indian Army (Prithvi-1) since 1994 and in the Air Force (Prithvi-2) since 1998. Prithvi-3, with a 350 km-range and a CEP (circular error probable) of 25 m, is under development. (AFP)

GHAURI 2

The Pakistani missile Ghauri-2, with a 1,300 km-range and a warhead of 800 kg, has effected its first flight on April 1998. Operational since 1999, it parades in Islamabad for National Day. (AFP)

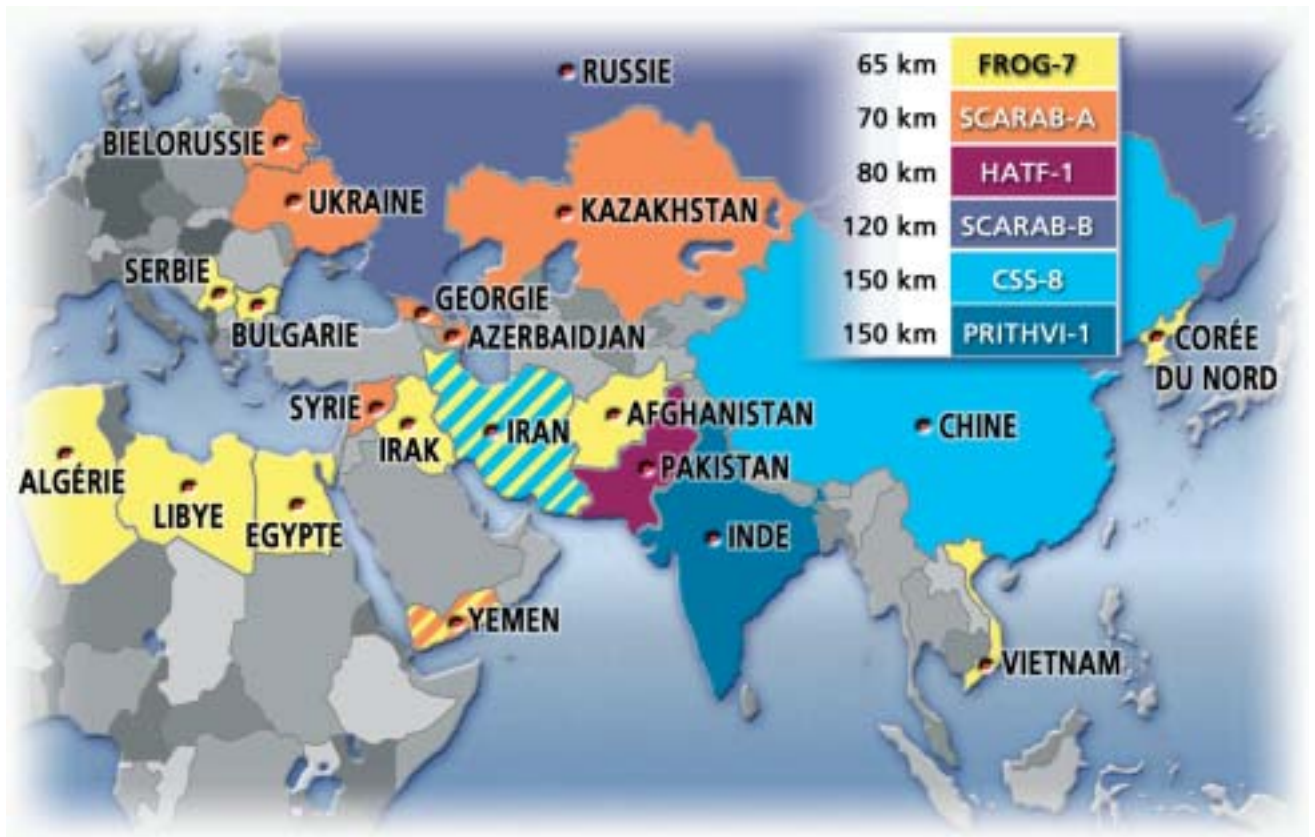


SHAHEEN 1

The Shaheen-1, a Pakistani missile with a 700 km range, has been tested in April 1999 at Ormara naval base, in the Chagi desert. The initial production started in mid 1998. It is in service since the end of 1999. Countries from this region declare their missiles operational from their maiden flights. This is unlike western qualification standards, which require many years. (AFP)



Zones within the range of ballistic missiles



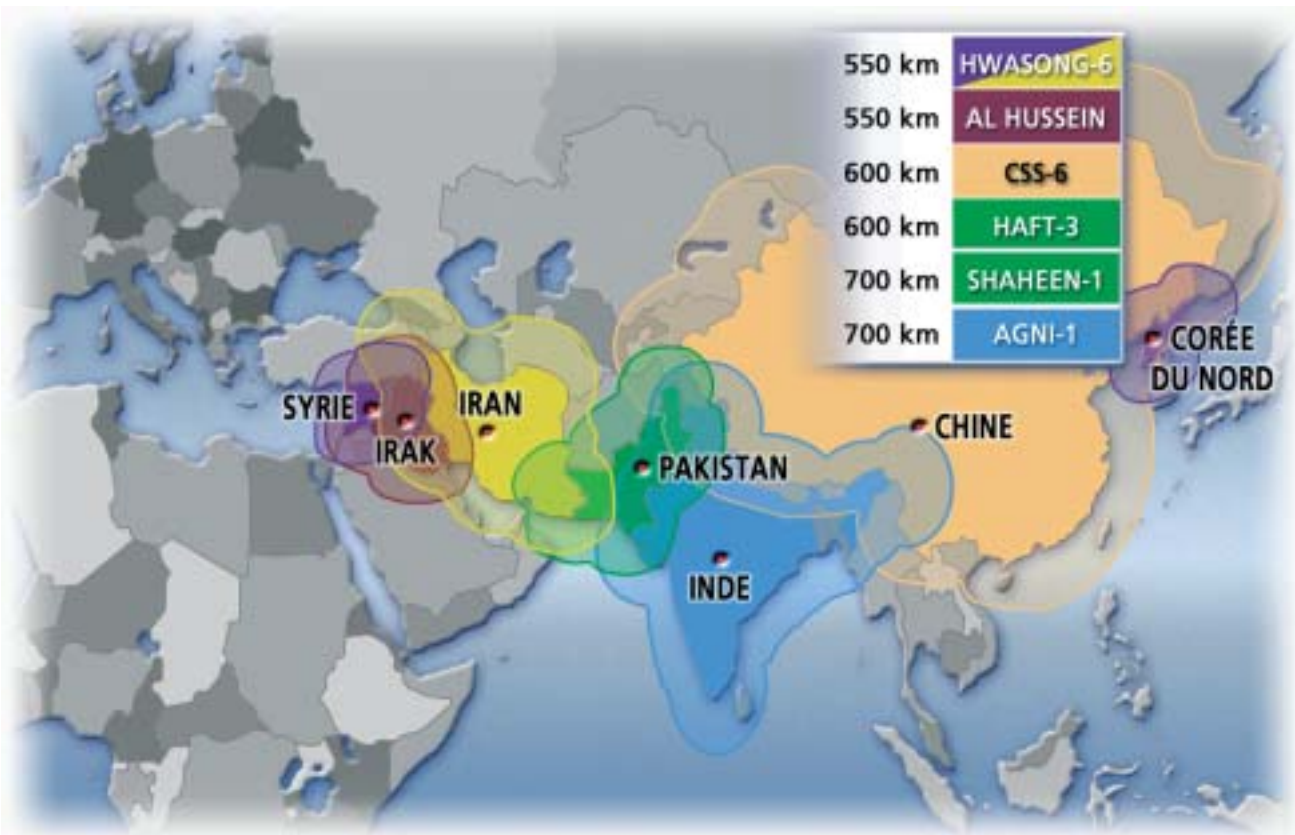
65 to 150 km range missiles



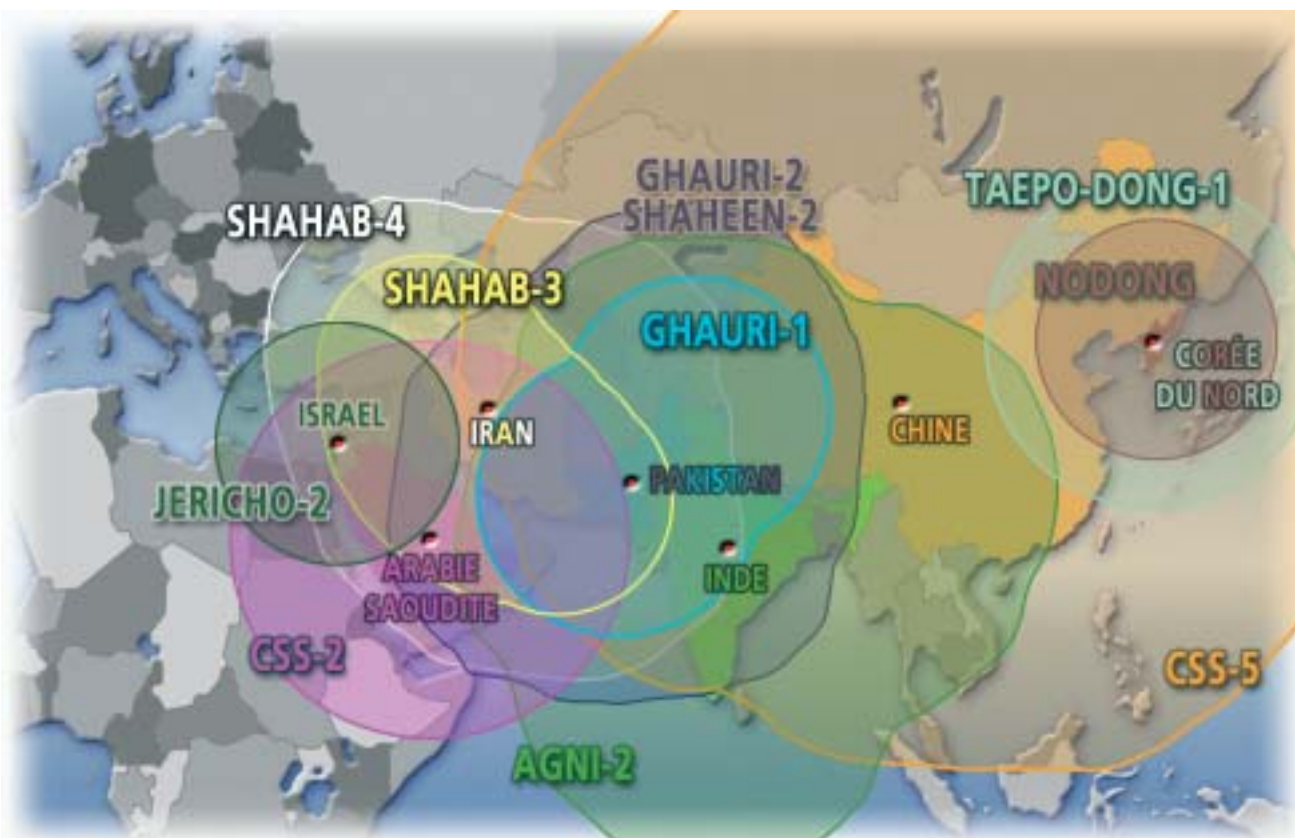
250 to 350 km range missiles

are increasingly broad

A large section of the world, from Istanbul to Taiwan, now lives under the threat of theatre ballistic missiles.



550 to 700 km range missiles



1,300 to 2,000 km range missiles



An asymmetrical threat denied by the Western vision

No Western country would consider the possibility of using theatre missiles without a nuclear load. These weapons, in fact, lack precision. In its role as a nuclear weapon, the Scud B compensates its Circular Error Probable (CEP), estimated at 900 metres, with its nuclear load.



CSS-8
Various countries transformed their Guideline SA-2 ground-to-ground missiles, outdated and available in large quantities, into "Mini-Scuds," with a 150 km range : China with its CSS-8 (pictured above), Iran, North Korea, Croatia, Iraq with its Al-Samoud, and Serbia. (D.R)

But in a conventional use, the impact within 900 metres of a target by only 50 per cent of the launched missiles is not considered effective enough, according to Western military staffs.

However, this did not prevent the Soviets from developing versions with conventional loads for Frog-7s and Scuds, and from exporting them in quantity, nor did it prevent users of these missiles from making massive use of them in operations.

The crux of the problem lies in the fact that while Westerners consider the cost/efficiency ratio of these missiles negatively, it is simply because it does not appear profitable to them, since, having powerful air forces, they have means that can accomplish more and at a lower cost. But the problem is not identified in these terms among current owners of theatre missiles, who consider their cost/efficiency ratio favourable, simply because they do not have any other alternatives for in-depth strikes. The Gulf War in 1991

amply demonstrated that no regional regime can reasonably hope to carry an operation faced with the military power of an allied coalition. However, it is interesting to note that nearly six months were needed for the operation "Desert Shield" to deploy its forces in the operations theatre in sufficient numbers, to train them under local conditions and to concentrate them, without any problems. Any potential future adversary can also draw lessons from the Gulf War and strive in the future for military capabilities intended to prevent the allied forces from having fast access to the coast, the ports and the airports, which are necessary "to enter" the theatre of operations. Then, the objective would not be so much to achieve victory on the ground but to threaten from the very start the allies' capability to project the forces (theatre denial) and then disturb their concentration by attacking the first bases and logistics (theatre disruption). A serious degradation of the possibilities of concentrating the forces on the theatre of operation can be carried out remotely, through a combined use of mines, anti-ship and cruise missiles as well as ground-to-ground missiles, with the objective to cause significant losses, far from the well-known concept of "zero dead". Consequently, the Allies would have to plan operations of force for their entry in the theatre of operations, such as the Normandy landing or that of Iwo Jima.

The intense media-coverage of ballistic missile firings

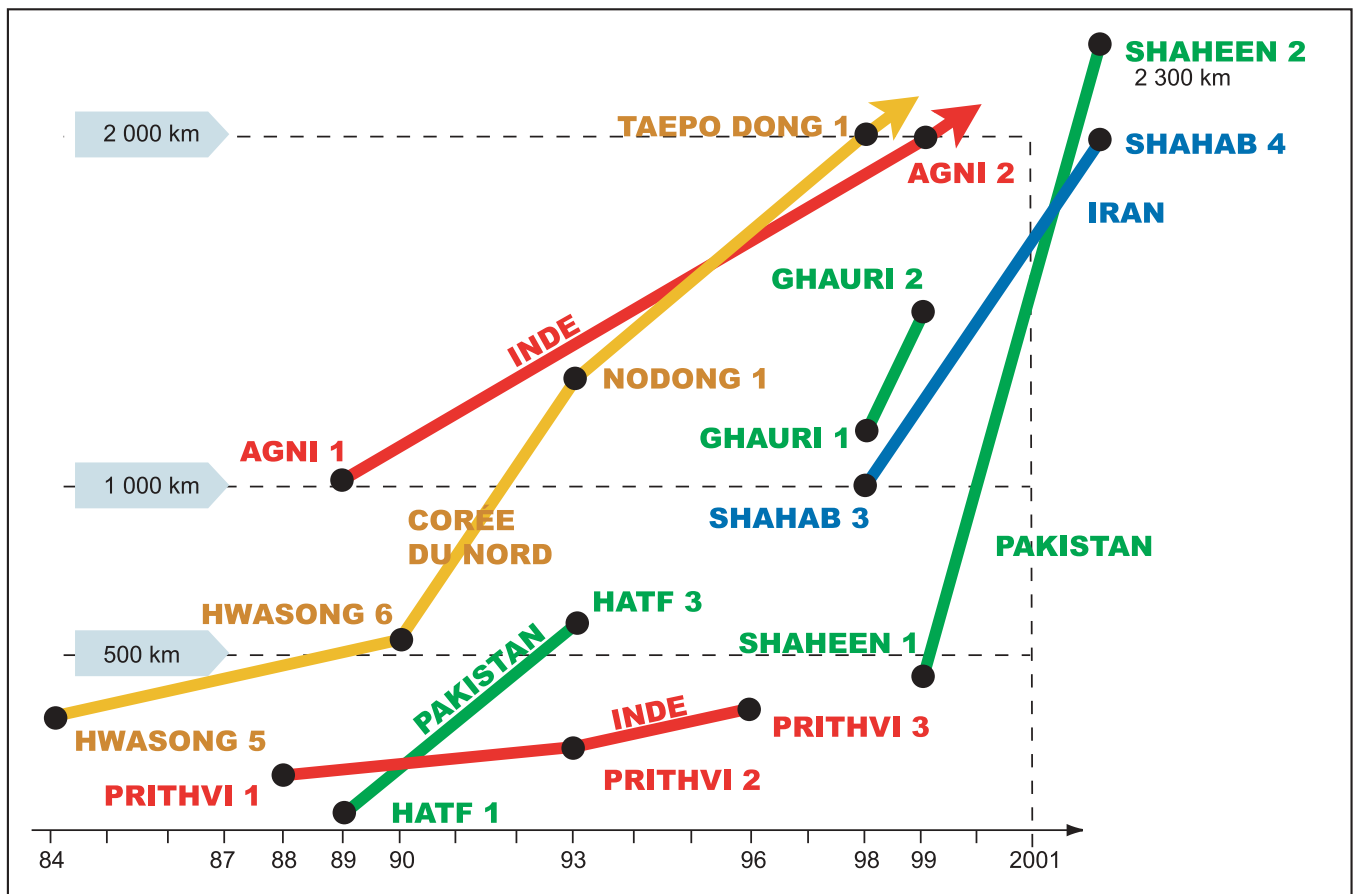
The strength of the conventional ballistic missile also resides in the extraordinary media coverage of its use. Everyone remembers the permanent media coverage, live, 24 hours a day, of the shelling over Tel Aviv and Riyadh, and the excessive dramatisation of selected and highly

repeated scenes of hard destruction and human distress... Which is how modern media cover "hot" events. Thanks to this glut of media coverage, the Iraqi offensive using Super-Scuds took on an importance disproportionate to the results actually obtained by these attacks.

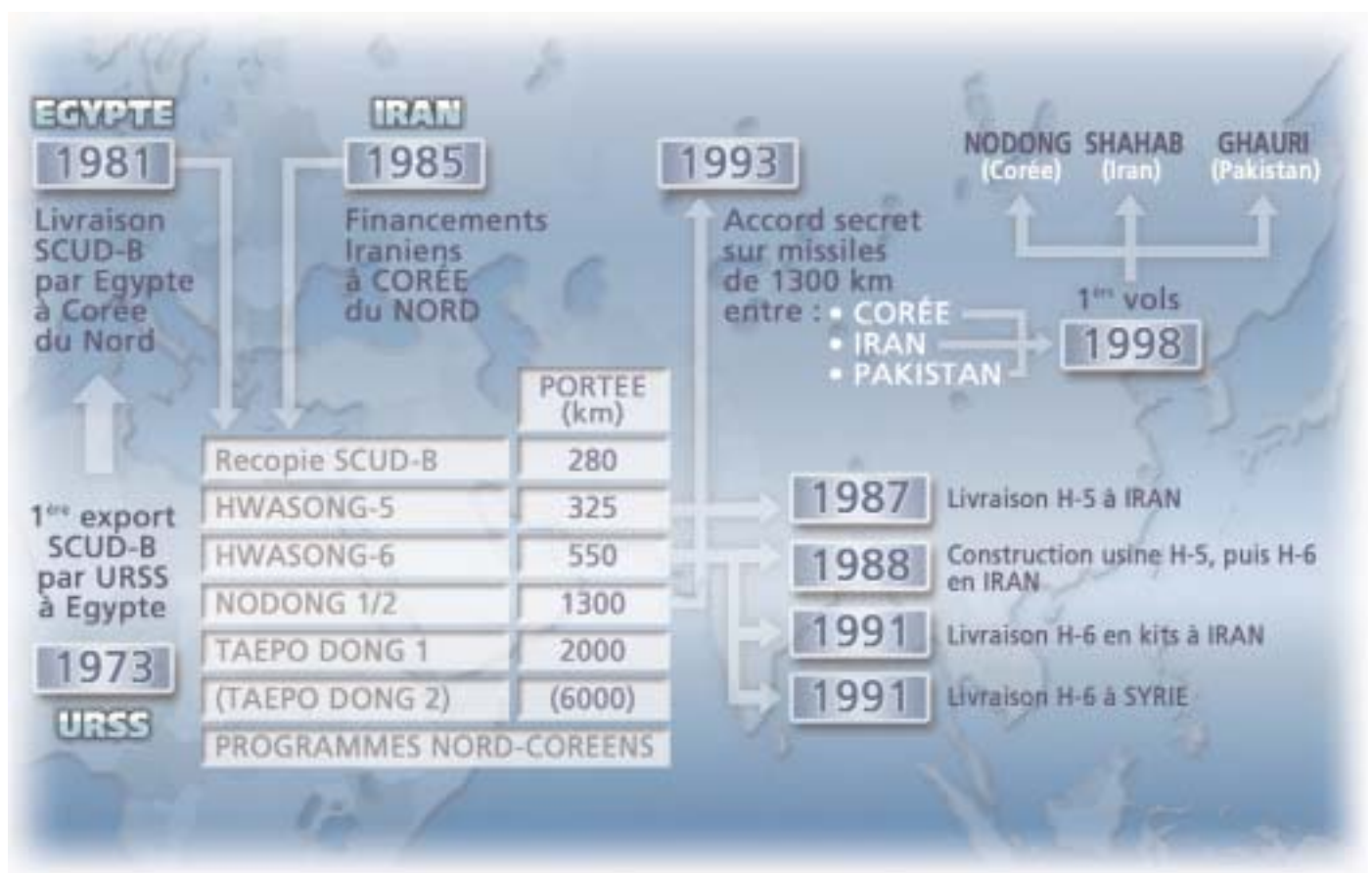
The uncertainty regarding the nature of the warheads transported (explosive, biological or chemical) always brings to mind the worst scenario. The effects of these shellings can thus be very different from the actual military utility of such raids.



A coastal battery with anti-naval missiles, CSSC-2 Silkworm, belonging to the Chinese Navy, parading in Tiananmen Square in October 1999. Many Silkworm Coastal Batteries have been sold to Iraq and Iran. Silkworm can provide an inexpensive base for transforming them into cruise missiles, with modern inertial guidance. (AFP)



The range indicated above are those recorded during the first firing, and not the maximal range indicated by the manufacturers.



Proliferation in the world of Scud and Super Scud missiles and the regular growth of its range, since the first Scud-B exportation to Egypt in 1973.



Means of ant

The American Patriot solution : history's heritage

THE UNKNOWN FACTORS OF MEADS

The future MEADS system is aimed at correcting the disadvantages of the Patriot batteries, by using the new CAP 3 missile Erint in a reduced battery, more mobile, needing less personnel and ensuring a 360° coverage.

The development is expected to start in 2004, with a budget of 3 billion dollars, shared between the United States (55 per cent), Germany (28 per cent) and Italy (17 per cent), for an introduction between 2012 and 2015.

However MEADS is currently facing several unknown problems : the support of the American Congress, the high cost of the CAP 3 missile and German budgetary difficulties.

EVOLUTION, RATHER THAN REVOLUTION

Dominating the ground-to-air defence market since the 1960s, the American industry chose a process of successive upgrading of Hawks and Patriots, rather than coming up with new systems. Allowing the industry to hang on to the same customers, this policy, less risky for the industrials, met, however, with certain limitations.

The Patriot programme started in 1972 as a successor to the long range ground-to-air Nike Hercules. It entered in service in 1985. The "Euro-missile" crisis triggered by the deployment of very precise Soviet ground-to-ground missiles, such as the SS-20, revealed the vulnerability of the batteries of U.S. Patriots deployed in Europe.

Beginning in 1985, a series of modifications was thus undertaken to allow the Patriot batteries to auto-defend themselves against ballistic missiles aimed at them. This led to the CAP 2, brought into service at the end of 1990, just in time for the Gulf War. The Patriot's results in the defence of Tel Aviv and Riyadh were, after the war, the subject of controversy. Following some critical work by Israeli researchers, the Americans, after having asserted 100 per cent of targets were hit, conceded in May 1992 a success rate of 25 per cent successful interceptions in Saudi Arabia and 15 per cent in Israel. The analysis of these bad results led to the launching of a third phase of upgrade, known as CAP 3, while waiting for the

arrival of new ERINT missile, thought to be capable of intercepting a ballistic missile of 800-km range, at between 15 and 20 km of altitude (low-endo-atmospheric).

ERINT is, in fact, the confirmation that the Patriot missile CAP 2 is too heavy to be really nimble (915 kg, 410-mm calibre, 5.2 m length, single-stage). This new missile was refined with a mass one-third as heavy, a calibre divided by half for an identical length (320 kg, 255-mm calibre, 5.2 m length). The CAP 3 batteries will mix CAP 2 missiles as anti-aircraft and CAP 3s as anti-ballistic missiles to realise a multi-role system. The CAP 3 programme costs 7.5 billion dollars for the first 1,000 missiles, the unit cost of the ERINT missile estimated between 2 and 2.5 million dollars each. Nevertheless, this system shows the age of its original design, remaining heavy, with cumbersome vehicles, creating air transportability problems, requiring significant manpower (more than 100 people) and a lengthy installation time. More importantly, it ensures coverage only by sector, the launchers being inclined at 45° and the fixed radar having to be oriented in the direction of the threat.



Tests firings of PAC-3 missiles (ERINT) intended to modernise Patriot batteries. (Lockheed Martin)

Three Patriot PAC-2 quadruple launchers in the Saudi desert on 25 January 1991. (AFP)



Anti-ballistic defence

Russian SA-10 and SA-12 : heavy but operational

Russia is proposing the export of modernised versions of its SA-10 and SA-12 systems, with anti-ballistic missile capabilities.

The SA-10 Grumble (NATO code) or S-300 PMU, manufactured by Almaz in Russian designation, was deployed beginning in 1978 to fight against low altitude penetration bombers (F-111, Tornado) and against American Lance-type ground-to-ground missiles. Its modernisation was launched in 1990. Named SA-10D by NATO and S-300 PMU2 or S-400 by the Russians, it is primarily based on two new and lighter missiles (9M96 and 9M96/2) of a two-stage formula, employing the same interception stage (140 kg), with an active electromagnetic homing head. The flight tests began in 1995 and the operational evaluation is being carried out by the Unified Russian Air Forces (VVS) for the defence of air bases and sensitive areas against short-range threats. The system, relatively heavier than the Patriot, is embarked on huge 8x8 trucks.

The SA-12 (NATO) or the Russian S-300V made by Antey, has been in service with the Gladiator missile SA-12A (9M83) since 1986/87 and with the Giant missile SA-12B (9M82) since 1990. The Gladiator weighs 2.3 tons (speed of 1.7 km/s, 75 km-range and 20,000 m of altitude compared with aircraft). It is designed to engage aerodynamic targets, including Cruise missiles, as well as ballistic missiles. The Giant, its big brother, weighs 4.6 tons (speed of 2.4 km/s, 100-km range and 30,000 m altitude). It is more exclusively aimed at fighting against ballistic missiles. The two missiles have a conical form and a two-stage formula, but their significant weight nevertheless casts doubt on their effectiveness faced with manoeuvring targets. The S-300V is in service in Byelorussia, Ukraine, Kazakhstan and in Russia (the only one having an ABM capacity). It was also sold in China and Greece (for Cyprus). Its modernised version, the S-300VM or "Antey-2500" has been operational since 1998. It

was sold in India, with an improved range and operational capacity. The interception range of the modernised Giant (9M82M) would thus be of 200 km, enabling it, according to its manufacturer, to engage ballistic missiles with a 2,500-km range.

This system is capable of defending a broad perimeter on the ground. Its concept meets the need to protect wide areas of territory and to protect battle corps against the saturating attacks by Cruise missiles and Pershing II built during the Cold War period. In fact, in Russia, the SA-12 belongs to the ground forces. This explains why the battery elements (double Giant launchers and quadruple Gladiator launchers, sector monitoring radars, surveillance radar, firing control station and C2 station) are all assembled on huge tracked and armoured vehicles to allow them to move around on difficult terrain. But their transport by air requires enormous cargo aircraft.

SA-12 tracked launcher (S-300 V) for SA-12 A Gladiator missiles, easily recognisable with their quadruple launcher tubs. The SA-12 B Giant (9M82), the larger one, is fired from the same tracked vehicle, but with a two-tubs configuration. These Ukrainian S-300 V are shown here on the 10th anniversary of that country, on 24 August in Kiev. (AFP)



Quadruple launcher on a SA-10 Grumble truck (S-300 PMU). Shown above is the modernised version, called S-400 by its manufacturer Almaz ; undergoing tests in the Kasputin Yar centre, near Astrakhan in February 1999. (AFP)



Aster, a european solution ...

In order to respond to new threats, three European countries (France, Italy and the U.K.) joined efforts to develop the Aster family aerial defence missiles.

THE CLEAN SLATE ADVANTAGE

The choice of the three European countries of the "Aster community" to develop their own ground/surface-air systems allows them to technically start from a "clean slate". Thus, they can avoid becoming exhausted in modernising systems that have already existed for 30 or 40 years based on anti-aircraft concepts, such as the Hawk, the Patriot or the Sea Sparrow, and the Standard. This has helped concentrate the financing on the direct development of a new generation of anti-missile missiles, in going with the riskier gamble –but obviously with success– of carrying out a "quantum jump," i.e. a true conceptual step. Hence, the Aster missile results from a major technological innovation: piloting in forces (PIF-PAF concept) in the missile's centre of gravity, with a quasi-instantaneous response time, and associated technologies, such as the 2,000° C gas commutation which eases with the commutation between the four central conduits a lateral one tonne thrust in a few milliseconds. Conceived from the beginning as an anti-missile, the Aster benefits from superior characteristics compared with its competitors. The Naval Aster 15 is distinguished by the agility and manoeuvrability of its final stage, known as "vehicle-killer," in the final fight faced with very manoeuvring attackers. It also offers the advantage of reactivity when confronted with targets that are revealed late, thanks to its extraordinarily increase in speed, its high shooting rate and its engagement capability on the short-range. The Aster is also the only missile offering a protection function for ships from the same task force. Regarding the Ground or Naval Aster 30, it competes with the current or future Patriot and SM2, providing a greater



When entered into service in 2005, SAMP/T, based on the Terrestrial Aster 30 missile, will be the first European system capable of intercepting a Scud of 300 km range as well as the Super-Scud (600 km range). ATBM configuration of the Terrestrial Aster 30, known as "Block 1", has been settled in a development contract between France and Italy in May 2000. (DGA/CEL).

shooting rate, a better manoeuvrability and a higher effectiveness in altitude thanks to its mixed PIF-PAF driving mode. The old missiles indeed suffer from their weight, with a lower manoeuvrability and agility, which renders the interception of ballistic missiles beyond an altitude of 10 km hypothetical. With their advanced concept, systems based on the Aster fulfil the operational requirements of a modern air force in far better, since they are capable of countering all new threats, and always improving.



SAMP/T Block 1 batteries (12 French and 6 Italian) are characterised by a high strategic mobility thanks to their air portability by C-130 Hercules; as well as tactical mobility due to the reduced staff and vehicles needed for their positioning. Launchers are fitted on highly mobile 16 tons trucks. Shown above, an Italian 8x8 Iveco. (MBDA).

The first missile of the Aster family entered into service is the Naval Aster 15 of the anti-missile Surface-to-air system (SAAM), with more than a 30 km range. Since December 2001, it ensures the close protection of the CV Charles de Gaulle. Naval Aster 15 and Sea capable Aster 30, under development, will constitute the basis of the U.K.-French-Italian PAAMS system for theatre naval defence, ensuring the defence of several aerial layers of more than 100 km range in order to protect a task force. (DGA/CEM).



FROM THE ANTI-TACTICAL MISSILE TO THE ANTI-BALLISTIC MISSILE

Proliferation of theatre ballistic missiles is today a danger taken into account in Europe. Indeed, in 2000, the Italian and French armies considered this proliferation sufficiently alarming to launch the Terrestrial Aster 30 Block 1 missile configured with anti-ballistic capabilities, to equip their first Samp/T batteries. With its entry in service in 2005, the Aster-Samp/T Block 1 will be the first European system capable of intercepting either Scuds (of 300-km range) or the Super-Scud-class (of 600-km range). It will, for example, be capable of stopping the flight of a ballistic missile penetrating the atmosphere at a speed of Mach 7. Its tactical mobility, due to the reduced manpower and vehicles needed, and its fast battery set-up and displacement time, which are the weak points of its competitors, gives it certain advantages for the protection of forces projected in overseas theatres. By 2012, the Aster-Samp/T Block 2 will offer the ability to counter theatre ballistic missiles of 1,500-km range. Thus the Aster family

is reinforced and supplemented year by year, with systems which easily compete against their American rivals, Patriot CAP 3, MEADS or Thaad. The Aster family also represents a major technological argument for the new European missile systems company, MBDA, within the framework of NATO research on the architecture of future air defence systems, in the definition of a complete protection system on a European scale. After a broad international competition, two teams were selected to carry out this study, including the Janus team, in which MBDA was given the responsibility for architecture. Henceforth, with the Aster, MBDA has the master piece necessary for such a defence architecture. Indeed, any nation wishing to play a major political and military role within an allied coalition in overseas operations will have to be able to protect the task force as well as the sensitive cities and sites of the host country, against all air threats, including theatre ballistic missiles.



The fast positioning of the SAMP/T batteries allow them to be ready to fire in only 20 minutes after the debarkation from a tactical aircraft. Terrestrial Aster 30 "Block 1" is a hypersonic missile (Mach 4.5) with a range of more than 100 km, capable of intercepting a ballistic missile arriving through the atmosphere at Mach 7. (DGA/CEL).



ZAYLZAL
IRAN



SHAHAB-3
IRAN



SHAHEEN-1
PAKISTAN



PRITHVI-1
INDIA



AGNI 2
INDIA