

ARMORED CAR

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MOWAG MOTORWAGENFABRIK AG

The Shark

A step towards a wheeled tank

by Raymond Surlémont

Since the tank appeared on a battlefield for the first time during World War One, the idea of producing a wheeled tank has obsessed some military engineers as a secret dream. As early as 1915, M. William Tritton, chief executive and designer of the British company Foster & Company, of Lincoln, worked on a "Big wheel Landship" design as a possible competitor for the tracked machine which was under construction by this time.

If the British attempt was dropped at an early mock up stage, the French revived the concept by the late twenties, when the Renault automobile company produced the prototype of the SK wheeled tank in 1929. On the other side of the border, and by the same time, the German companies of C.D. Magirus AG in Ulm and Bussing-NAG AG in Braunschweig, worked on eight driven wheel *Achtradwalgen* chassis, while Daimler-Benz AG in Stuttgart Untertürkheim produced a ten driven wheel *Zehnradwalgen* chassis which could have been the basis for wheeled tank designs.

However, the first to produce what could be termed as a true "wheeled tank" were the French when, in 1952-54, they grafted the FL-10 turret of the AMX-13 light tank onto their eight-wheeled EBR-75 armored car, thus converting it into a powerful and versatile tank destroyer. Since then they have developed the six-wheeled AMX-10RC as a successor for the EBR, but its powerful armament (105mm gun) moves it out of the armored car range, and into the combat tank category.

In 1981, the Swiss company of Mowag Motorwagenfabrik AG in Kreuzlingen unveiled their eight-wheeled Shark armored vehicle, said to be able to perform not only the task of a combat tank, but also numerous other missions as well.

Design and development

When it first appeared in the early 1980's, the Shark was the most impressive wheeled armored vehicle yet produced. It looked externally like an out growth of the Piranha 8x8 multi-purpose armored vehicle (MPAV). Work on the drawing board began in 1978 and the first prototype was completed in March of 1981. First displayed at the Paris Air Show of 1981, it was provisionally fitted with an Oerlikon two-man turret armed with a 35mm automatic cannon. Initial trials for the Shark occurred between autumn of 1981 and spring 1982.

The vehicle was officially demon-

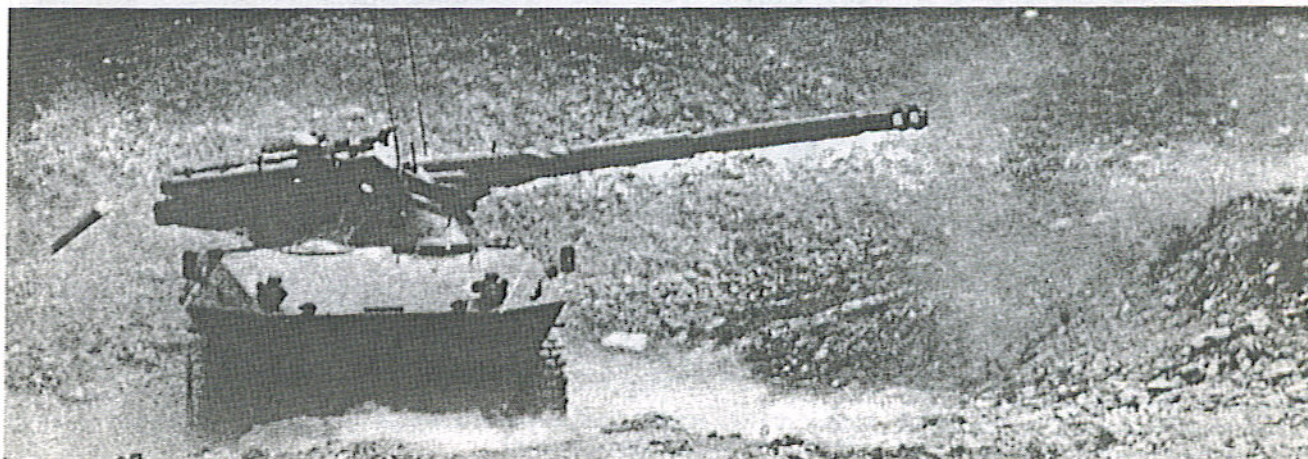
strated as a gun-armed tank destroyer at Unterlöss, Germany in May 1982, and then at Elm Switzerland during the following June. For the first of these demonstrations the Shark carried a Rheinmetall *Leichtpanzerturmsystem* (LPTS) turret housing a 105mm Rh-105-11 gun and for the second version, a Fives-Cail-Babcock FL-12 turret with a 105mm CN-57 gun fitted. Neither of the variants went any further as the design of the LPTS turret system was never finalized and the FL-12 turret was being succeeded by the FL-15 and FL-20 turrets. Two additional Shark pilot models were built and respectively completed in May 1983 and April 1984.

Mobility

The Shark was powered by a General Motors Diesel engine which developed 530 hp (390 kW) at 2,500 rpm. It was a two-stroke, turbo-compressed, V-8 cylinder model, giving a power-to-weight ration of 24 hp/ton at a combat weight gauged at 22 tons. It allowed the vehicle to sustain a road speed of 100 kmh (62 mph) through its eight driven wheels. Located at the rear of the vehicle, the engine was easily accessible through two large hatches.

The transmission included an Allison automatic gearbox with five forward speeds and one reverse, and four self-locking differentials. The latter (or only two of them) could be pneumatically engaged by the driver according to the driving requirements and/or the nature of the terrain.

Below: The FL-12 turreted MOWAG Shark with 105mm cannon.
Photo: MOWAG Motorwagenfabrik AG.

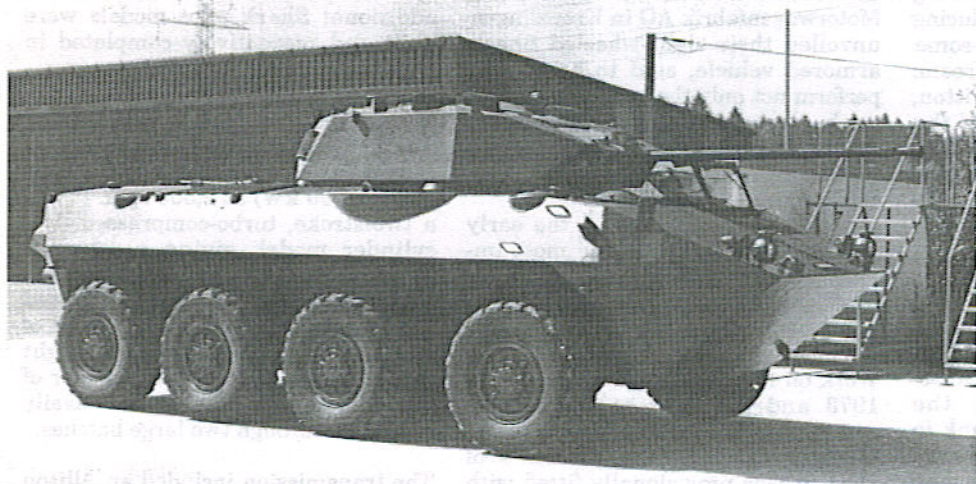


Top, middle and bottom: The Shark fitted with an Oerlikon turret and 35mm automatic cannon, for exhibition purposes. Photographs were taken by the author on 12 September 1985, at Buerglen, Switzerland, at the MOWAG proving ground. All photos: © Raymond Surlémont.

The weight distribution had been carefully studied so as to profit from a low center of gravity, on the Shark, ideally positioned at 1.25m (49 inches) above ground level between the second and third wheel stations. Derived from the one designed for the Piranha 8x8, the suspension acted independently on each of the eight wheels. Both the leading and trailing wheels were steerable; they were spring by wishbones, oversized helical springs and hydraulic dampers. The two mid-axes were not steerable, and were fitted with shock absorbers, their wheels being mounted on oscillating arms connected to torsion bars. The maximum possible vertical movement for each wheel could be raised up to 42cm (10 cm more than on the Piranha). Steering was hydraulically assisted and the four (front and rear) steerable wheels allowed the vehicle to turn around in a circle of only 12.5 meters diameter. The lack of caissons under the four middle wheels freed more internal space, to the benefit of the room available for the turret and ammunition load.

The Shark disclosed an astounding capability for moving over rough terrain at high speed -80 kmh (50 mph), for climbing sharp slopes of up to 70% and for stabilizing itself in three or four seconds after firing a large caliber weapon.

The Shark prototypes were running on Michelin 13.00 x 20 tubeless tires, fitted with



Hutchinson VP-PV inner tubes which enabled the vehicle to travel even when their tires had been punctured by bullets. These inner tubes contained numerous gas filled cells which partly filled the tires. Under normal conditions these inner tubes did not affect the functioning of the tires.

At customer's request, the Shark could be fitted with other emergency running systems, such as the ones designed by the Swedish firm of Trelleborg or the German company of Vorwek & Shon.

Armament

Conceived as a heavy wheeled weapons carrier, the Shark could take a wide range of turrets and weapon systems thanks to a heavy payload of 6,000 kg (13,228 lbs). The following systems had been considered for mounting on the Shark:

- The *Wildcat* Air Defense System of the German Krauss Maffei company was mounted in 1983. It was based on two 30mm Mauser Mk. 30F automatic

cannons, each with a standard rate of fire of 800 rounds/min., a muzzle velocity of 1,150 m/sec and an effective ceiling of 3,000 meters. This was a modular weapon system which could combine various optional fire control systems including search radar with an 18 km range, a TV tracker, a laser range finder, an infrared tracker, or target tracking radar. Firing trials were carried out in October 1983 at Lombardsijde, Belgium.

- The *Crotale* all weather low altitude Air Defense Missile Weapon System of the French Thomson-CSF company was mounted on the Shark in 1983. It included a four tube anti-aircraft rocket launcher, a monopulse tracking radar, TV system which allowed the missile to be automatically aimed in clear weather, or in case of electronic countermeasures, without radar emission. An infrared device was also included for bringing the missile onto the sight line after launch.

- The (at the time) brand new two-man FL-20 turret of the French Fives-

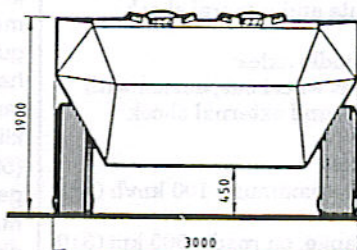
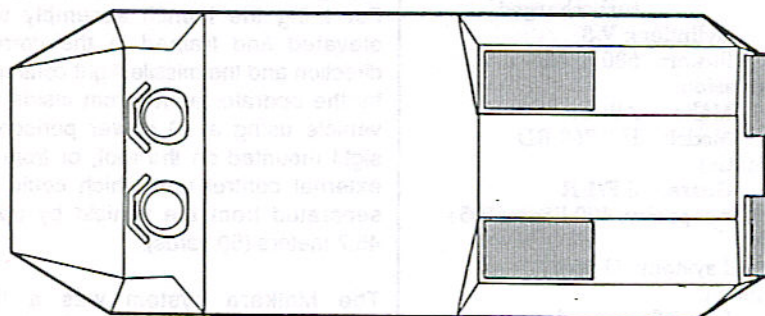
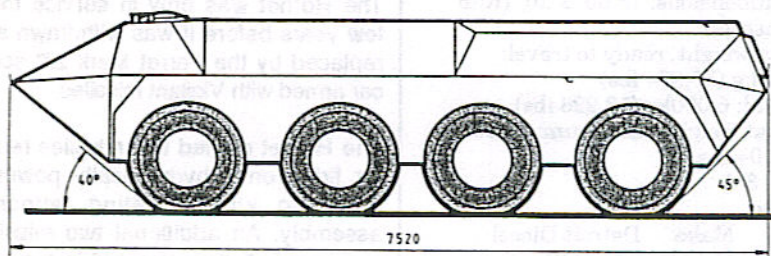
Cail-Baccock company was adapted to the Shark chassis during the first half of 1985. It was an oscillating turret designed to supersede the former FL-12 and FL-15 designs. This turret housed a 105mm G1 cannon of which the 44 caliber long barrel was fitted with a thermal jacket and was capped with a muzzle brake designed for the Armor Piercing Fin Stabilized Discarding Sabot (APFSDS) round. The available ammunition range included an APFSDS projectile, the so-called "obus flèche" (OFL), a hollow charge projectile (OCC 105 F1), a high explosive round (OE 105 60) and a phosphorus smoke shell (OFUM PH 105 F1), all of them being selected as required and loaded into the breech block by an automatic loading system.

Laying for the 105mm cannon was electro hydraulically operated by either the commander or gunner. The gun could be depressed or elevated from a down angle of -8° to an up angle of +12°, while the whole turret could be traversed through 360° at a speed of 36° per second.

Sighting and fire control systems provided the commander with a second generation day/night light intensification and overriding control, while the gunner had a fire control system associated with a laser range finder provided with automatic elevation correction and tachimetry for firing against moving targets. A computer processed all the data concerning such variables as ballistics, distance, temperature, and slant. The secondary armament included an optional 20mm automatic cannon and eight smoke grenade dischargers.

- The Air Defense Anti-Tank System (ADATS) designed by the Swiss firm Oerlikon-Bührle in association with Martin Marietta Orlando Aerospace of the U.S. had also been mounted on the Shark chassis later in 1985. This was a dual purpose missile weapon system intended for both anti-aircraft and anti-tank defense. This weapon system included a search radar for detection and identification (IFF) of aerial targets, an electro-optic module for passive tracking of targets, and guiding of the missiles, an eight tube rocket launcher and some auxiliary equipment. Using both hollow charge and fragmentation effect, the missiles were meant to destroy either an aircraft up to a range of 5,000m (16,400+ ft) or an armored vehicle at ranges of more than 6,000m (19,600+ ft).

- The anti-aircraft turret designed by Oto-Melara of Italy was also combined with the Shark in a technical feasibility study. The Oto-Melara design was a one-man turret armed with four



MOWAG

Mowag Shark 8x8 Basic Vehicle - 1/76th scale.
Drawing: Mowag Motorwagenfabrik AG

25mm Oerlikon KBA automatic cannons. Each of cannon had a firing rate of 570 rounds/minute and three modes of firing (one round at a time, bursts of 15 to 25 rounds, and continuous fire). The fire control system included a self-stabilized optical, dual periscope with DL TV camera, Low light level TV camera, a laser range finder and an Identification Friend or Foe (IFF) device.

Protection

The Shark was proof against 14.5mm armor piercing bullets thanks to a high hardness armor plating sloped at various angles to increase its relative thickness. Some of the more exposed spots of the armored hull were strengthened with spaced armor.

The level of vulnerability of the Shark was also lowered by reducing its total height to 2.85m (9.35 ft) as measured above the FL-20 turret and to 1.9m (6.23 ft) when measured at the hull top. Thanks to these characteristics, the Shark was fairly easy to conceal from observation and direct fire.

The heavy payload foreseen for the Shark enabled it to be up-armored at discretion with some amount of light add-on armor to increase its level of protection against high velocity armor piercing projectiles.

No future for the Shark

The Shark was also proposed as an alternative to the Trailing Arm Drive (8x8) vehicle originally proposed by the Swedish firm of Bofors AB to meet the Canadian Low-level Air Defense (LLAD) requirement. For this purpose it was fitted with the prototype Bofors "Trinity" air defense system and submitted for firing trials in Sweden, late in 1985. This system integrated the all-weather Bofors 40mm automatic gun with an RBS ARMAD laser guided missile and a "Girage" search radar.

Unfortunately, despite the tremendous possibilities of the Shark, all efforts by Mowag to find a mission for the vehicle remained without any effect. No contracts rewarded the Swiss company, and what was to be a wonder weapon, didn't make it beyond the prototype stage.

However, today, the Shark can be considered as a significant stage in the wheel versus track debate, as it perfectly illustrated some of the most valuable arguments in favor of wheeled combat vehicles.

First, the Shark provided a stable platform for any weapon system up to the then favored high-velocity 105mm gun. As such, it could claim the same

fire power as a 3-5 ton tracked battle tank of its generation. Like the tank, it could strike far and hard, but much faster than a tracked vehicle. It would have been cheaper to produce and cheaper to operate than an equivalent tracked vehicle. It could run up to 100 km/h (60+ mph) and sustain high speeds for a longer time with less wear. Its mechanical components were less prone to being strained, and wore out less rapidly. Its sound signature was at a lower level than for a tracked vehicle, thus it was less easily detectable. It could have been a suitable component for a "Rapid Deployment Force" vehicle, or a "Fast Action Force" as the concept was beginning to be developed at the time within several armies. What a sorry end for such a promising vehicle!

Technical Data

Length, hull: 7.52m (24.6 ft)
Width, hull: 3.00m (9.8 ft)
Height, Hull roof: 1.9m (6.2 ft)
Ground clearance, hull: .46m (18 in)
Wheelbase: 1.51m (4.9 ft) + 1.4m (4.6 ft) + 1.49m (4.88 ft)
Angle of approach: 40°
Angle of departure: 45°
Tire dimensions: 13.00" x 20" (Run flat inserts)
Empty weight, ready to travel: 16,000kg (35,274 lbs)
Payload: 6,000kg (13,228 lbs)
Combat weight, maximum: 22,000kg (48,500+ lbs)
Crew: 3-4
Engine:

Make: Detroit Diesel
Model: 8 V-71 T
Type: Two-stroke diesel turbocharged
Cylinders: V-8
Power: 530 hp/390 kW

Transmission:

Make: Allison
Model: HT-750 RD

(Automatic)

Gears: 5 F/1 R

Fuel tank capacity: 400 liters (105+ gallons)

Electrical system: 24 volt

Suspension:

Front & rear axles:

Independent wheel suspension with spring struts and integral shock absorbers

Middle axles:

Independent wheel suspension with torsion bars and external shock absorbers

Performance:

Road speed, maximum: 100 km/h (62 mph)
Cruising range, on roads: 500 km (310 miles)
Gradient: up to 70%
Side slope: 35%
Climbing capacity: 0.45m (18 in)
Trench crossing ability: 2.30m (7.5 ft)
Wading capability: 1.30m (4.3 ft)

FV 1620 Hornet A British 'Pig' with an Australian Sting by Andrew Moores

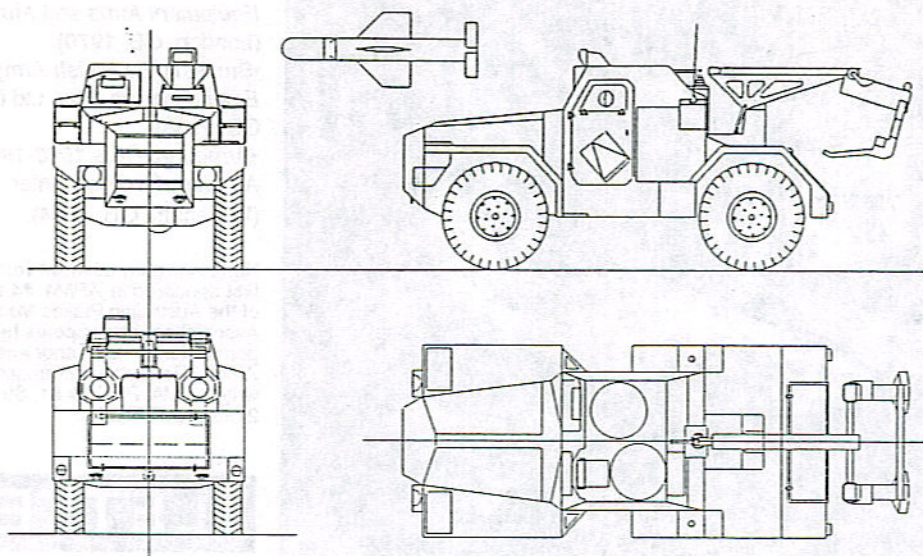
Developed in 1962, the Hornet was a short-lived variant of the Humber "Pig" 4x4 1 ton Armored Truck (FV1601). Armed with the Australian developed 'Malkara' anti-tank missile system, it had a crew of three and a fully laden weight of only 5.7 tons.

With its low weight it was air-transportable and capable of being dropped by parachute. As a result it was earmarked for use in support of airborne operations prior to the arrival of tank support and its use was limited to the sole air-portable squadron of the Royal Armored Corps which was attached to the 16th Parachute Brigade. The Hornet was only in service for a few years before it was withdrawn and replaced by the Ferret Mark 2/6 scout car armed with Vigilant missiles.

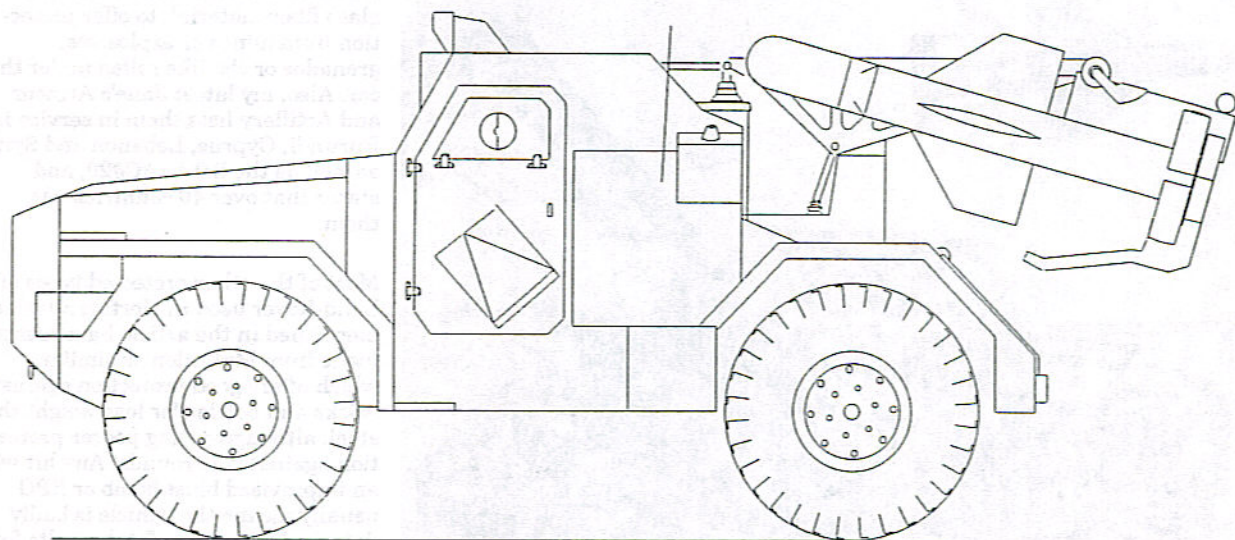
The Hornet carried two missiles ready for firing on a hydraulically powered elevating and swiveling launcher assembly. An additional two missiles were carried disassembled in the rear storage below the launcher assembly. For firing the launch assembly was elevated and trained in the correct direction and the missile flight controlled by the operator either from inside the vehicle using a 10 power periscopic sight mounted on the roof, or from an external control unit which could be separated from the vehicle by up to 45.7 meters (50 yards).

The Malkara system was a first generation anti-tank missile developed in Australia by the Australian Government Aircraft Factory. It was wire guided to the target by an operator who had to be highly skilled to hit a moving target. Each missile weighed over 90 kilograms and had a 27.2 kilogram (59.9 pound) warhead. Unlike other first generation and some later missiles, the Malkara had a 200mm (7.9 inch) diameter squash head warhead instead of the more common shaped charge warhead. The missile had a cylindrical warhead and rocket sections, separated by a square profile section that held the main fins.

Hornet with Malkara Missiles



FV1620 HORNET 1/76 scale



FV1620 HORNET 1/35scale

- drawing © Andrew Moores 1995

Statistics

Hornet Vehicle (1 ton 4x4 Armored Air Portable gw Carrier/Launcher Truck)

Length: 5.05m (16.56ft)

Width: 2.22m (7.28ft)

Height: 2.34m (7.67ft)

Weight: 5.7 tons (11,400lbs)

Engine: Rolls-Royce B.60 Mk 5A gasoline engine @ 120 bhp

Max speed: 64kph (40mph)

Range: 402km (250 miles)

Crew: 3 (Driver, missile operator, commander)

Malkara Missile

Wire guided anti-tank

Optically tracked

Length: 1968mm (77.5in)

Wing span: 800mm (31.5in)

Weight: 93.4kg (216lbs)

Diameter: 200mm (7.9in)

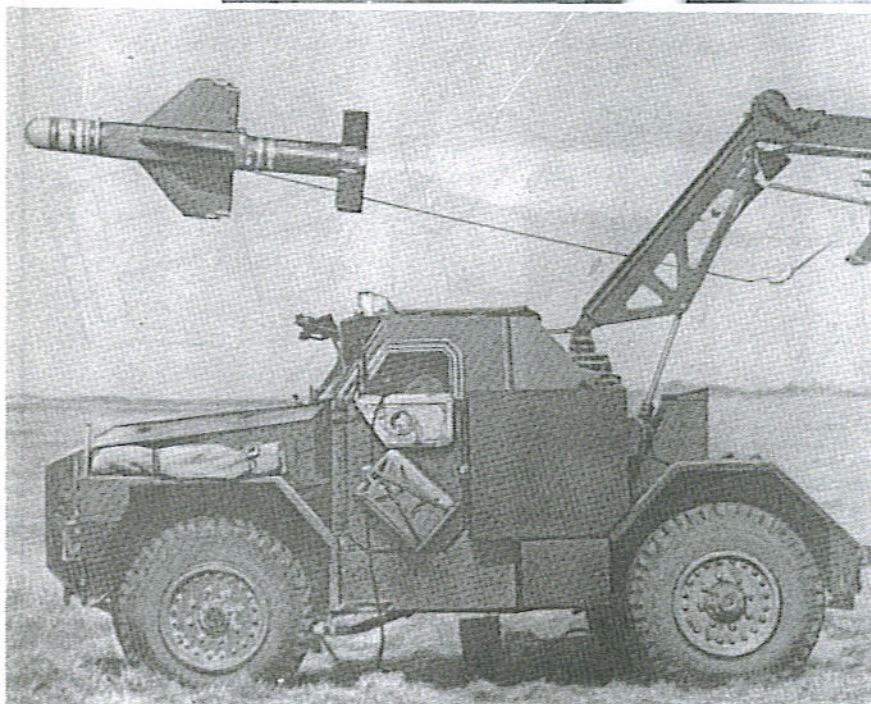
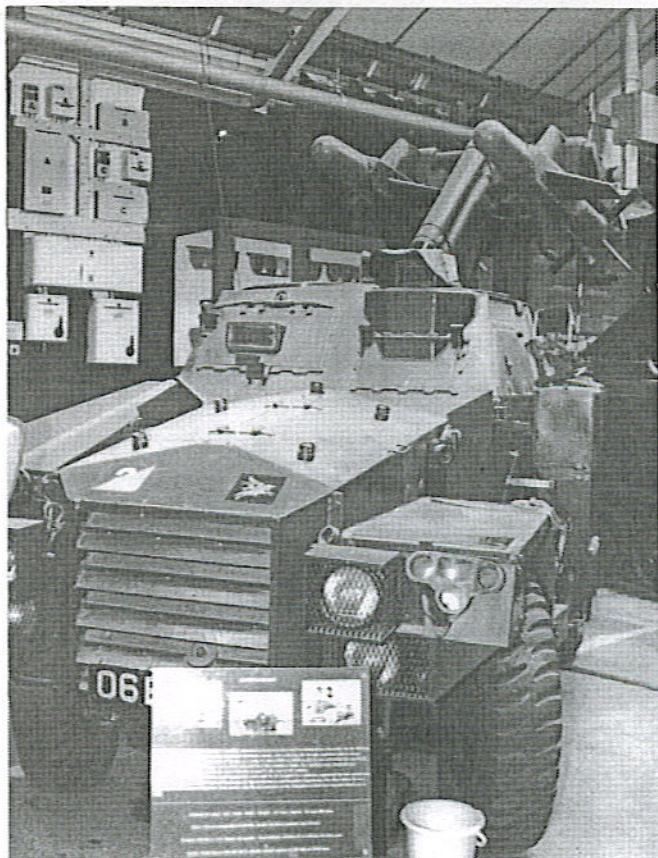
Warhead weight: 27.2kg (59.9lbs)

Warhead type: Squash Head

Range: 300-3000m (328yds-3280yds)

Right: The Hornet launcher vehicle with Malkara missiles presently on display at the Tank Museum, Bovington, GB. Photo: Stephen "Cookie" Sewell.

Below: A Malkara at first launch, this was a very large and relatively heavy missile, a contemporary of the smaller French SS11 series. The square center section of the Malkara can be seen just to the rear of the warhead.



An example of the Malkara missile is on display at Drages Air World in Wangaratta, Victoria, Australia. There is also an example of the Hornet vehicle in the Museum of Army Transport at Beverly in England (according to the "Tank Museum Guide" Bovington Camp at Wareham, dated 1992, they have a Hornet with Malkara missiles; perhaps this is the same vehicle that was at the Museum of Army Transport -ed).

Markings

At least one registration number for the Hornet/Malkara is 09BK63.

Sources:

- Ogorkiewicz, R.M., *Missile Armed Armoured Vehicles Profile AFV Weapons #56 Profile Publications* (Windsor, GB, 1973).
- Wheels & Tracks #23.
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Other Reading:

- Chamberlain, Peter and Chris Ellis, *Modern British Tanks and Fighting Equipment Arms and Armour Press* (London, GB, 1970).
- Smith, R.E., *British Army Vehicles and Equipment* Ian Allan Ltd (Shepperton, GB, 1968).
- Armoured Cars 1900-1963* Royal Armoured Corps Center, Bovington (Wareham, GB, 1964).

Note. A slightly different version of this article first appeared in APMA #4 1994 (the journal of the Australian Plastic Modellers Association) and appears here with the permission of the author and the editor of APMA. For further information on APMA write APMA, PO Box 51, Strathfield, NSW 2135, AUSTRALIA..

LETTERS

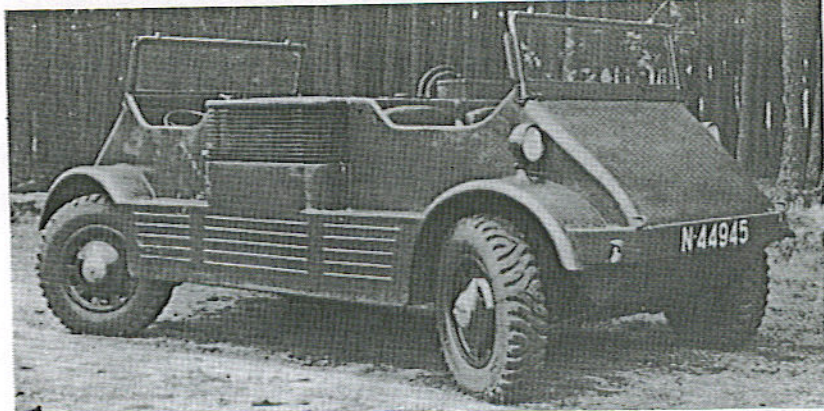
Shorland Thoughts. I found the article by Jochen Vollert on the Shorland in AC#29 very interesting, but I would take issue on one small point. It states that the vehicle has 'a Makralon type armor plate body' which does not agree with my sources which state that the armor is steel. The floor is made from reinforced glass fiber material to offer protection from mines or explosives, grenades or the like rolled under the car. Also, my latest Jane's Armour and Artillery lists them in service in Burundi, Cyprus, Lebanon and Syria, as well as the list in AC#29, and states that over 40 countries use them.

Most of the other protected types of Land-Rover used in Northern Ireland mentioned in the article have armor made from Makralon or similar, which offers good protection against bricks and bottles for less weight than steel, although giving poorer protection against rifle rounds. Any hit with an improvised blast bomb or RPG usually means the vehicle is badly damaged with often fatal results for their crews. Hopefully, such things will soon become a thing of the past. Peter Brown, 8 Saddle Close, Colehill, Wimborne, Dorset, BH21 2UN, GREAT BRITAIN.

Wanted, photos of French tanks in service from 1950 till today. Photos, photocopies, drawings, originals from magazines, everything is welcome! Mark Salisbury, Middleton Hall Farm, Goosnargh Lane, Goosnargh, Preston, Lancashire PR3 2JU, GREAT BRITAIN.

World War II Dutch MC-139 Amphibious Car

by Hans Heesakkers



Above: DAF amfibievoertuig 1939, carrying one of its many registration plates (N-44945).
Photo: DAF Trucks.

In 1939 the Dutch company of D.A.F. based in Eindhoven (The Netherlands), presented the prototype of an amphibious car developed by Dr. Hub van Doorne. The somewhat remarkable vehicle had nearly identical front and rear surfaces, with the engine and transmission placed in the middle. The hull of Dr. van Doorne's design, was made out of one piece, being both light and watertight, with provisions made for the option of placing armor plate on the front and rear of the vehicle.

A crew of four were seated in pairs of two in the front and back compartment with their backs toward the engine. A canvas top could be opened and closed by one simple hand movement, making it possible to get in and out of the car. The canvas top could also be removed altogether. It was also possible to fold down the two windscreens allowing for the mounting of a pair of light machine guns.

Both the front and rear compartments of the MC-139 had a steering wheel and full driving controls, steering action could be applied to the front, rear or all four wheels as required. When using four wheel steering the vehicle was able to make very sharp turns. This together with an already small turning circle and the ability to drive as fast backwards as forwards, made the car very mobile.

The MC-139 had three gears forward and one reverse (for normal use), however it also was equipped with a so called "Reversing Gear", if necessary driving direction was changed and the three "forward" gears could be used for driving "backwards".

As both the front and rear of the vehicle were nearly identical it was very difficult to tell when the car was

being driven backwards; only when the propeller was placed in position (for propulsion in water) did the difference become clear. This similarity of front and rear was the source of a series of jokes about a simultaneous offensive and defensive operational use of the car.

In the water the car was propelled by a detachable propeller. This propeller could be removed and placed quickly and easily. Steering in water was by the use of its wheels, which were also driven while in the water; this last was to prevent the car getting stuck on a sandbank or in the shallows.

The use of driven wheels while in the water also enabled a smooth landing, the car being directly operational on land when exiting from the water without having to change propulsion systems.

The combination of four wheel drive and steering, along with amphibious capabilities and the ability to drive forward or backward at speed without having to turn around made the car one of the best of its type at the time. The vehicle was very well suited to the Dutch terrain with its many waterways.

The MC-139 carried a crew of four, the propeller (removed when on dry land) the canvas top, and two light machine guns. When necessary a smoke screen could be produced with a built in smoke discharger.

Even though the car was simple to build, had great mobility and good performance, it never reached the production stage. This was due to several circumstances including that all (DAF) production lines were occupied in turning out the "Pan Trado 3"

(the M-39 armored car), and the reluctance of the French firm of Andre Citroen S.A. to deliver the engine and part of the driving-suspension which were used in the MC-139.

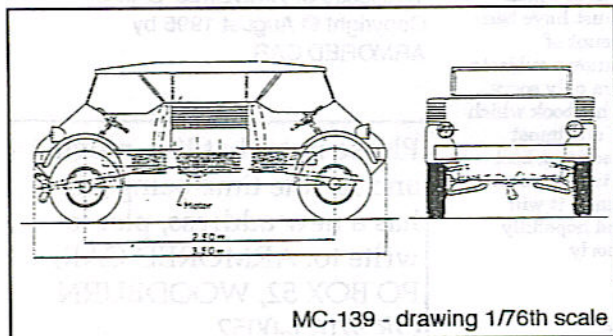
After testing by the Dutch government, the vehicle was used during the mobilization period (winter 1939 /spring 1940) by the Royal Dutch Army. The MC-139 was driven with several different number plates to make foreign armies believe that the Dutch Army already had several of these cars operational. Be sure however, there was only one built.

After the Germans invaded The Netherlands in May of 1940, they searched the whole country for the MC-139, but it was never found. The vehicle had vanished and no one ever heard or saw anything of the car again.

Data D.A.F. MC-139

Length:	3.50m
Width:	1.70m
Height:	1.60m - 1.50m with canvas top removed
Wheel base:	2.50m
Weight:	1250 kgs
Max. grade:	51.5% in first gear
Max. road speed:	70 Km/h
Max speed in water:	4 Km/h
Armament:	(2) modified Lewis M-20 7.9mm LMGs
Transmission:	
1st gear	5.96:1
2nd gear	3.3:1
3rd gear	1.97:1
Reverse	7.9:1
Engine:	Citroen 7S, 1.9 liter, 4 cyl, 48hp @ 4000rpm

Note. A slightly different version of this article first appeared in Dutch in the magazine MILCIV Vol 4 #1, 1994, and appears here with the permission of the author. For more information on MILCIV, write: Hans Molter c/o MILCIV, A. Jacobsdreef 106, 2135 NB Hoofddorp, THE NETHERLANDS.



REVIEWS

Museum Ordnance Special No 5 "Fuchs" Transportpanzer (TPz1) and Variants, by David R. Haugh with photos by Gerd und Marco Schwiers. 24 pages, soft covers, many black and white photos and line drawings. Available from Darlington Productions Inc, PO Box 5884, Darlington, MD 21034. Price \$7.95 plus \$1 postage in USA and \$2 overseas.

The "Fuchs" or "Fox" was designed to provide the German army with an armored, amphibious transport vehicle, hence its designation of Transportpanzer 1. As often happens with what are basic utility vehicles, a range of specialist types is produced using the basic version. Best known of those based on Fuchs is the Nuclear, Biological and Chemical Reconnaissance vehicle, the SpurFuchs, which has found its ways into US, British and Israeli use and served in the Gulf War. Often overlooked but valuable when needed are the radio jamming versions, more normal command post, ambulance, specialist engineer vehicles with purpose designed bins for barbed wire - the Germans are nothing if not thorough - radar carrier and MILAN anti tank missile carrier based on the standard armored personnel carrier.

All these are covered in great detail, with some fine photos mostly from Gerd and Marco Schwiers with others from a number of sources from around the world, including the manufacturers. The text describes the vehicle's development history and the main differences between types. Photos illustrate these, with general shots and super detail ones of both the outside and interior. Captions for these are very good, pointing out many details which may otherwise be missed as well as describing the markings and color schemes.

The variety of types is amazing. Not only is the Fuchs shown in its many roles, it can be seen in a variety of color schemes from standard Bundeswehr, desert sand, UN white and even one-off schemes such as the few Norwegian ones used by their UN contingent in Somalia.

End result of all this is great coverage of a vehicle which may lack the appeal of a main battle tank and be simply dismissed as an armored truck. It would be hard to envisage a better coverage of a vehicle, a lot of information has been put into these few pages. Ideal for the modern wheeled AFV enthusiast and unbeatable reference for the modeler.

Museum Ordnance Special No 7 Armored Fighting Vehicles of El Salvador, by David Spencer. 24 pages, soft covers, many black and white photos and line drawings. Available from Darlington Productions Inc, PO Box 5884, Darlington, MD 21034. Price \$7.95 plus \$1 postage in USA and \$2 overseas.

El Salvador may not be the first nation which springs to mind when thinking of

AFVs. Looking them up in the specialist reference works such as Jane's Armour and Artillery, they would seem to have only a few armored vehicles, generally lighter ones. So this book from David Spencer is a real eye-opener, and should result in some very interesting and unusual armor being brought to light.

The text gives a brief history of El Salvadorian armor, but the bulk of the coverage is photographic. While some photo books are just a collection of pictures, this is a real work of reference using photos. Besides what they say about each vehicle in themselves, their captions give detailed coverage of the design, development, construction, use and color schemes of a range of vehicles.

Some of these are tracked, such as old M3A1 Stuarts and highly modified M114 APCs which look almost as if they came from the imagination of a Hollywood props department. *ARMORED CAR* readers will home in on the wheeled vehicles which form just over half the book. Here we have Panhard AML245's with 90mm gun turrets, some standard and some with extras such as anti RPG screens and loudspeakers. Thyssen UR416 APCs also appear plain and screened, and there is even one with an added machine gun turret.

What will intrigue many is the range of home produced vehicles, based on a variety of military and civilian chassis. These were adopted as they were cheaper than conventional imported types, and could be built using local materials not subject to any international sanctions or embargoes. While many look improvised and may have had technical or tactical faults, they show what can be done with ingenuity and hard work, as well as hard metal and other materials.

There were several 'standard' types, the *Mazinger* based on 6x6 chassis, *Astroboys* using Ford pickups and *Cashuats* based on military style Dodges. These often existed in a variety of forms, and were modified in use to provide basic transport or fire support vehicles. There are also some armored dump trucks, one locally improvised while another was formally designed and mounted three 20mm anti aircraft guns. To round off the survey, some Jeeps in both protected and fully armored guise appear, showing that the chassis is not best suited for armored use.

The photos used are very clear, apart from one or two older shots, but the general quality is high and the research which went into the whole work must have been considerable. Given the amount of rehashed material on well known subjects which enjoys high sales, I am only sorry that something as good as this book which offers a first class survey of an almost unknown subject will not become a best seller. Among those with a true interest in unusual and improvised armor, it will become a standard work and hopefully inspire coverage of other poorly documented subjects.

All reviews by Peter Brown.

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