PROFILE

AFV WEAPONS

33

German Armoured Cars

by Major General N. W. Duncan

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Schwerer Panzerspähwagen (8 Rad) Sd Kfz 233 had an open superstructure in which was mounted a 7·5 cm StuK (SturmKanone) L/24. The 233's assault gun was intended to provide supporting fire for the more lightly-armed 8 Rad 231 and 232 cars. (RAC Tank Museum)

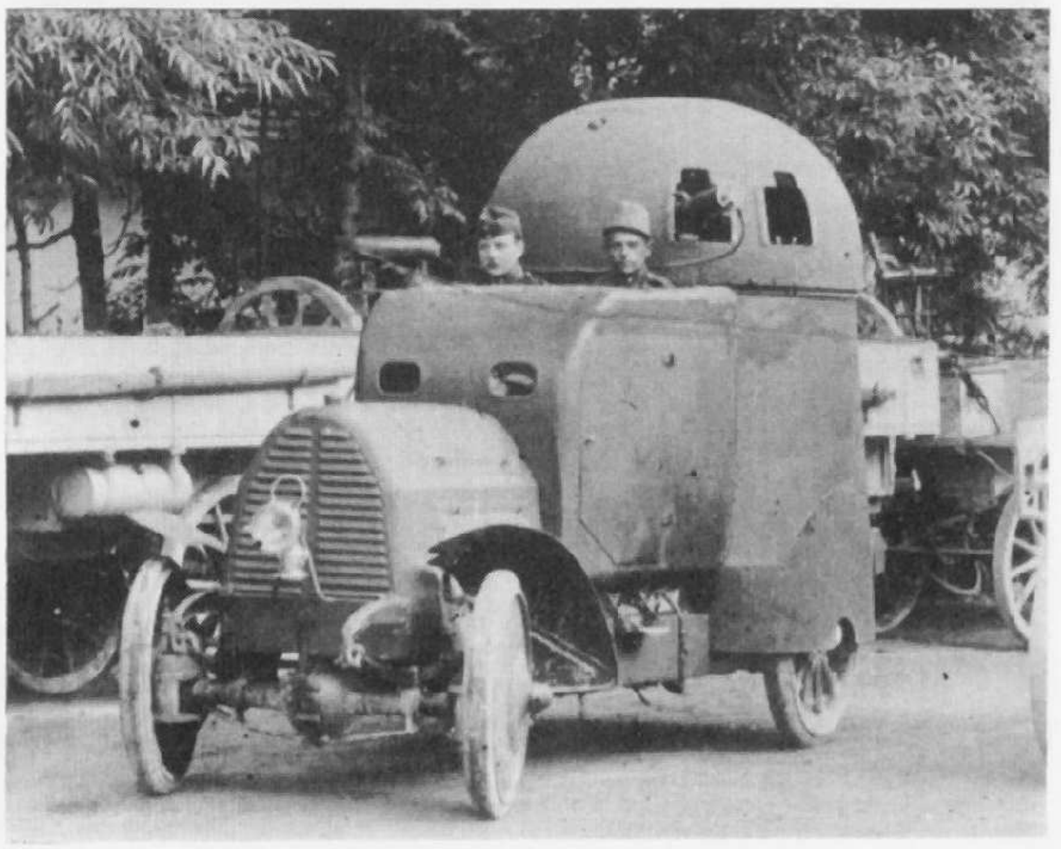
German Armoured Cars

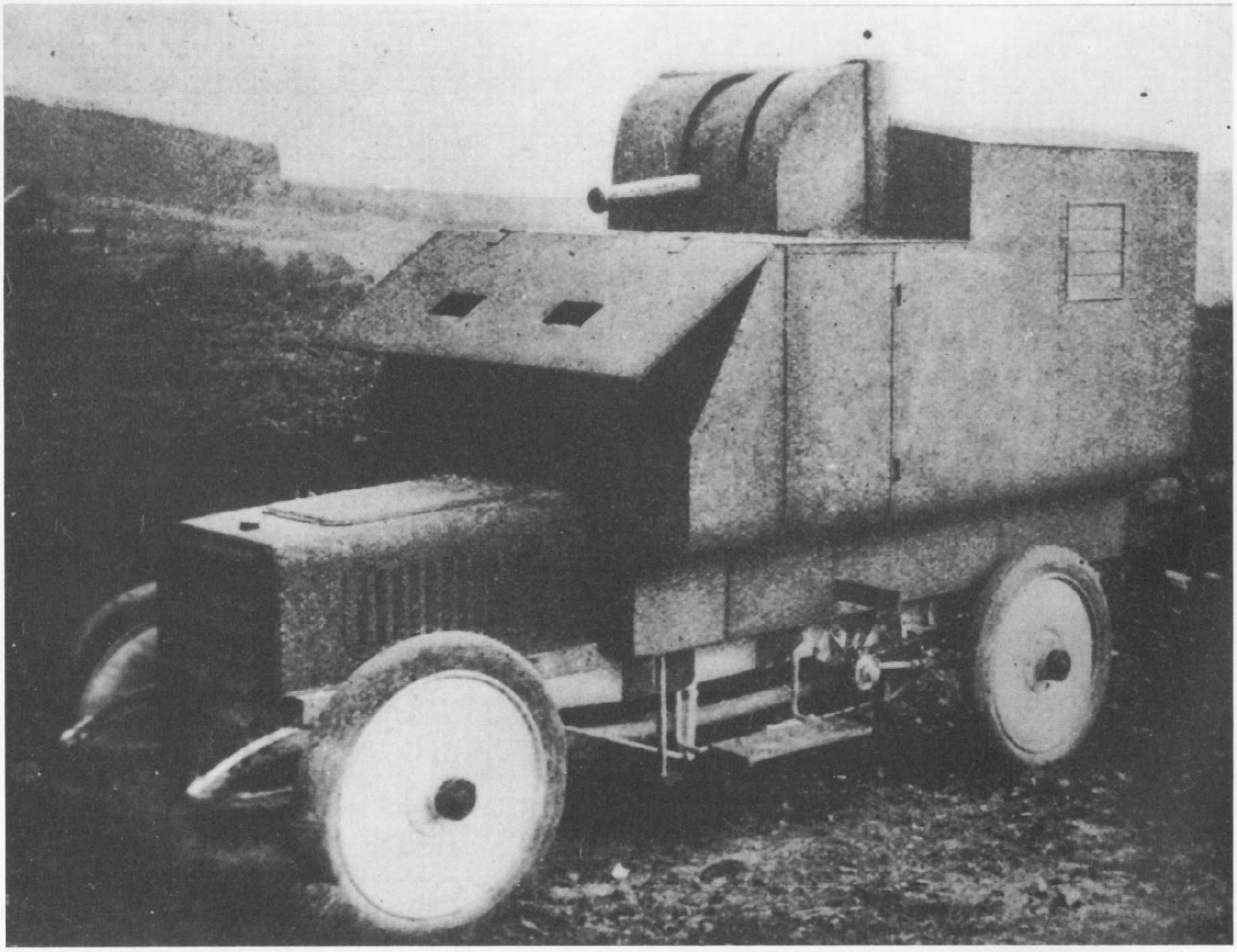
by Major-General N. W. Duncan

Although the Germans played a prominent part in the development of the internal combustion engine they were slow in the application of this invention to military use. In 1904 the firm of Austro-Daimler in Austria built an armoured car with four-wheel drive and a revolving turret in which was mounted a water-cooled machine-gun. Nothing came of this but in 1906 the German firm of Ehrhardt who had close technical connections with Austria and who had been concerned with the early petrol engines, built an armoured car as a private venture. This extremely interesting vehicle was intended to provide high angle fire against balloons: it mounted a 50 mm gun in a turret with a traverse of 90 degrees either side of the centre line of the car which could fire at all elevations from 0 to 90 degrees. This is the first recorded instance of an AA armoured car and foreshadows those built during World War II. It indicates the attention paid in Germany, even at that early date, to the possible dangers of aerial reconnaissance. Although the aeroplane was not at that time a practical military proposition, both balloons and man-lifting kites were in use and had achieved results which made the provision of fire against them a valuable selling point for a private venture such as Ehrhardt's. However novel the point of view it failed to impress the German General Staff and nothing more was heard of this design, although Krupp's produced several experimental models of 57 mm AA guns on both armoured and unarmoured Daimler chassis between 1909 and 1911.

The potential of the armoured car continued to attract inventors and up to 1914 various prototype vehicles were constructed—although none of them were officially adopted for use in the German Army, which at that time was organised on a horse-drawn basis: motor cars were rare and motor lorries virtually non-existent. German military thought relied chiefly on man-power for victory and discounted the possibility of using machines on a large scale, either to reduce casualties or to achieve victory at a greater pace than that at which a horse could move.

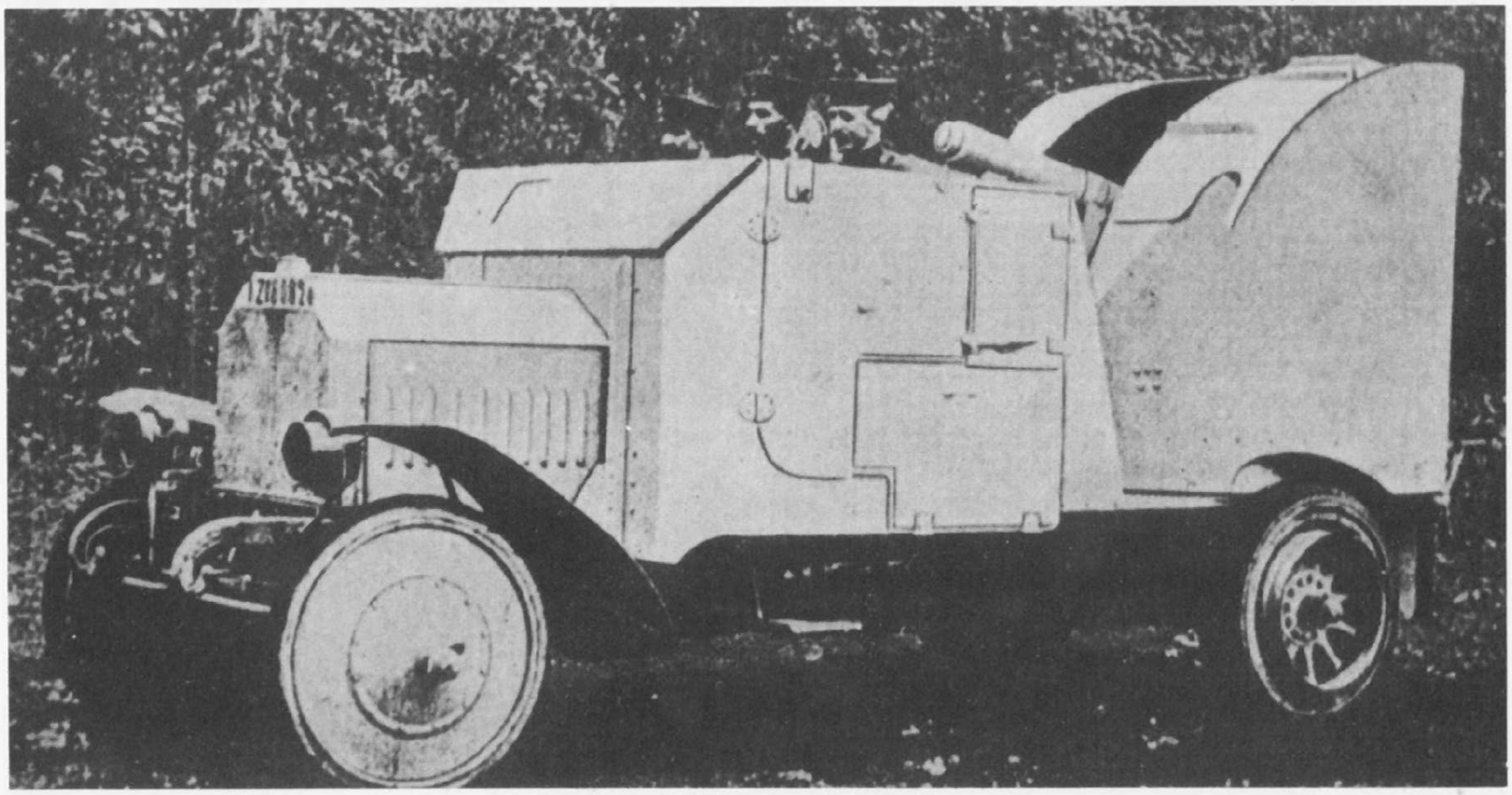
Austro-Daimler 1904 armoured car after modification with two machine-gun ports in the revolving turret. (via Col. R. J. Icks)





The first AA armoured car: Ehrhardt 1906 with 5 cm BAK (Ballon Abwehr Kanone). Chain drive to near side rear wheel visible.

5·7 cm FlAK (Fleiger Abwehr Kanone) on Daimler Panzerkraftwagen 1909. ('The Times' History of the War)



During the advance into Belgium in 1914, the leading Germans were frequently engaged by improvised armoured cars manned by British or Belgian troops. These civilian pattern vehicles, clad with sheets of boiler plate to provide some protection for the driver and the machine-gun which they carried, were quickly replaced by cars with bodies designed for their task, protected by proper armoured plate and eventually equipped with revolving turrets mounting machine-guns.

In response the Germans built a range of armoured cars of the same general pattern as those produced by the Allies, but which, instead of using touring car chassis, were derived from 4-wheel drive commercial chassis. Prototypes were produced in 1915 by the Büssing, Daimler and Ehrhardt firms. They were considerably heavier than contemporary Allied armoured cars, weighing between 8 and 10 tons (and the Büssing was over 30 feet long) and all had duplicate driving positions at the rear. The Büssing in addition steered on all four wheels. The three cars were sent to the Western Front early in 1916 but do not appear to have taken part in any operations there. By the time they appeared the line had stabilized, trench warfare was in full swing and the chances of armoured car operations were reduced. They were, however, later used on the Russian front where they encountered Russian armoured cars. Subsequently, more, improved cars of the Ehrhardt type were built and used chiefly on the Russian front, but German armoured vehicles made no significant contributions to the campaigns in that part of the world.

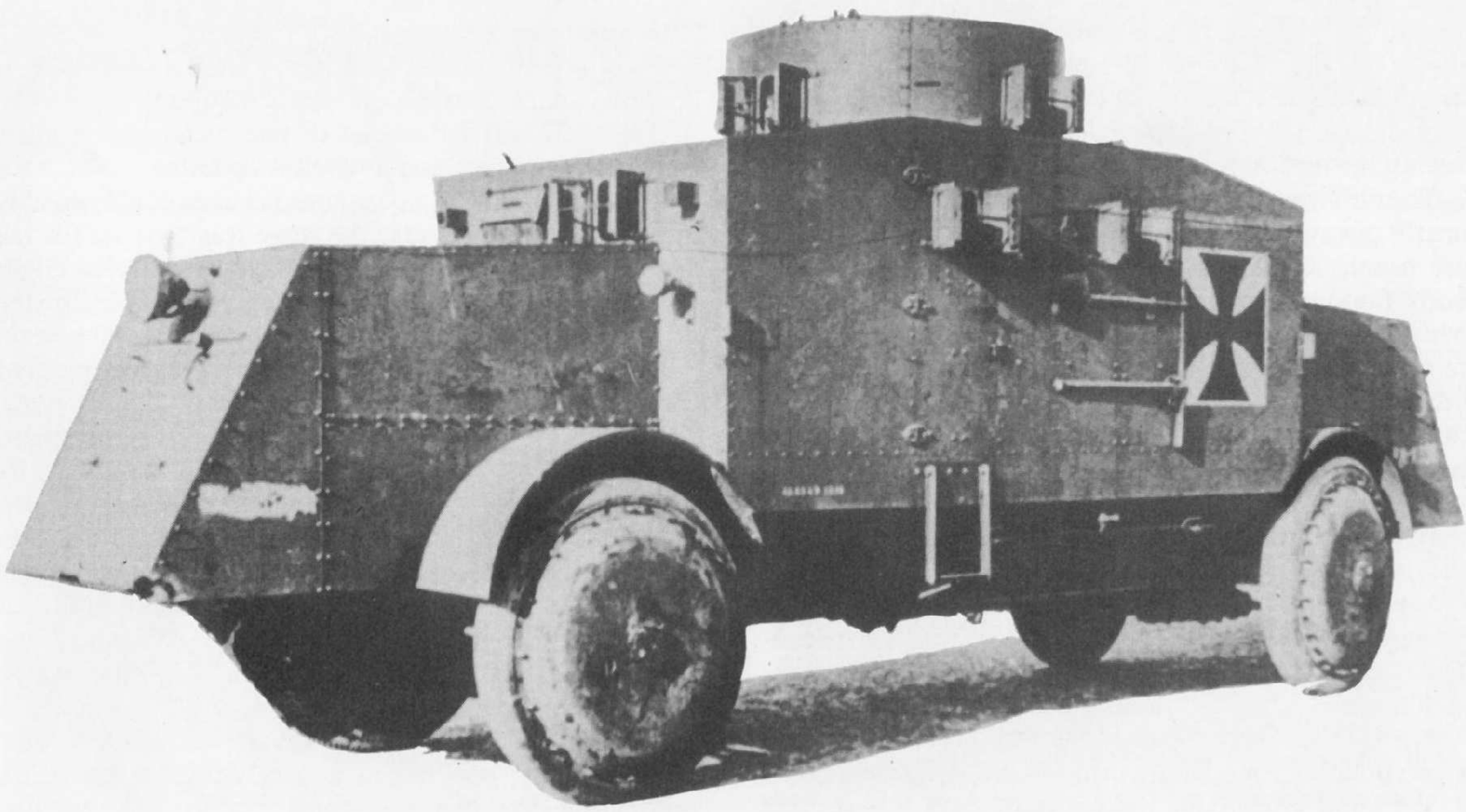
Under the Treaty of Versailles Germany was forbidden to build tanks and was allowed only a limited number of armoured cars, primarily for internal security use.

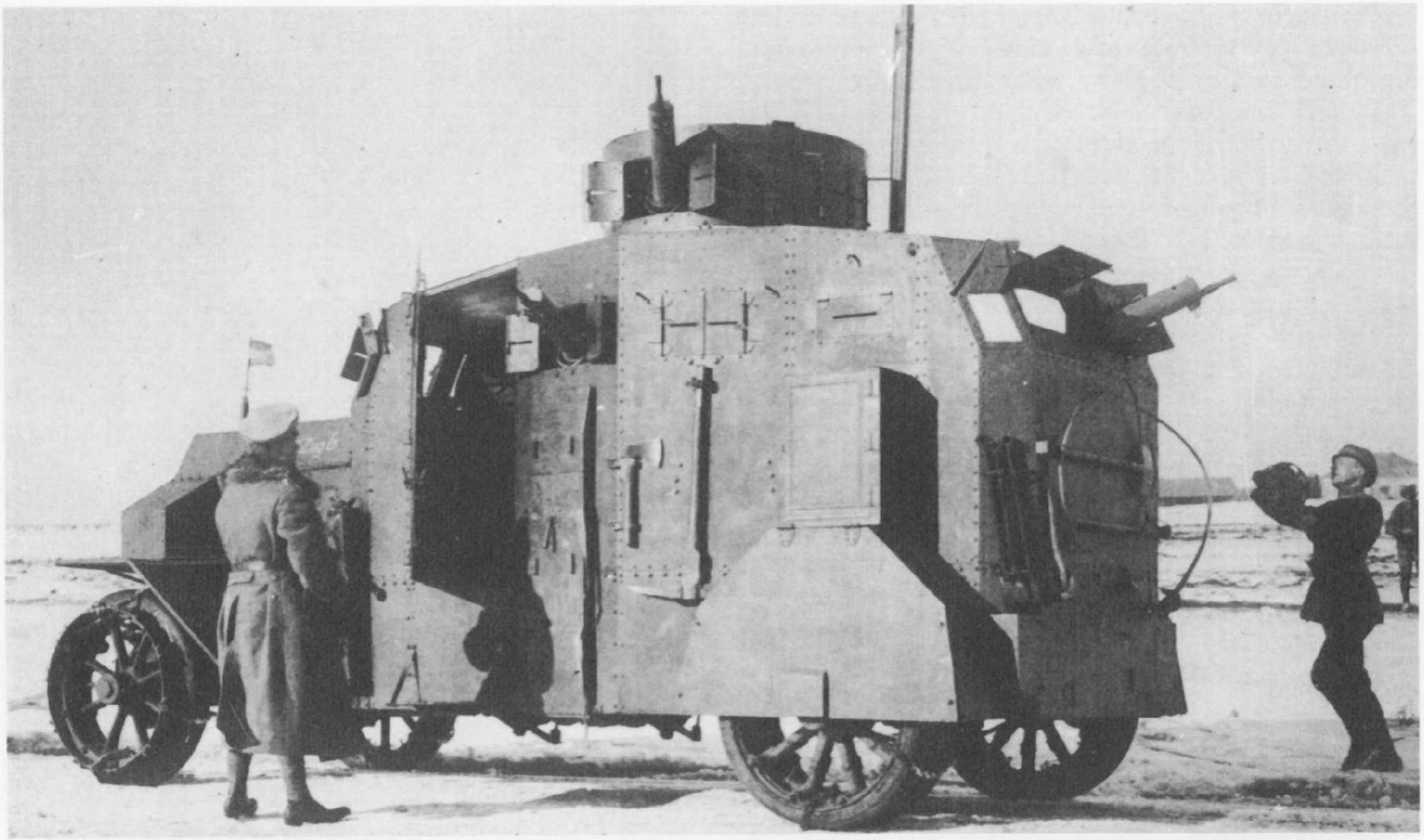
Those built for the Army were prohibited under the Treaty from having revolving turrets and the design was also limited in other ways to prevent them being used as fighting vehicles. The standard Army vehicle, designated

Ehrhardt Panzerkraftwagen 1915. (O. Munzel)

Sdkfz 3, was produced as an armoured personnel carrier although some were subsequently converted to wireless command vehicles. The 4-wheel drive chassis was a modified version of the Daimler DZVR used during the war. The Police armoured cars (Polizeisonderschutz-wagen), which were used for internal security duties, were much more formidable vehicles. There were three models —Daimler, Ehrhardt and Benz. The first Daimlers were built in 1919, but improved Daimlers were built in 1921–1922, together with the Benz and Ehrhardt types. Four-wheel drive chassis of similar type to that of the Sdkfz 3 were used for the Police vehicles but with the addition of rear steering wheels; and the armoured hulls had twin machine-gun turrets, command cupolas and searchlights. All these vehicles were heavy and cumbersome and, despite their four-wheel drive, virtually road-bound.

Büssing Panzerkraftwagen 1915. The vehicle was over 30ft long and steered on all four wheels. (via B. T. White)





Ehrhardt Panzerkraftwagen 1917: snow chains on wheels for operations on Eastern Front. Identification painted on bonnet is 'Zug 6'.
(Imperial War Museum)

Despite the absence of suitable vehicles for training, interest in the postwar German Army centred on the possibilities of the armoured car for medium and distant reconnaissance for which it was specially suited: it fitted the concept of the reborn German Army, envisaged by its creator General von Seekt, as a compact mobile hard-hitting, fast-moving force. The armoured car was used by the Germans to back up the motor-cyclists, both solo and side-car borne, who were the spearhead of the reconnoitring thrust. As thought and experience crystallised, both armoured cars and motor-cyclists were to be found in the reconnaissance battalions of Panzer divisions, but it took the Germans a long time to mount anything heavier than a 20 mm gun in their armoured cars despite the important role assigned to them in the search for information.

The development of armoured cars in all countries has nearly always followed the same pattern: early models are usually civilian pattern vehicles with an armoured body (amounting almost to a standard pattern everywhere) clapped on to a chassis which may or may not be reinforced to carry the extra load. In due time the limitations of 4 × 2 drive (or even 4-wheel drive not designed for the job) become so obvious that recourse is had to the specialised lorry with multiple axles or four-wheel drive. The advantages of using a standard chassis in reducing cost and production time are so obvious that the next step is always delayed as long as possible. However, eventually it is always impossible to avoid recognition of the fact that the armoured car is a specialised weapon and it can only achieve its ultimate possibilities if it is built for its particular task.

The German Army reached this last stage in 1927 when a specification for a future armoured car was issued:
1. On good level roads the car must have a maximum speed of 41 m.p.h. and a circuit of action of 125 miles at an average speed of 20 m.p.h.
2. The armoured car must climb a slope of 1 in 3.
3. The armoured car must cross a ditch $1\frac{1}{2}$ metres wide without bellying and without any external assistance.
4. The armoured car must wade in water 1 metre deep.
5. Provision must be made for movement in either direction. The change over from forward to reverse driving position must not take more than 10 seconds.
6. The weight of the chassis must not exceed 4 tons and the complete car $7\frac{1}{2}$ tons.
7. Ground clearance must be ·3 metre.
8. The track of the car must be of such a width that it could be adapted to run on rails if required.
9. The crew was to consist of five men: commander, driver, two gunners and a wireless operator.

It was obvious that no standard chassis could possibly meet these requirements: the stage was thus set for the appearance of a purpose built vehicle, a point that Great Britain, which had been the leading protagonist for the armoured car, only reached years later.

Development contracts for multi-wheeled armoured cars were accepted in 1929 by three firms, Daimler-Benz, Magirus and Büssing-NAG. The first two produced 8-wheeled versions while Büssing-NAG built a 10-wheeled prototype. The Daimler-Benz vehicle, known as ARW/MTW1, had several advanced design features including chassis-less construction, with the automotive components being attached direct to the hull, and was amphibious. The 10 wheeled Büssing-NAG model was also amphibious, as was the Magirus. All three models were tested extensively in secret in Germany and, by special arrangement, in Russia. Development would probably have resulted in a very effective design for production but this was ruled out in 1930 because

these specialised multi-wheeled armoured cars were too expensive.

The same three firms—Daimler, Magirus and Büssing-NAG—had in the meantime been engaged in the development of a 6-wheeled armoured car on the commercial chassis which were on offer for the public. The Daimler-Benz models were first on the scene and appear to have played the greater part in the evolution of the production model, but nevertheless all three firms eventually built cars of this type for the Army on their own chassis up to 1935–1936. There were three versions in service, with different functions as follows:

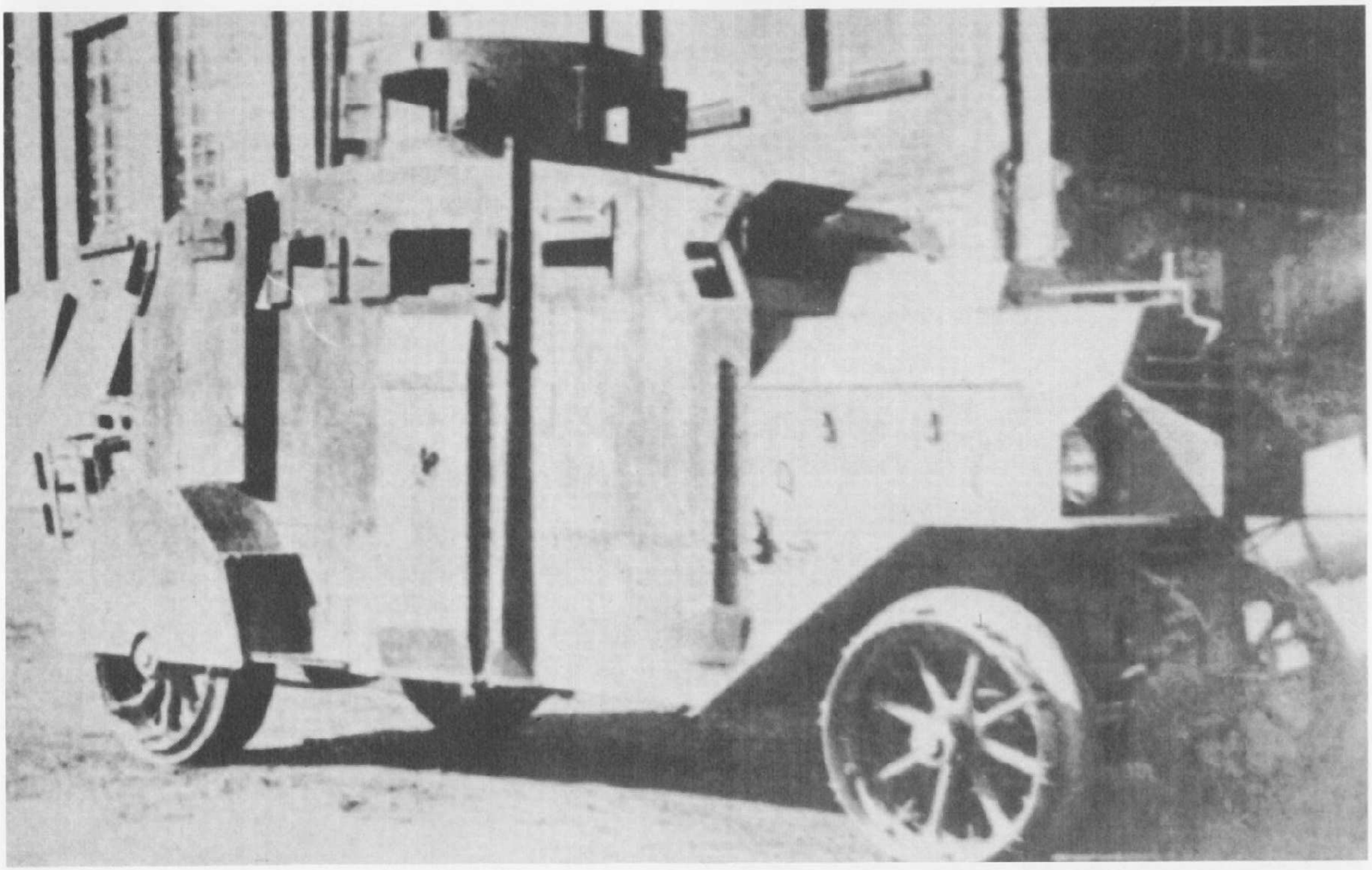
Schwerer Panzerspähwagen Sd Kfz 231—6-wheeled armoured car with 2 cm gun and one MG.

Schwerer Panzerspähwagen Sd Kfz 232—6-wheeled armoured car with same armament and a medium range wireless set.

Panzerfunkwagen Sd Kfz 263—6-wheeled armoured car with non-revolving turret and long range wireless set.

Side by side with the development of the heavy 6-wheeled armoured cars the German Army also put out a requirement for a light 4-wheeled armoured car. By 1933 this had been produced in two versions, the first, Kfz 13, carrying an MG, protected by a small shield and carried on a pivot mounting in an open body. The second version, Kfz 14, carried a wireless set but had no armament: the crew of this car was increased to three men in place of the two in the gun car version. Both types had their engine in front, and had armour 8 mm thick.

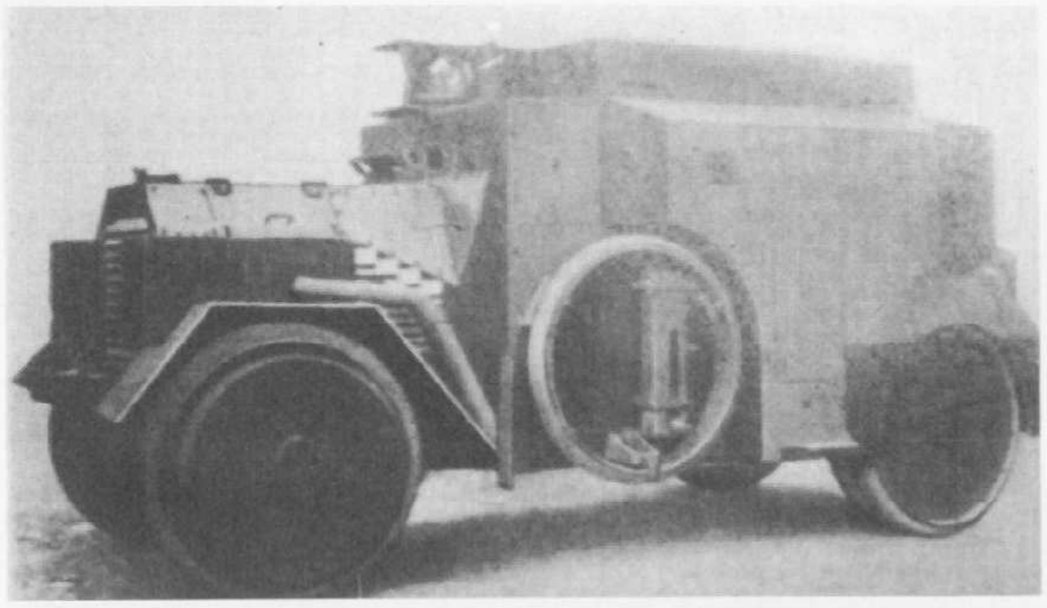
These small lightly armoured four-wheeled vehicles were the forerunners of Germany's light armoured cars. They were issued to cavalry regiments which had been converted to the armoured role. Easy to produce and



Ehrhardt Panzerkraftwagen 1919 was externally similar to the 1917 model. (via B. T. White)

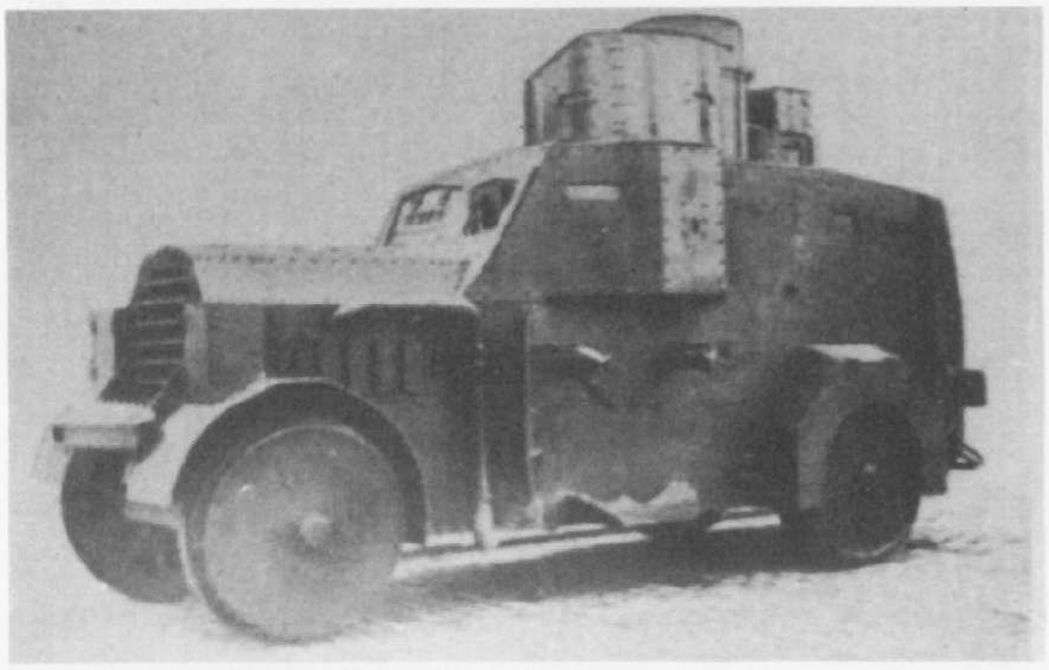
Standard German Army vehicle in post-Versailles period was the MTW (Mannschaftstransportwagen) Sd Kfz 3 produced as an armoured personnel carrier. Some were converted to wireless command vehicles. On the left is a Pz SpWg (Panzerspähwagen) Sd Kfz 221. (Col. R. J. Icks)

Three-quarter front view of MTW Sd Kfz 3 converted to a wireless command vehicle (left) with Pz SpWg Sd Kfz 221. (O. Munzel)

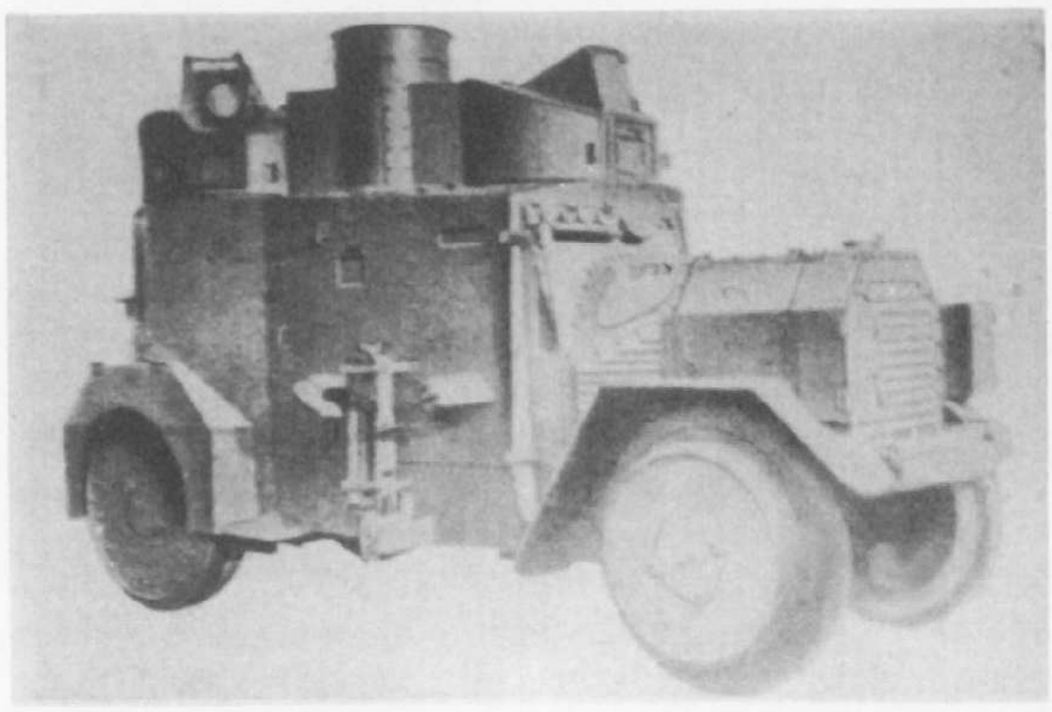


Side view of MTW Sd Kfz 3, Daimler 1921. ('Taschenbuch der Tanks')

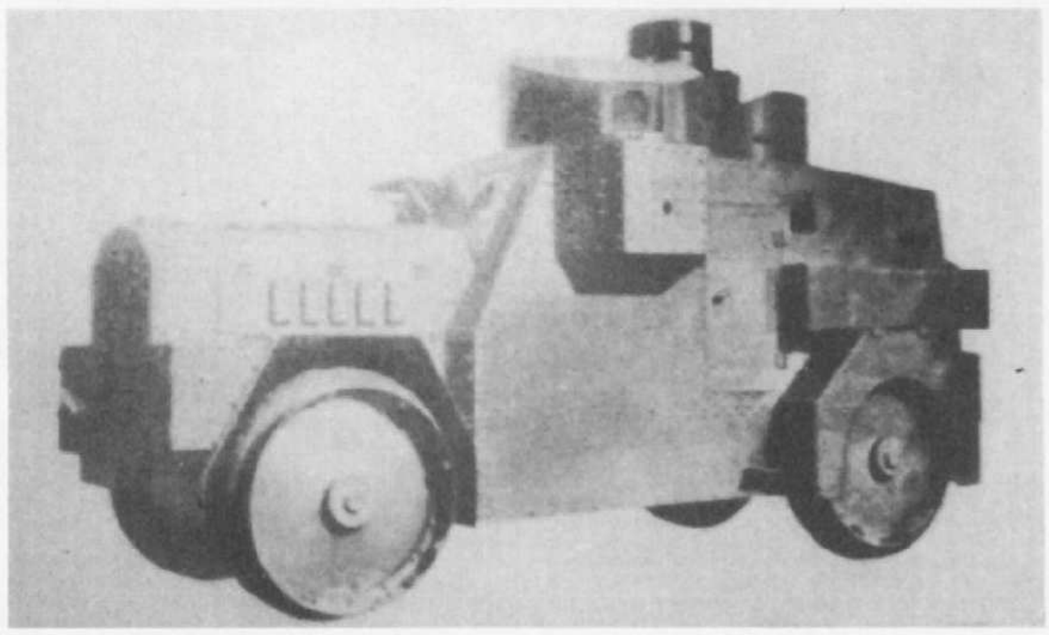
There were three models of the formidable armoured cars built for the German Police in the post-Versailles period. These Polizeisonderwagen were—



the Ehrhardt 1921—



the Daimler 1921, and—



the Benz 1921.

relatively inexpensive they met the immediate requirements of the newly elected Nazi government for something in the shop window to stimulate Germany's rising pride in her armed forces.

By 1935 the Kfz 13s had proved their value and a fresh requirement for a more sophisticated car was issued. In 1937 the 4-wheel drive SdKfz 221 series was in production, with a rear-mounted engine of 3·5 litres, armour varying between 14 and 8 mm, and a top speed of 50 m.p.h. The chassis in its normal front engine version was also used for other purposes, as an artillery tractor and as an APC: it was designed by Horch and the armoured car version had an open-topped turret with 360 degree traverse mounting a 7·92 mm MG.

There were six versions in the 221 series:

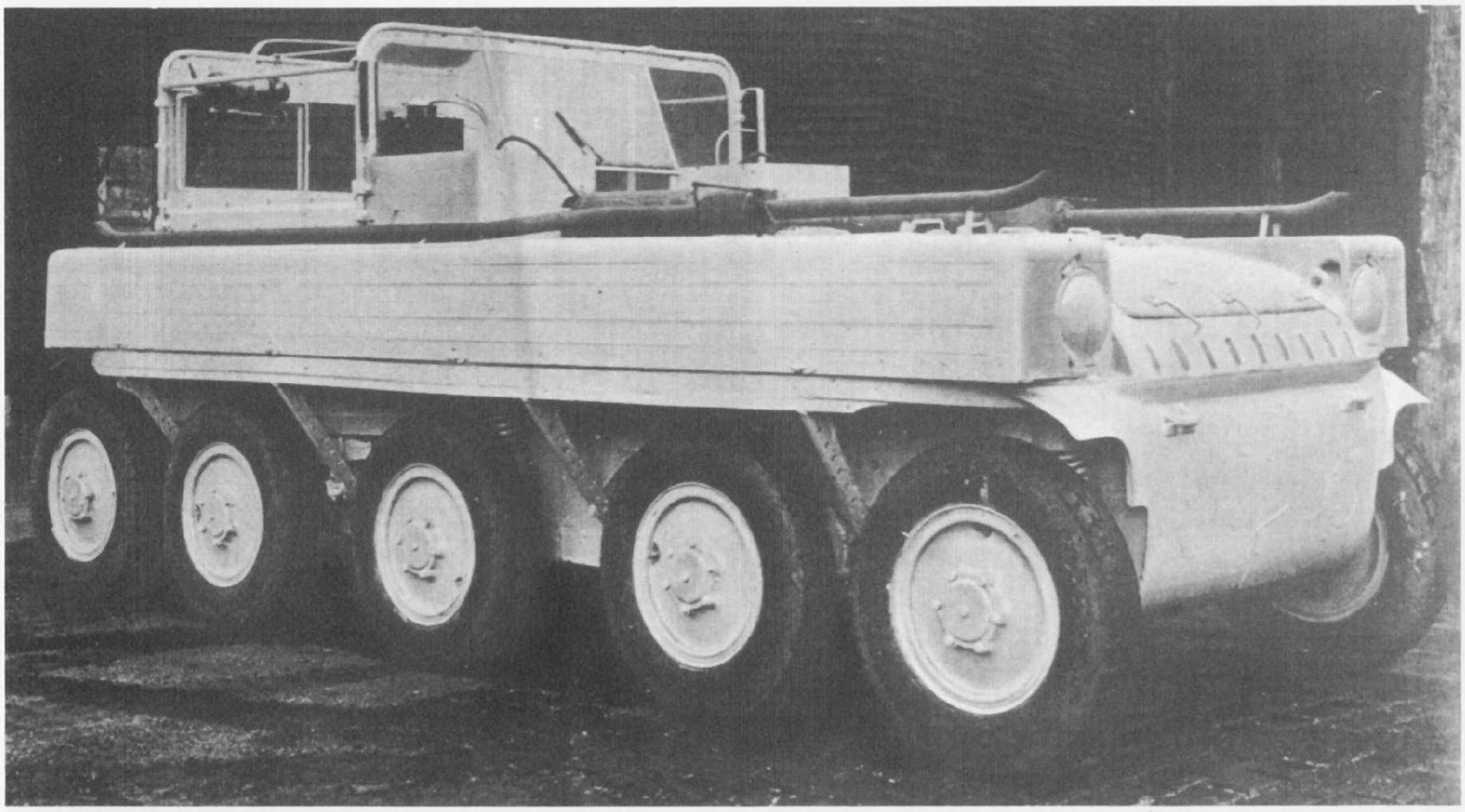
Leichter Panzerspähwagen Sd Kfz 221 (MG)—	mounting MG only.
Leichter Panzerspähwagen Sd Kfz 221 (2·8 cm. PzB41) —	mounting an anti-tank rifle in an open-topped turret.
Leichter Panzerspähwagen Sd Kfz 222 (2 cm)—	mounting 2 cm gun and machine-gun in turret with a hinged wire grille head cover.
Leichter Panzerspähwagen Sd Kfz 223 (Fu)—	MG version but with a medium range wireless set.
Kleiner Panzerfunkwagen Sd Kfz 260—	Both these vehicles were special wireless cars with
Kleiner Panzerfunkwagen Sd Kfz 261—	long range sets.

In 1935, with the Rhineland re-occupied and Germany re-established in her own eyes, the provisions of the Versailles Treaty were openly defied and there was much activity in the German armoured world. As far as armoured cars were concerned the 8- and 10-wheeled designs which had been rejected in 1933 were again examined and were developed into an 8-wheeled armoured car which appeared in the following versions in 1938:

Schwerer Panzerspähwagen (8 Rad) Sd Kfz 231—	armed with 2 cm gun and machine-gun.
Schwerer Panzerspähwagen (8 Rad) Sd Kfz 232 (Fu)—	as above, but with a wireless set.
Schwerer Panzerspähwagen (8 Rad)—Sd Kfz 233—	armed with 7·5 cm gun Stuk L/24.
Panzerfunkwagen (8 Rad) Sd Kfz 263—	no turret, heightened hull with MG in front plate. Long range wireless vehicle.

For some reason the Germans gave these 8-wheeled vehicles the same vocabulary number as those of the earlier 6-wheeled cars. To distinguish between the two the description (6 Rad) or (8 Rad) was added to the vocabulary number. The 231 series (6 Rad) were used by the armoured car companies of the Panzer divisions from 1935 onwards until the 8-wheelers took their place. Some of them were in action in Poland and in the early stages of the campaign in France in 1940.

Two years after the appearance of the Sd Kfz (8 Rad) 231 series there was a further demand from the German Army in August 1940 for armoured cars specially adapted for work in tropical conditions; the North African campaign was then the only active war theatre. They were to be powered by an air-cooled CI engine, to have a more powerful armament than the earlier 8-wheelers and were to carry more armour. This new 234



Three-quarter rear view of the 10-wheeled ZRW (Zehnradwagen) Büssing-NAG prototype, 1929–30. The vehicle was amphibious. (B. H. Vanderveen)

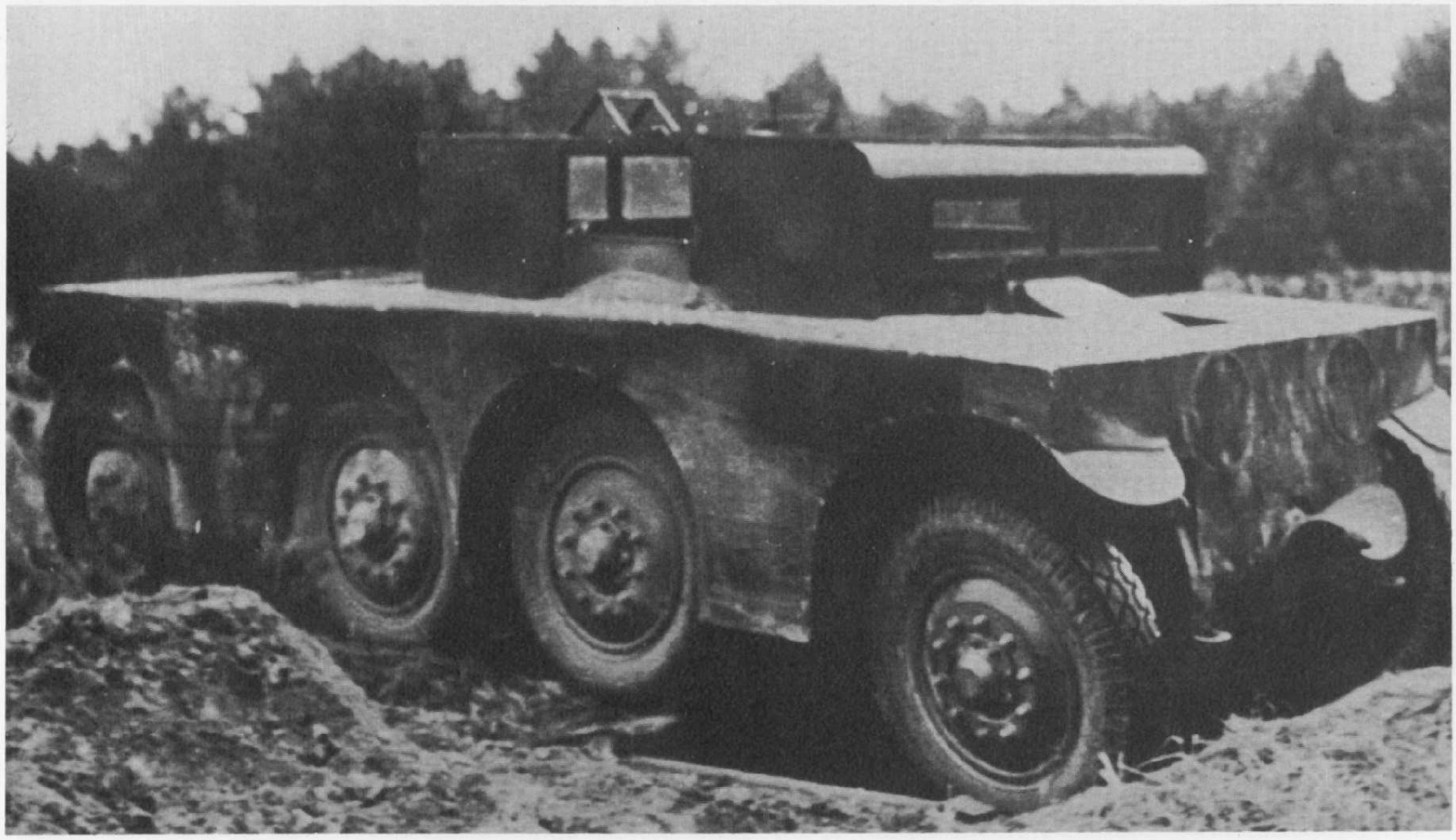
range proved very successful: they were formidable cars and proved very good performers across country, a characteristic also of the earlier 8-wheelers. Their secret lay in the fact that all eight wheels were both driven and steered.

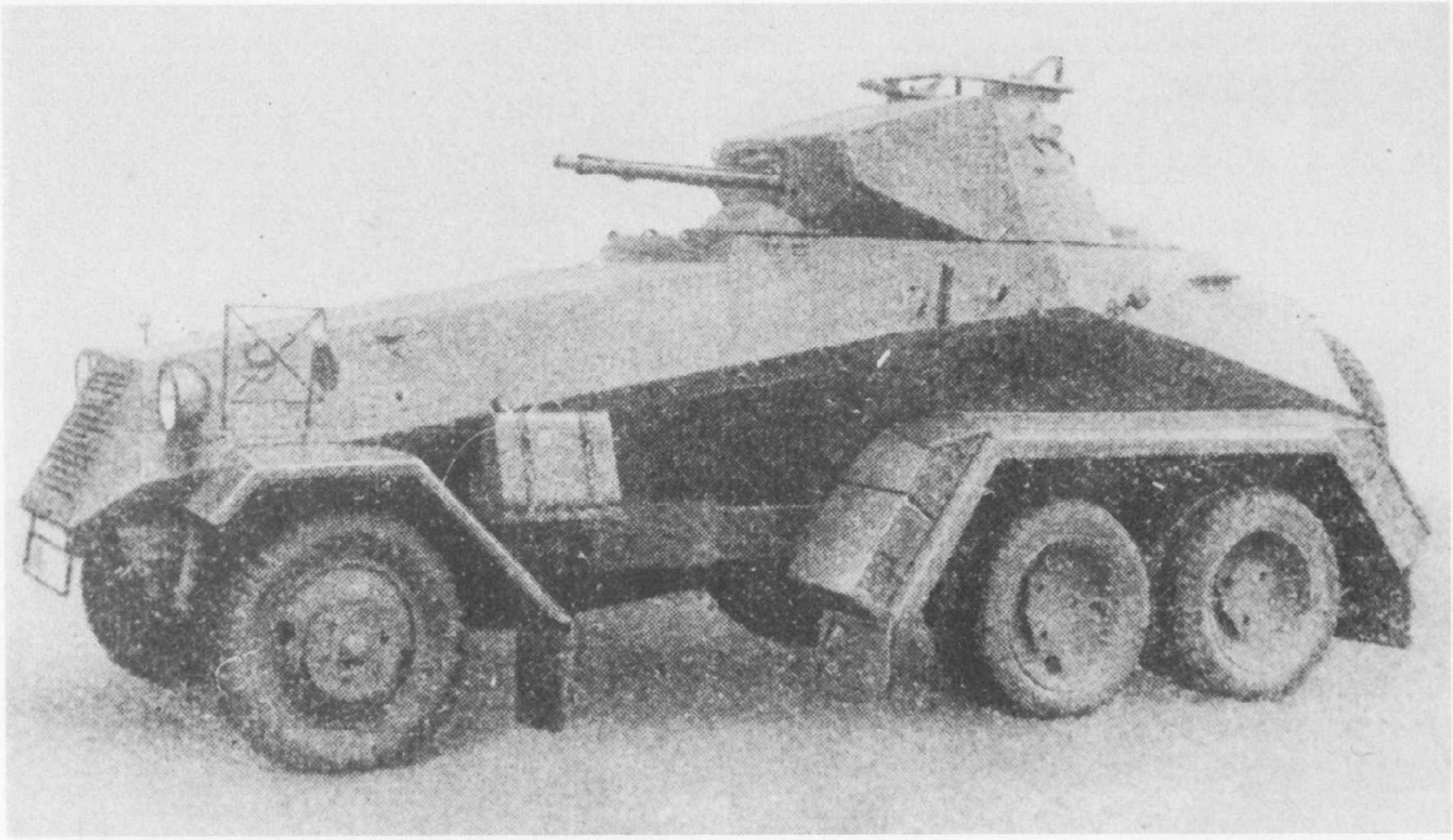
Hitler himself ordered the installation of the long 7·5 cm gun on the 234 chassis. It would have been ideally suited to the anti-tank role and the possibilities inherent in these cars in combination with tanks or static anti-tank guns are enough to make any tactician's mouth water.

The list of variants of the SdKfz 234 is as follows:

Schwerer Panzerspähwagen Sd Kfz 234/1—	armoured car with 2 cm Kwk and machine-gun in open turret with hinged wire grille top.
Schwerer Panzerspähwagen Sd Kfz 234/2 (Puma)—	5 cm Kwk L/60 and co-axial machine-gun in enclosed turret.
Schwerer Panzerspähwagen Sd Kfz 234/3—	turretless: 7·5 cm Stuk L/24 in open mounting.

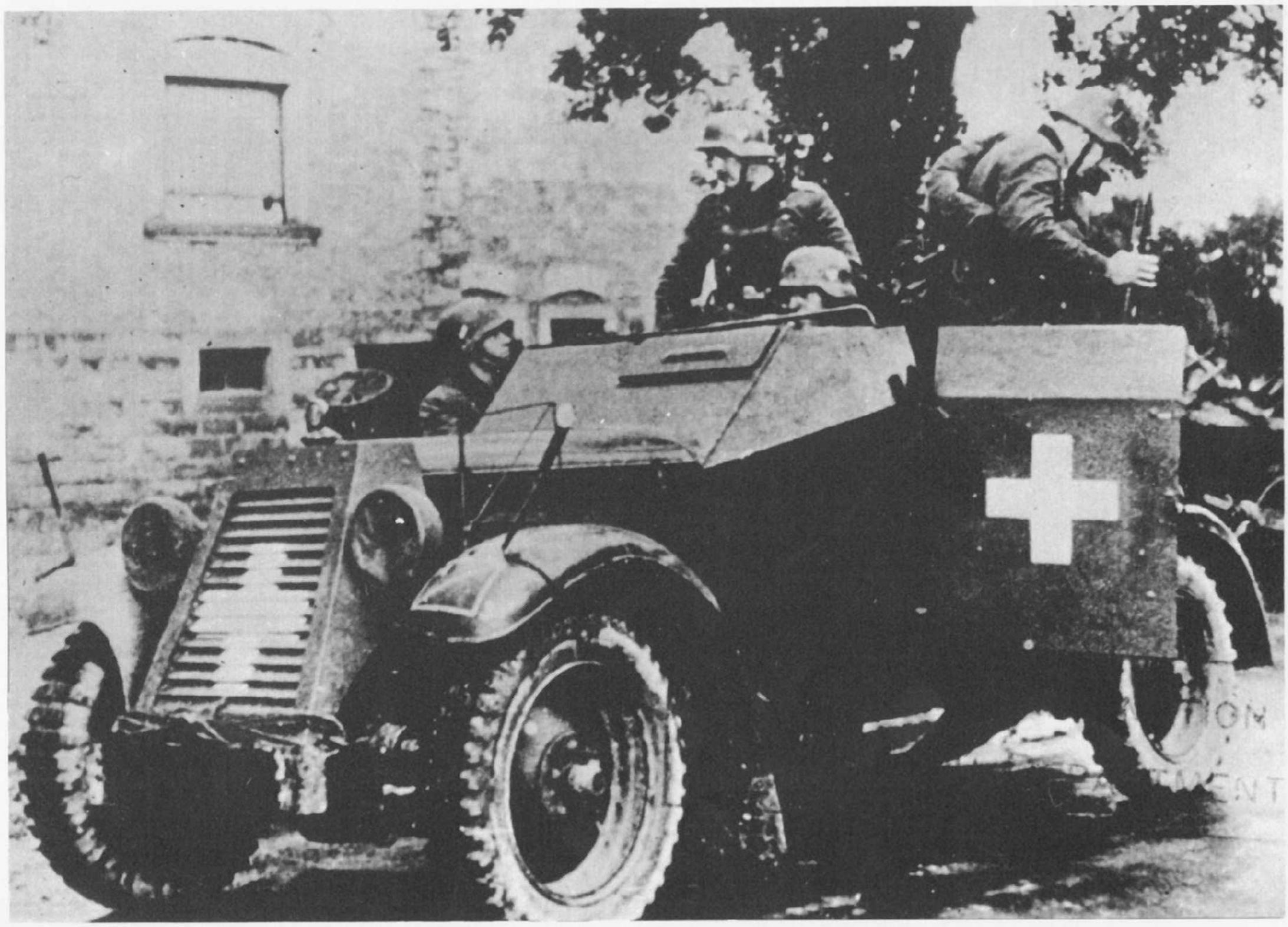
Three-quarter front view of the Daimler-Benz 8-wheeled ARW/MTW 1 (Achtradwagen/Mannschaftstransportwagen) during development. The vehicle, which was amphibious, had a chassis-less construction. (via RAC Tank Museum)

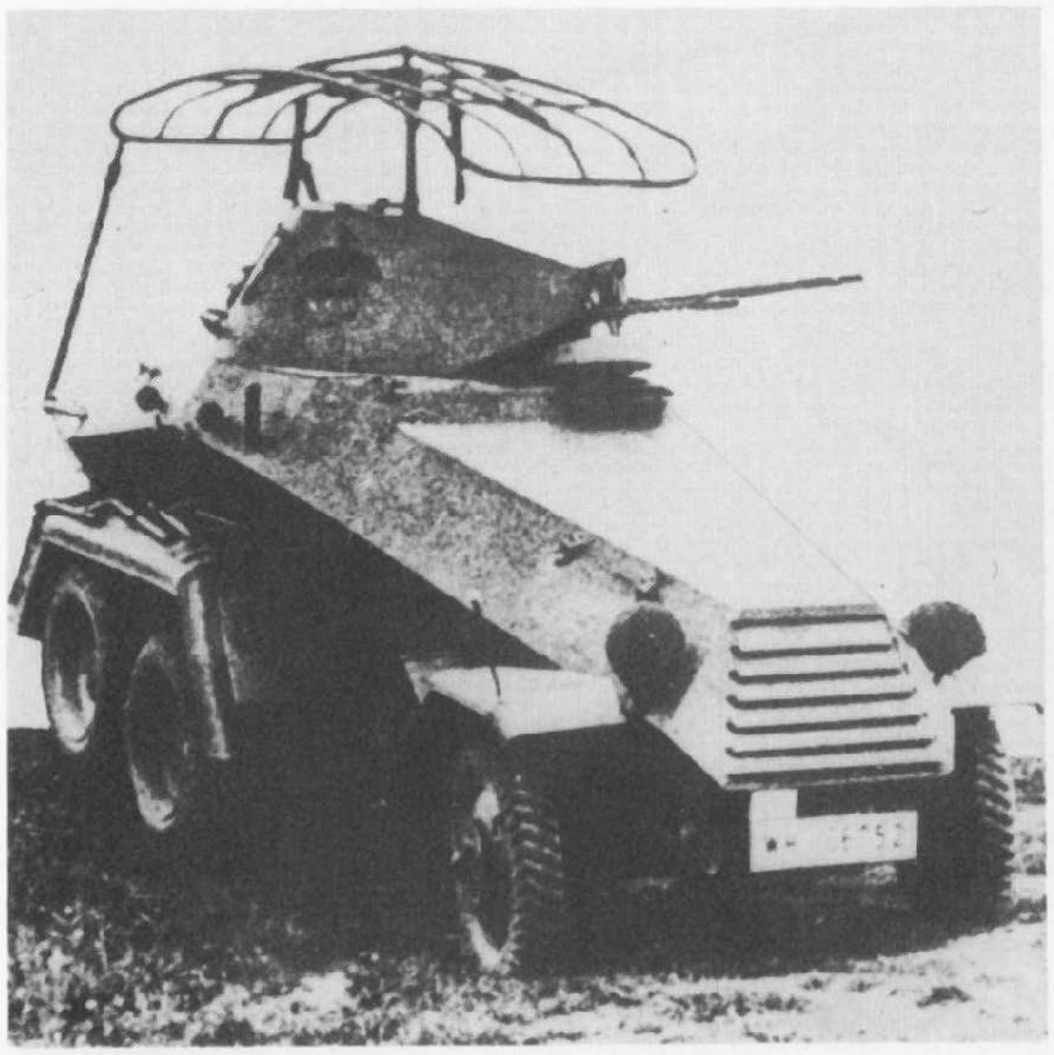




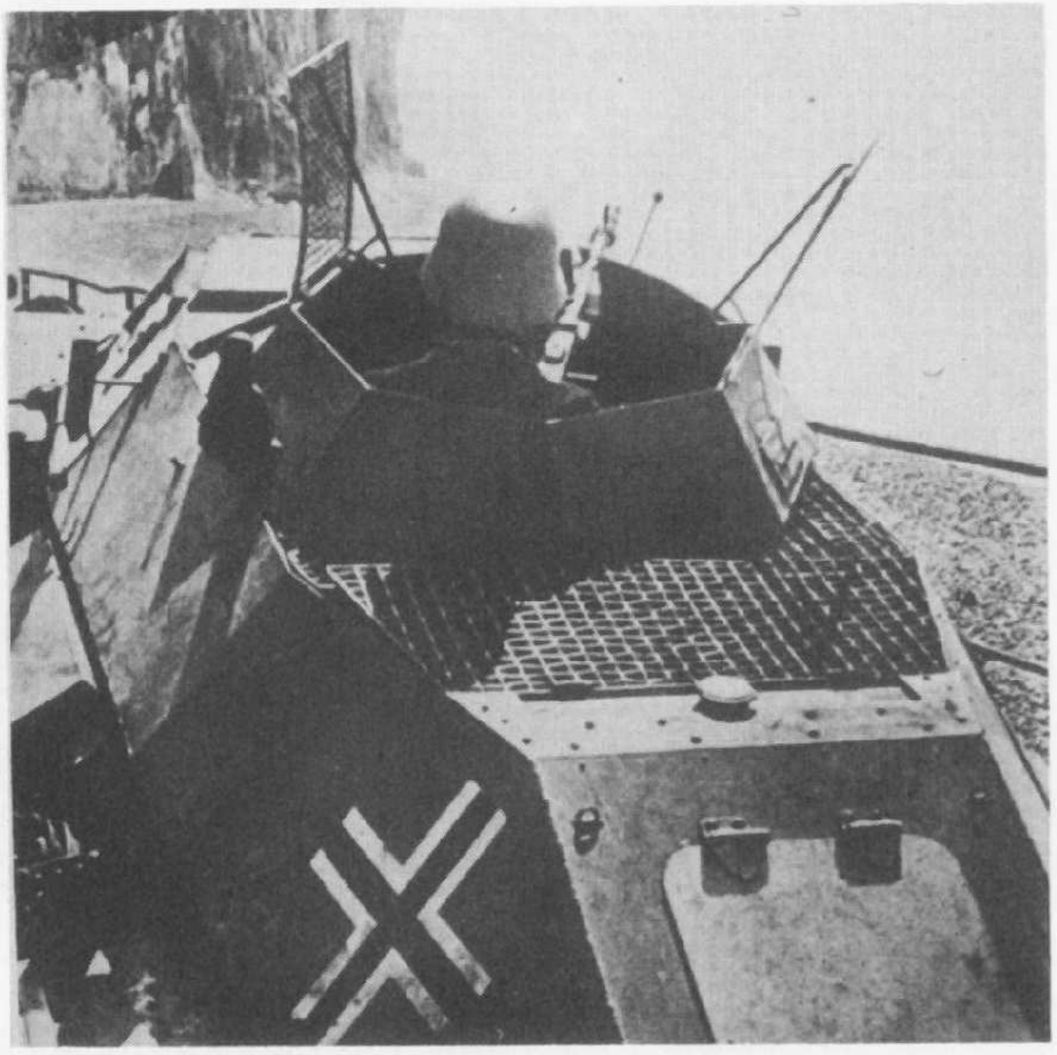
Schwerer Panzerspähwagen (6 Rad) Sd Kfz 231 with 2 cm gun and rail round commander's hatch for AA machine-gun. The long gap between the front and rear wheels was a noticeable characteristic of the six-wheelers. (via RAC Tank Museum)

Light 4-wheeled scout car with machine-gun. Maschinengewehr-Kraftwagen Kfz 13, in Russia, summer 1941. (via RAC Tank Museum)





Schwerer Panzerspähwagen (6 Rad) Sd Kfz 232: the wireless-equipped version of the Sd Kfz 231, showing the turret swung beneath the frame aerial. (via RAC Tank Museum)



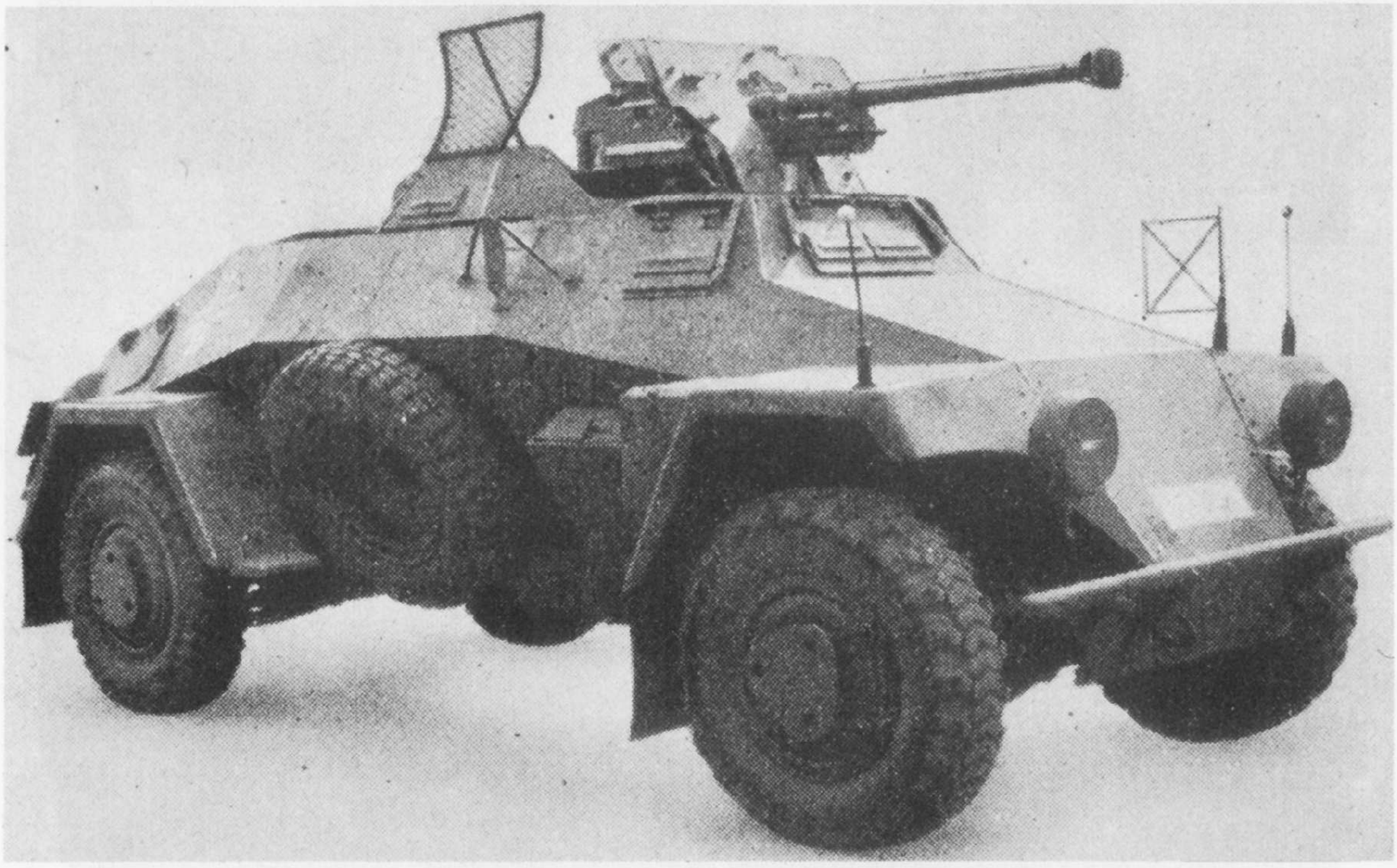
Leichter Panzerspähwagen Sd Kfz 221 (MG) at English Channel coast, 1940. (B. H. Vanderveen)

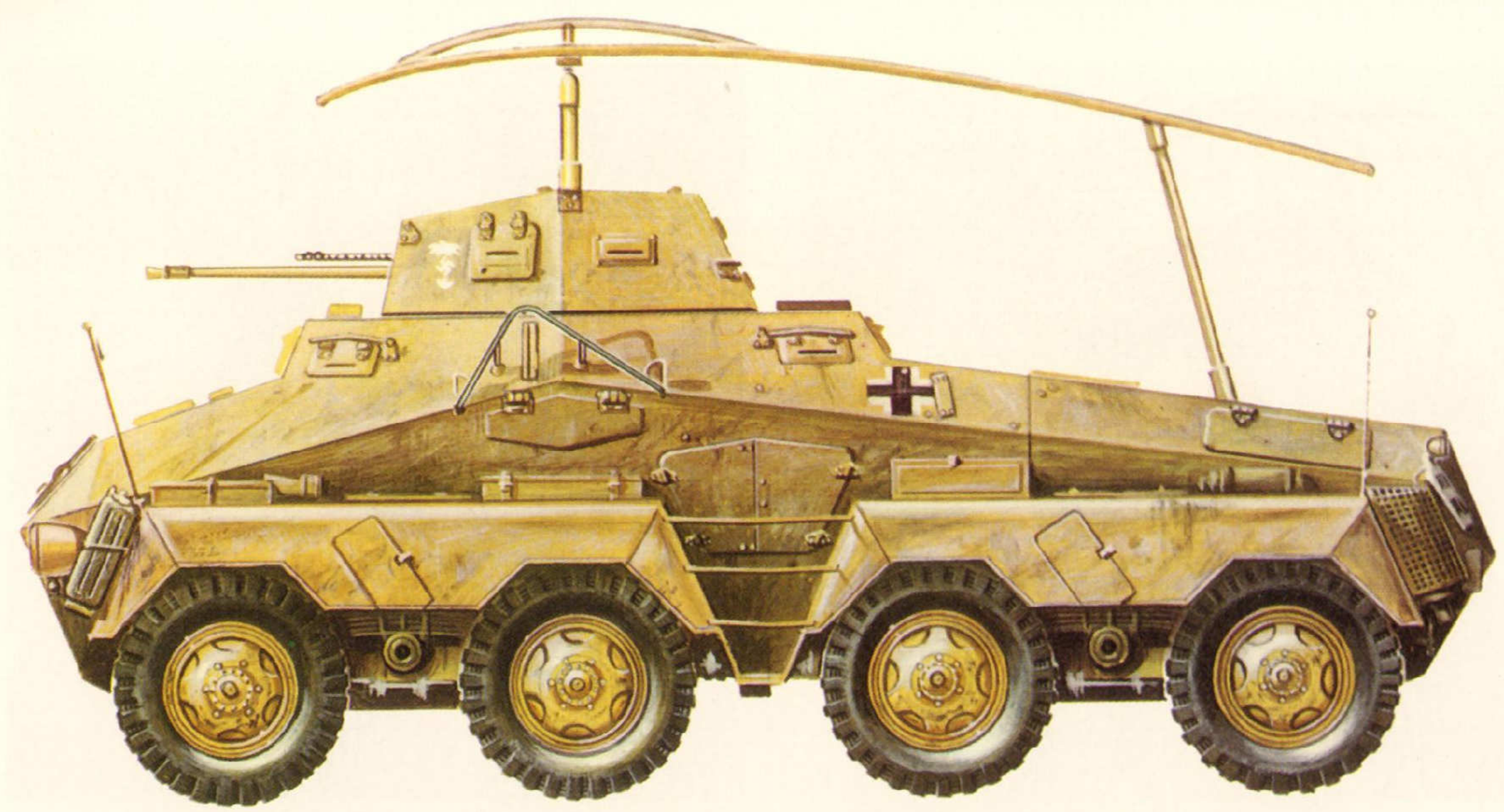
Schwerer Panzerspähwagen Sd Kfz 234/4— turretless: 7·5 cm Pak L/48 in open mounting.

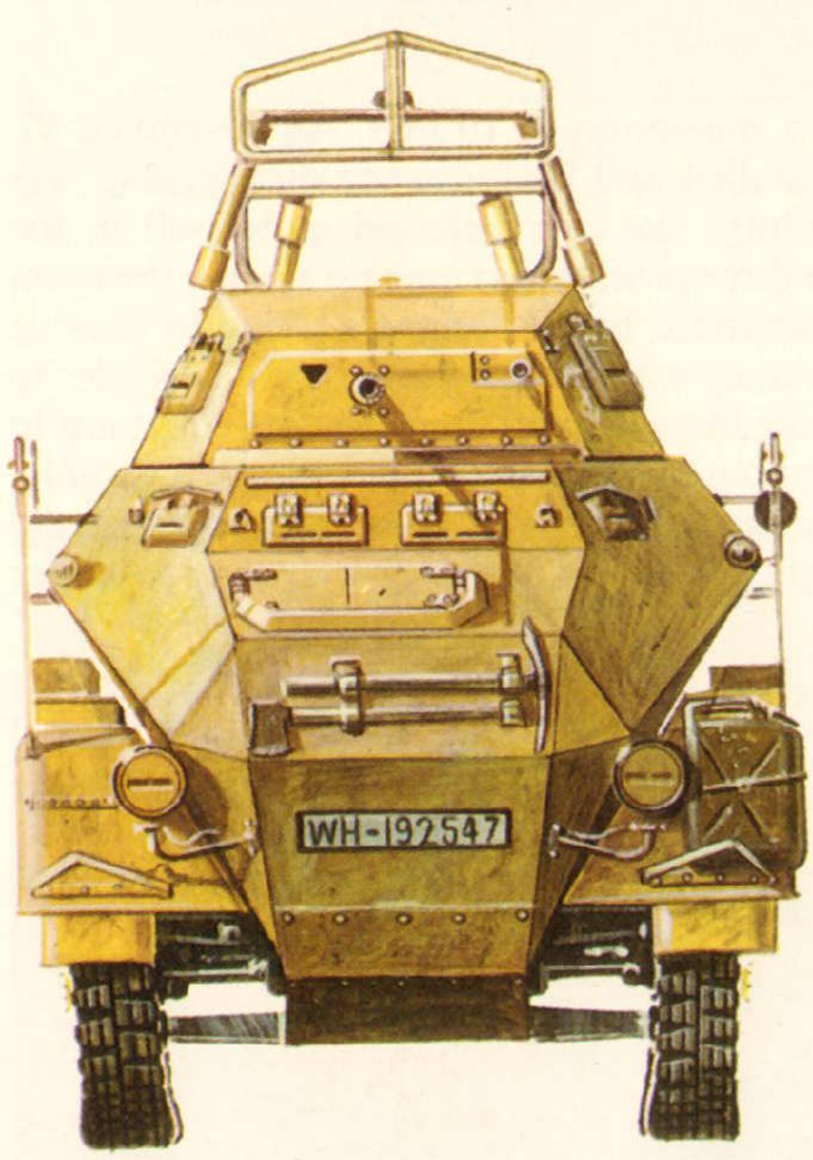
AMPHIBIOUS ARMOURED CARS

Prototype amphibious armoured cars were designed by Hans Trippel and built by the Trippelwerke in 1941 and 1942. Three versions, Schildkröte (Turtle) I, II and III, were produced armed respectively with a single MG, with two MGs, and finally with a 2 cm gun. Armour was originally on a 7 or 7·5 mm basis but this was later increased to a maximum of 10 mm. An air-cooled V8 Tatra was installed and performance on the road was quite satisfactory; the cars behaved quite well in the water but the three prototypes came up against the usual difficulty experienced by all designers trying to provide inherent buoyancy within the confines of the vehicle: to obtain anything like sufficient flotation the vehicle has to be very lightly constructed, which rules out the possibility of carrying either a weapon large enough to be of any value against hostile AFVs or sufficient armour to confer

Leichter Panzerspähwagen Sd Kfz 221 (2·8 cm PzB41) with a 2·8 cm Panzerbusche anti-tank weapon in place of the machine-gun. The turret was cut away in front and back to accommodate it. Note wire grille for protection on side wing of original turret. (RAC Tank Museum)



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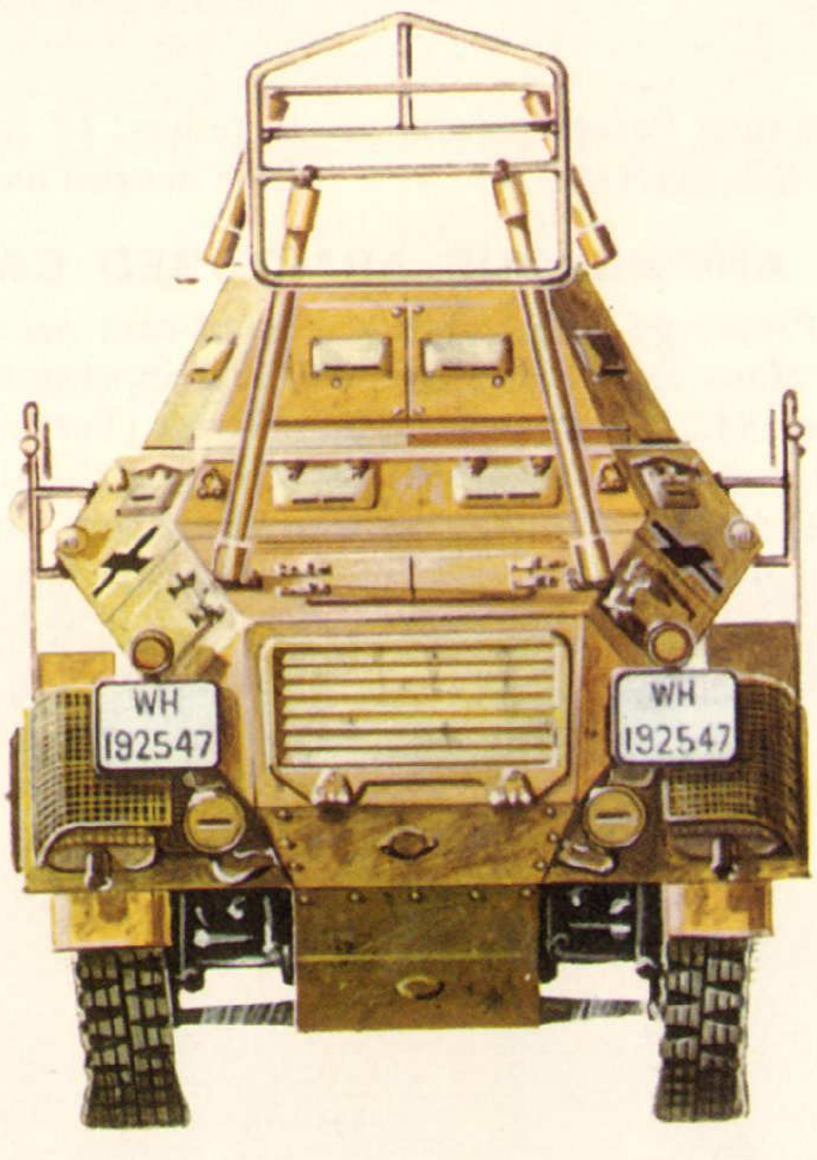
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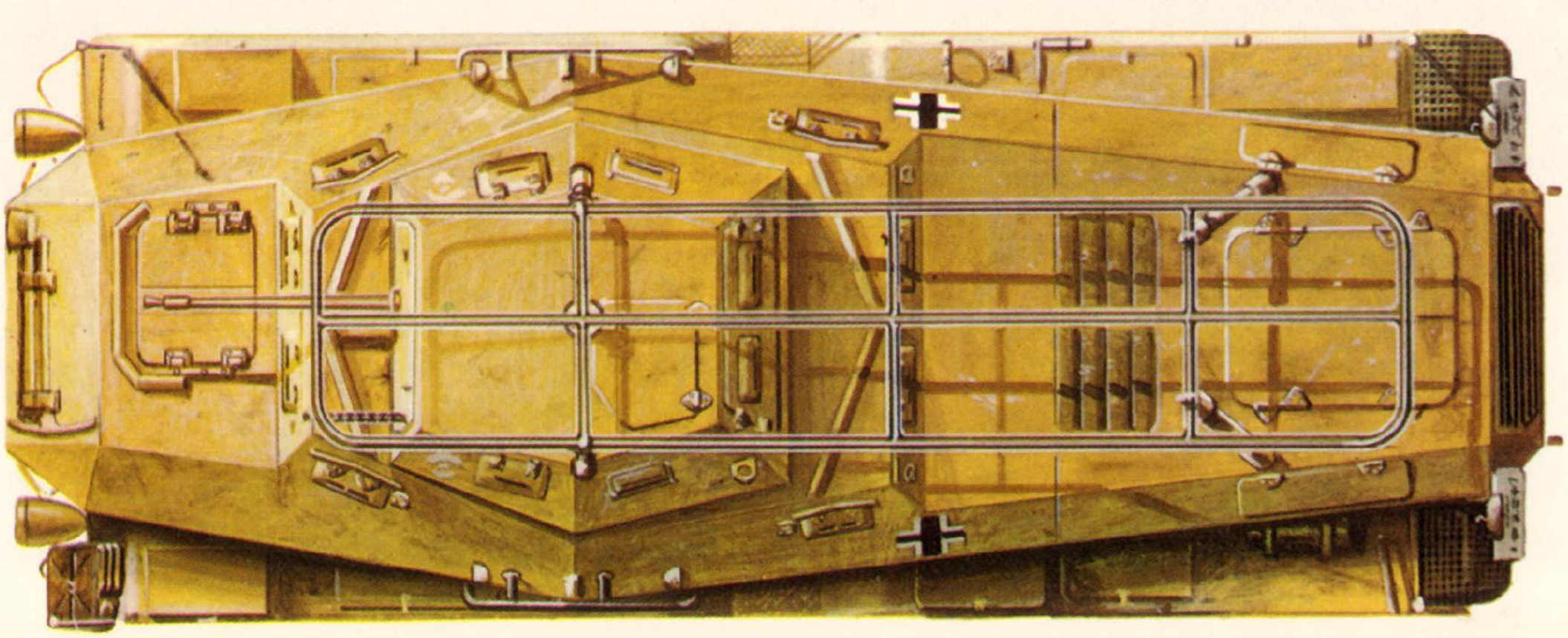
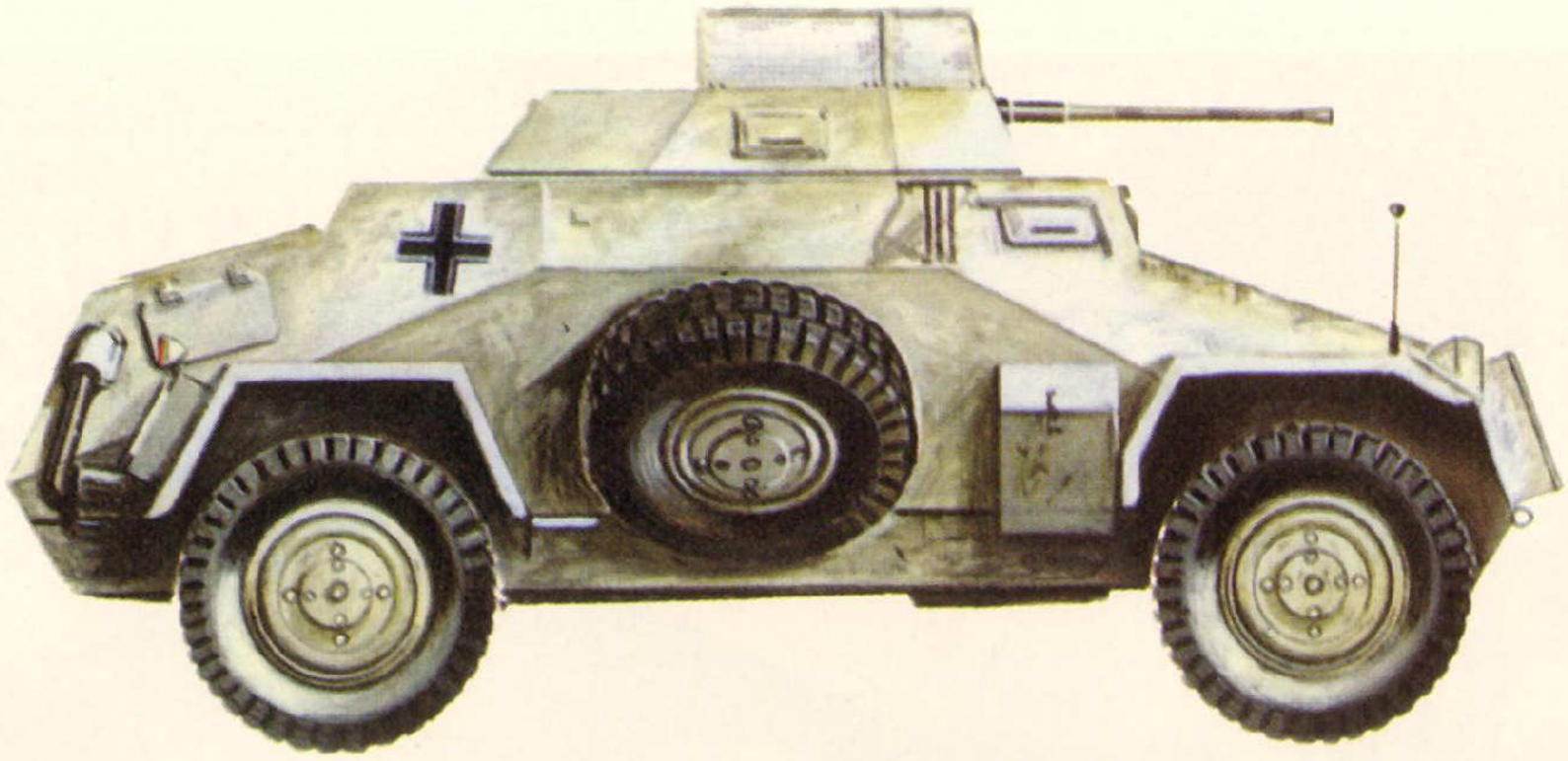
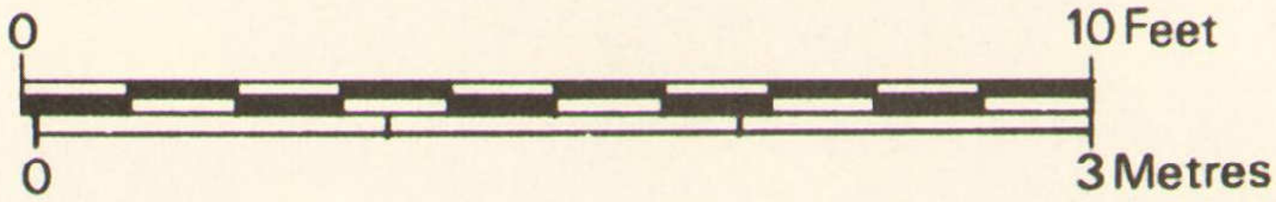




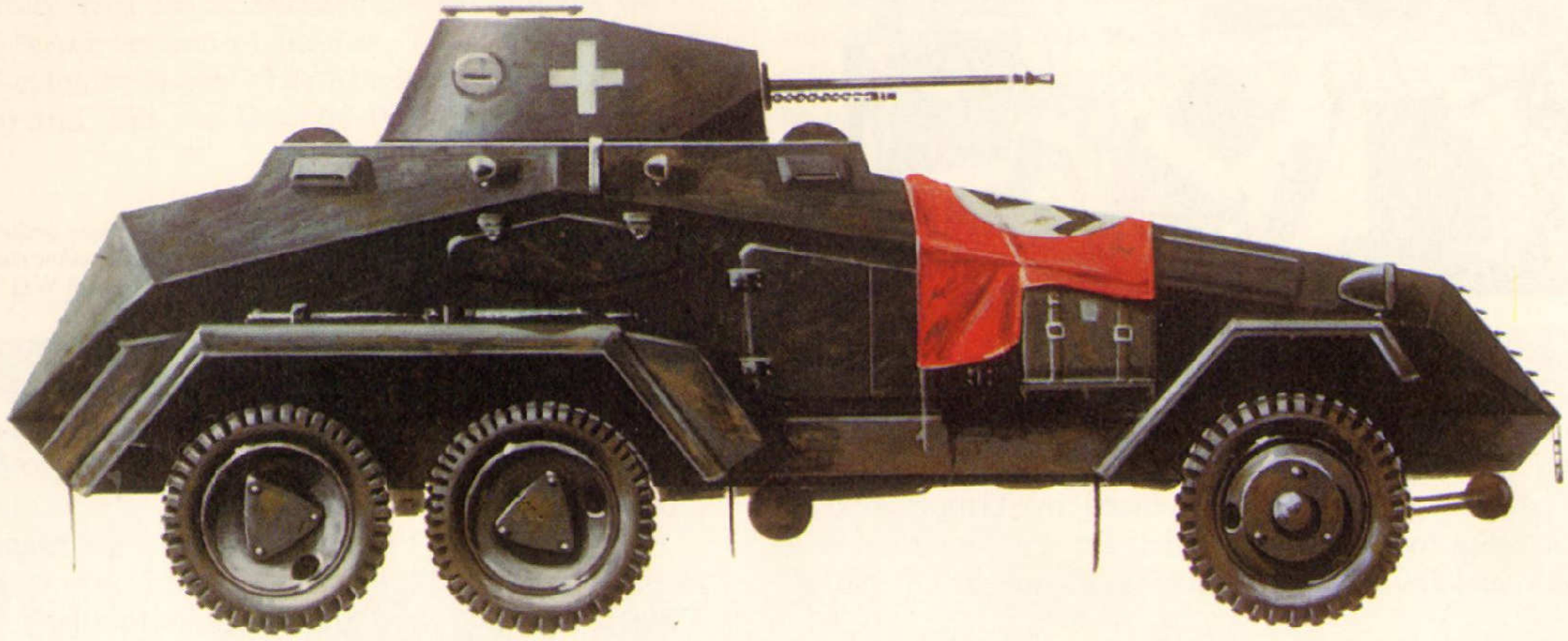


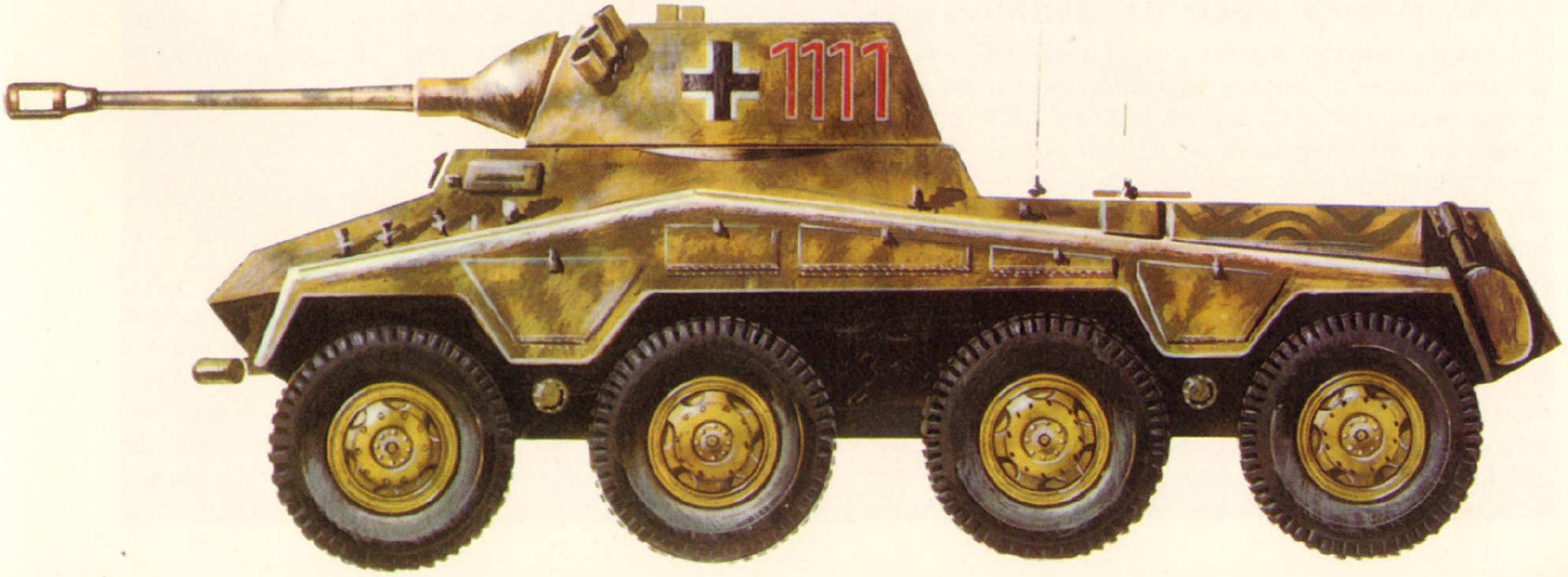
Above: Leichter Panzerspähwagen Sd Kfz 222 in winter camouflage.

Left: Four views of Schwerer Panzerspähwagen (8 Rad) Sd Kfz 232 (Fu) of the Afrika Korps.

Below: Schwerer Panzerspähwagen (6 Rad) Sd Kfz 231 at the time of the Polish campaign, September 1939.

Bottom: Schwerer Panzerspähwagen Sd Kfz 234/2 (Puma).





Leichter Panzerspähwagen Sd Kfz 222 in North Africa. The 222 had a 2 cm KwK (KraftwagenKanone) L/55 as its main armament, with a 7·92 mm coaxial machine-gun. Overhead protection in the turret was given by a hinged wire grille. (RAC Tank Museum)

Captured Sd Kfz 222 in North Africa. The two-part wire grille that gave side, front, and overhead protection has been opened to allow room for the special armament installation. (South African National War Museum)

any appreciable measure of immunity against hostile fire.

Great trouble was experienced by Trippelwerke in obtaining the materials needed for the construction of their vehicles and the project was abandoned in 1942.

ARMOURED CARS OF OTHER COUNTRIES USED BY GERMANY

Germany was not a great user of armoured cars and produced most of what she required for her own use. However there were a few types built by other countries which she did incorporate in her own forces. In 1930 Austria built a wheel-cum-track machine which eventually developed into Type RR 7. Fifteen of them had been built by January 1937 and these were afterwards taken into German service as Sd Kfz 254: production was continued until a total of 128 was built. By 1940 RR 9 had appeared, still with wheel and track capacity, but fitted with a revolving turret mounting a machine-gun. This machine and its proposed later developments interested not only the German Army but also the Waffen SS. Despite such powerful backing nothing further was heard of the project which was abandoned in 1942. About 50 Austrian 8-wheeled armoured cars were also taken into German service—these were the Austro-Daimler type ADGZ.

After the fall of France in 1940 the Germans requisitioned about 200 French Panhard armoured cars, Type 178, and gave them the vocabulary number Pz Spw.P 204(f). They were four-wheel drive cars, with a four man crew and were armed with a 25 mm gun and a machine-gun. They were powered by a 4-cylinder Panhard engine of 100 h.p. and, with up to 20 mm of armour, weighed 8·2 tons.

CONSTRUCTIONAL FEATURES

Maschinenegewehr—Kraftwagen mit MG: Kfz 13

This car was of conventional construction with 4 × 2 drive; it had a front-mounted Adler 6-cylinder engine of 60 h.p. coupled to a sliding pinion 4-speed gearbox and a back axle of normal pattern. The car had a crew of two men, carried in an open-topped body which had one MG mounted on a pivot with a small shield for the commander/gunner. It weighed 2½ tons and the armour was 8 mm thick.

Kfz 14

This wireless car used the same chassis as the Kfz 13 but it had no armament. This was the inevitable disadvantage of a bulky wireless set and had to be accepted until a small and compact set had been developed. Kfz 14 had the same open body as the fighting version and carried a frame aerial almost as big as the ground plan of the car: this could be lowered in the interests of concealment. The reputed range of the set was 20 miles. In Great Britain, the No 1 set was produced in 1931 and fitted into a light tank with a speech range of between 3 and 5 miles albeit with a performance that was both chancy and temperamental. Nonetheless special wireless tanks were not needed.

Pz Spw (6 Rad) Sd Kfz 231

These 6-wheeled armoured cars were the production versions of prototypes submitted by Daimler-Benz, Büssing-NAG and Magirus from 1929 onwards. The first prototype, Daimler-Benz Type G3(p), weighed 4·9 tons, the chassis having a notably long gap between the front wheels and the rear pair of axles: this remained a characteristic of the six-wheelers. A revolving turret mounted one 7·92 MG and a 6-cylinder 70 h.p. Daimler engine drove a standard sliding pinion gearbox, the drive being taken thence by a normal propellor shaft to the three axles, each of which had its own differential. Adjustable tracks could be fitted round the rear wheels to increase cross-country performance in bad going.

After experience with this model Daimler-Benz produced another version, Type G3a(p), which was successfully tried out on manoeuvres in company with a Büssing-NAG version of the car, Type G31(p), which had a 4-cylinder engine. The Magirus model was Type M206(p) and, like the Daimler-Benz, had a 6-cylinder engine. Out of these cars came the production versions which first appeared in 1933 as Sd Kfz 231. Weight had increased to approximately 6 tons and the crew had become four. A 2 cm gun was mounted in the revolving turret: duplicate steering positions with alternative controls were fitted, the second steering wheel and the controls coming into action when reverse gear in the direction gearbox was engaged. A coaxial MG was added together with a ring round the commander's hatch to allow a light MG to be used for AA defence. The long gap between the wheels was still evident and to reduce the chance of the car "bellying" a roller the complete width of the car was fitted across the middle of the chassis.

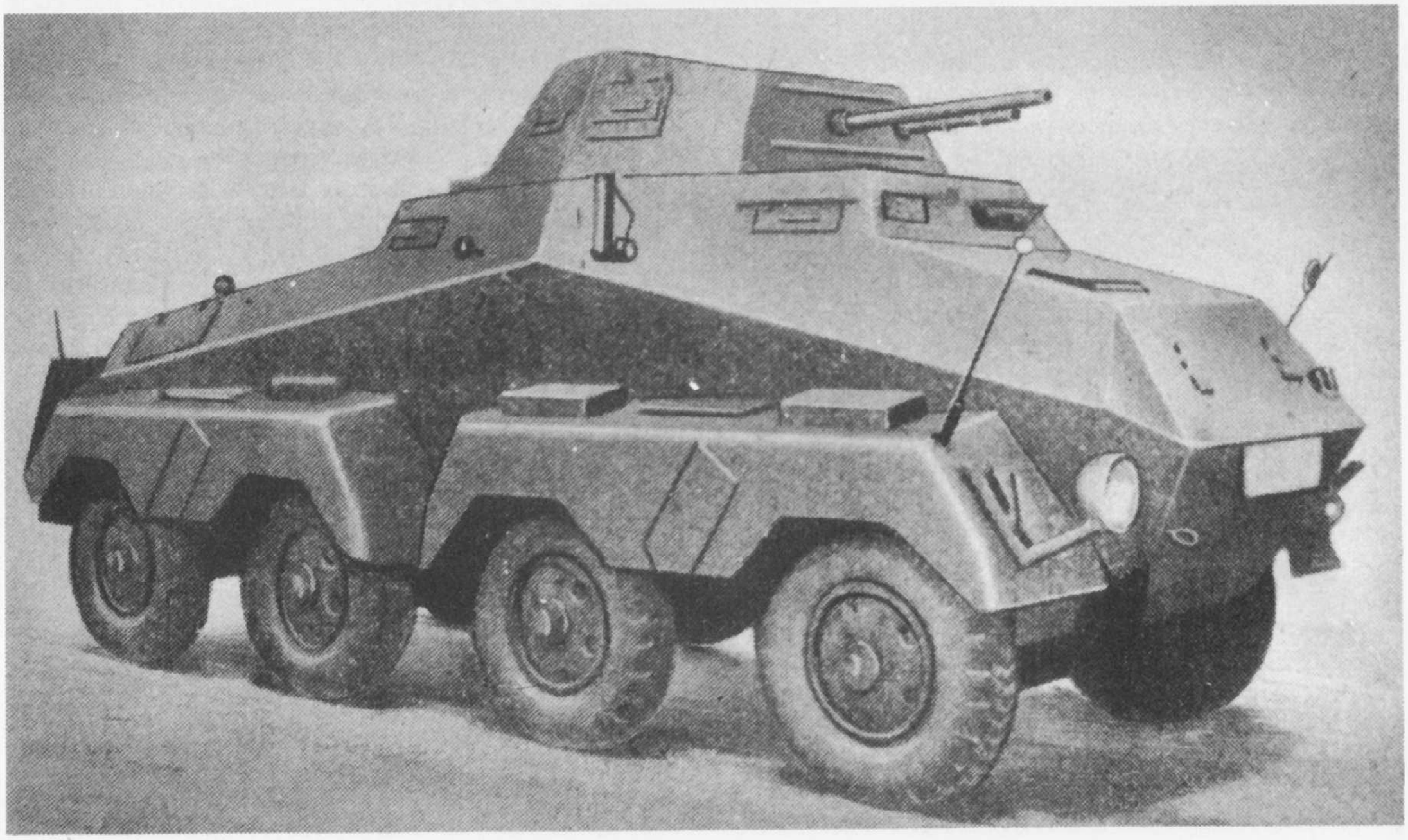
Pz Spw (6 Rad) Sd Kfz 232

This was the same car as 231 but was fitted with a wireless set and also mounted a coaxial MG. A horizontal frame aerial consisting of parallel tubes was carried on two outriggers at the back of the car. The frame had a central bearing which rested on a turret support shaped like an inverted "U". This allowed the turret to turn beneath the aerial without transmitting any movement to it. No provision was apparently made to avoid the danger of shooting away the rear aerial supports when the turret was turned to 160 and 200 degrees.

Panzerfunkwagen (6 Rad) Sd Kfz 263

This was an ordinary 231 chassis fitted with a non-rotating turret carrying in its front plate only one MG for defensive purposes. The extra space within the hull was used to house a long range wireless set. A frame aerial of similar design to that on Sd Kfz 232 (Fu) but of slightly different shape was supported at four points and could be lowered if necessary. Provision was made for trans-

Schwerer Panzerspähwagen (8 Rad) Sd Kfz 231 was armed with a 2 cm KwK and a coaxial 7·92 mm MG. (R. Surlémont)



Schwerer Panzerspähwagen (8 Rad) Sd Kfz 232 was the same car as the 231 and mounted the same armament, but it had a medium range wireless set with a frame aerial. (RAC Tank Museum)

mission through a mast aerial if greater range was needed.

The 6 Rad range of cars were robust and well-built with a good cross-country performance, though hampered by their tendency to belly in bad going even when fitted with the cross-car roller. It is possible that this weakness may have revived interest in the 8- and 10-wheeled designs which were submitted for consideration in 1929 when the question of multi-wheeled cars first came up. However, before going on to describe the range of 8-wheeled cars that came into service, there was the range of 4-wheeled armoured cars that came into service with the German Army from 1938 onwards.

Pz Spw Sd Kfz 221—Light four-wheeled armoured cars

These cars were built to meet a requirement for a range of light armoured cars and came into production in 1937. A 75 h.p. water-cooled V8 Horch petrol engine was mounted at the rear and the drive was taken to a sliding pinion gearbox of conventional design giving five forward speeds and one reverse gear. From this box the drive was taken to front and rear differentials and thence to the wheels. These were independently sprung, each having two radius arms controlled by parallel coil springs. Bullet-proof tyres were fitted and the car weighed 4 tons.

Pz Spw Sd Kfz 222

This was a later development of Sd Kfz 221 and appeared a year later in 1938. The same chassis was used but the front armour plate was increased in thickness to 14·5 mm which raised the weight to 4·8 tons. The engine power was increased to 81 and later 90 hp. The turret was higher and was provided with overhead cover in the form of a hinged wire grille. A 2cm KwK L/55 gun was mounted with a coaxial 7·92 mm MG and the crew was increased to 3 men.

Pz Spw (Fu) Sd Kfz 223

These cars were similar to the 222s but carried a medium range wireless set and were armed only with a 7·92 mm MG mounted in a small turret set on the top of the superstructure. A rectangular frame aerial was mounted on four supports hinged to the body and could be lowered when necessary to reduce the silhouette. This aerial, which was of a different pattern to that fitted to the multi-wheeled wireless cars, did not prove satisfactory and was replaced by a vertical rod.

One other version of these cars must be mentioned. In some cases the turret of the 221 pattern was cut back and a 2·8 cm Panzerbusche was mounted in it. This weapon was really an anti-tank rifle firing solid shot and using a "squeeze" device to obtain higher MV. It was a large gun and had to be mounted above the turret ring. A shield was provided for the gunner's protection and the side wings of the original turret were retained, but the protection could only be described as scanty at best.

Pz Spw (8 Rad) Sd Kfz 231

While the 6-wheeler armoured cars grew up from existing commercial chassis, however much these were altered in the process, the 8-wheelers were a new design from the beginning. The engine and gearbox were situated at the rear of the hull in a chassis of light construction which served to locate the various components, rigidity of the car as a whole being assured by the

armoured hull. This seems a clumsy form of construction and the British system of dispensing with the chassis and using the hull to locate components and give rigidity seems preferable, at least on grounds of weight saving.

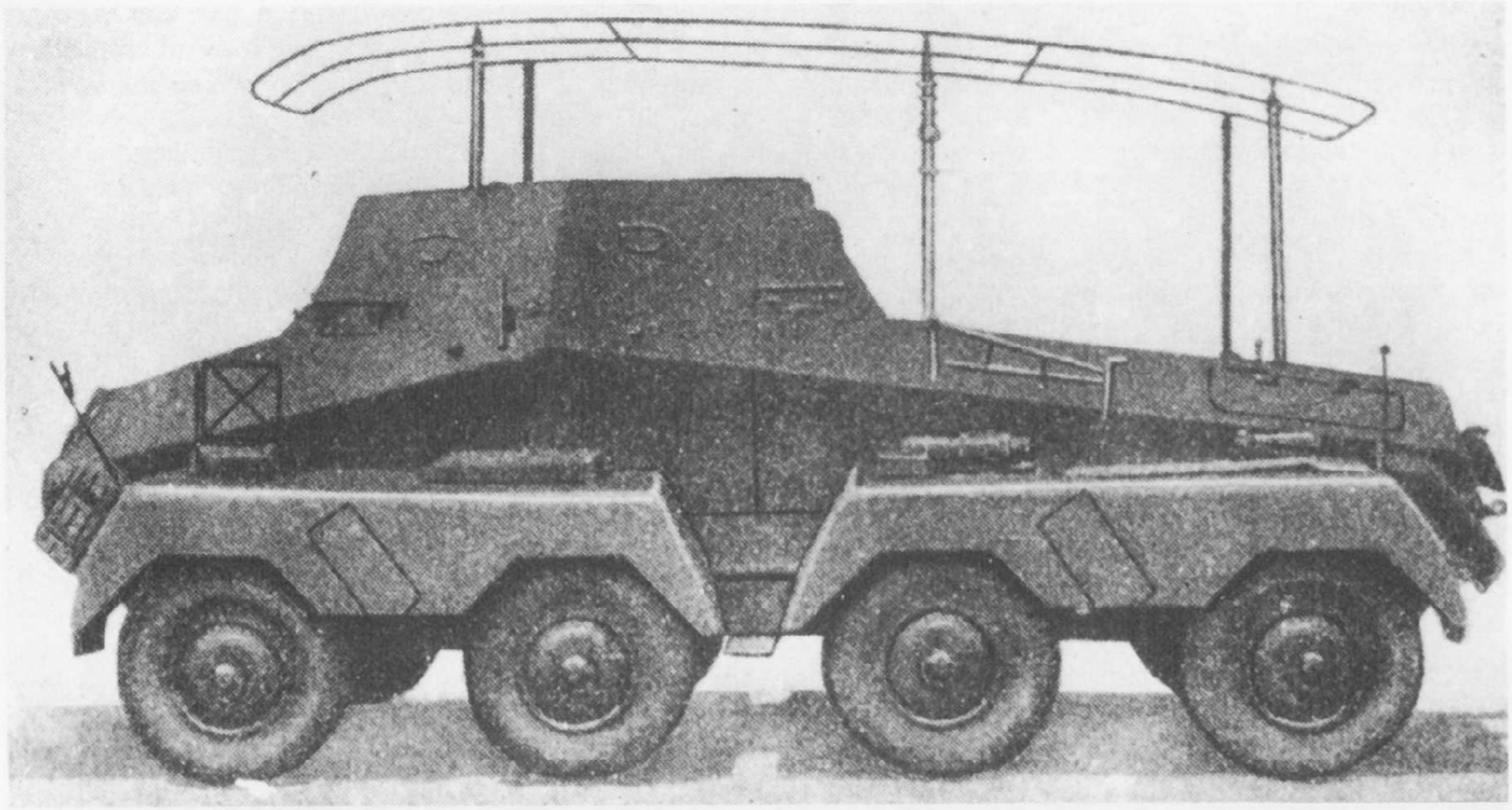
The eight wheels were mounted as two bogies of four, each wheel being linked to the hull by two parallel swinging arms. Each pair of wheels shared an inverted semi-elliptic spring, which pivoted at its centre about the extensions of two tubular cross members which ran across the chassis. Alternative steering positions were provided, with controls that could be engaged by a lever on the steering column.

A 155 h.p. Büssing V8 petrol engine drove a three-speed constant mesh gearbox which had an auxiliary two-speed box incorporated with it, giving a total range of six speeds. A separate direction box was provided which gave a full range of gears for forward and reverse movement. The drive was taken from these boxes to two auxiliary transfer boxes in the middle of the two bogies. From these transfer boxes limited slip differentials took the drive to the four wheels of the bogie concerned. All eight wheels were both steered and driven which involved some complicated design work especially over the geometry of the steering layout. The middle wheels have to turn less than those at either end of the car, and to compensate for the difference in the various radii a De Lavaud type of differential was incorporated in each of the transfer boxes. The layout sounds very complicated but it contributed in no small measure to the very good cross-country performance of these cars. On a curve

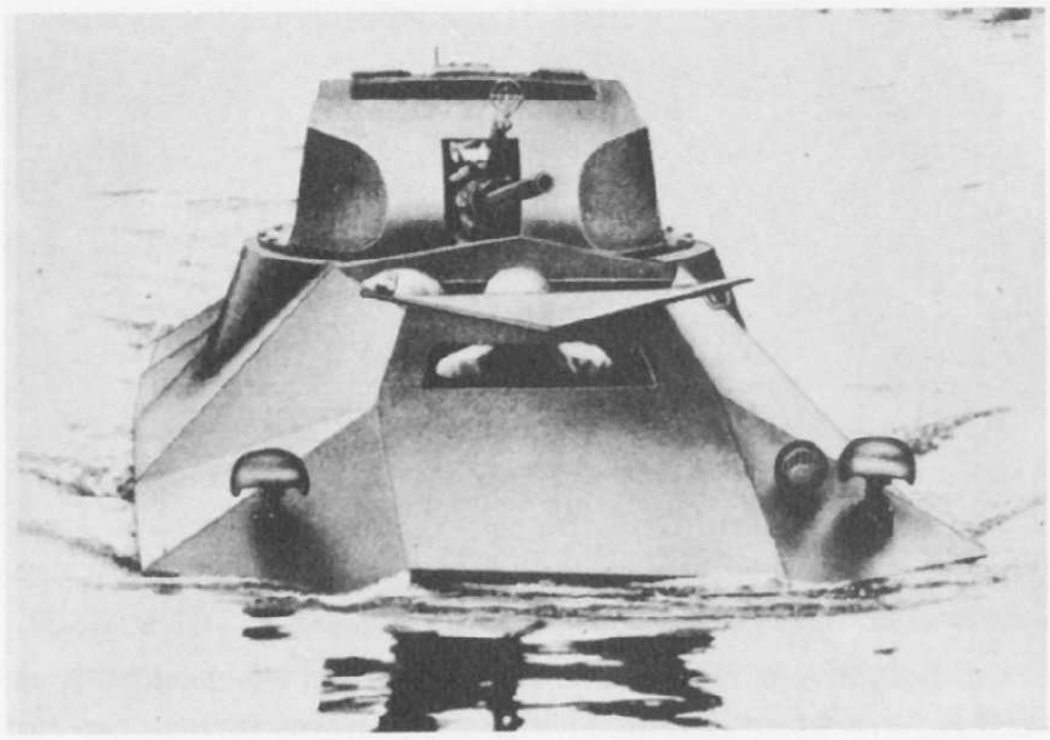
Pz SpWg (8 Rad) Sd Kfz 232 after capture in the Middle East. (Imperial War Museum)

Above the Australian officer's head as he lectures on the characteristics of a captured Sd Kfz 232 (8 Rad) in the Middle East can be seen one of the legs on the turret with which the arms from a central pivot engaged to support the front end of the frame aerial. (Imperial War Museum)

Lecture being given on a captured Sd Kfz 232 (8 Rad) in the Middle East. (Imperial War Museum)

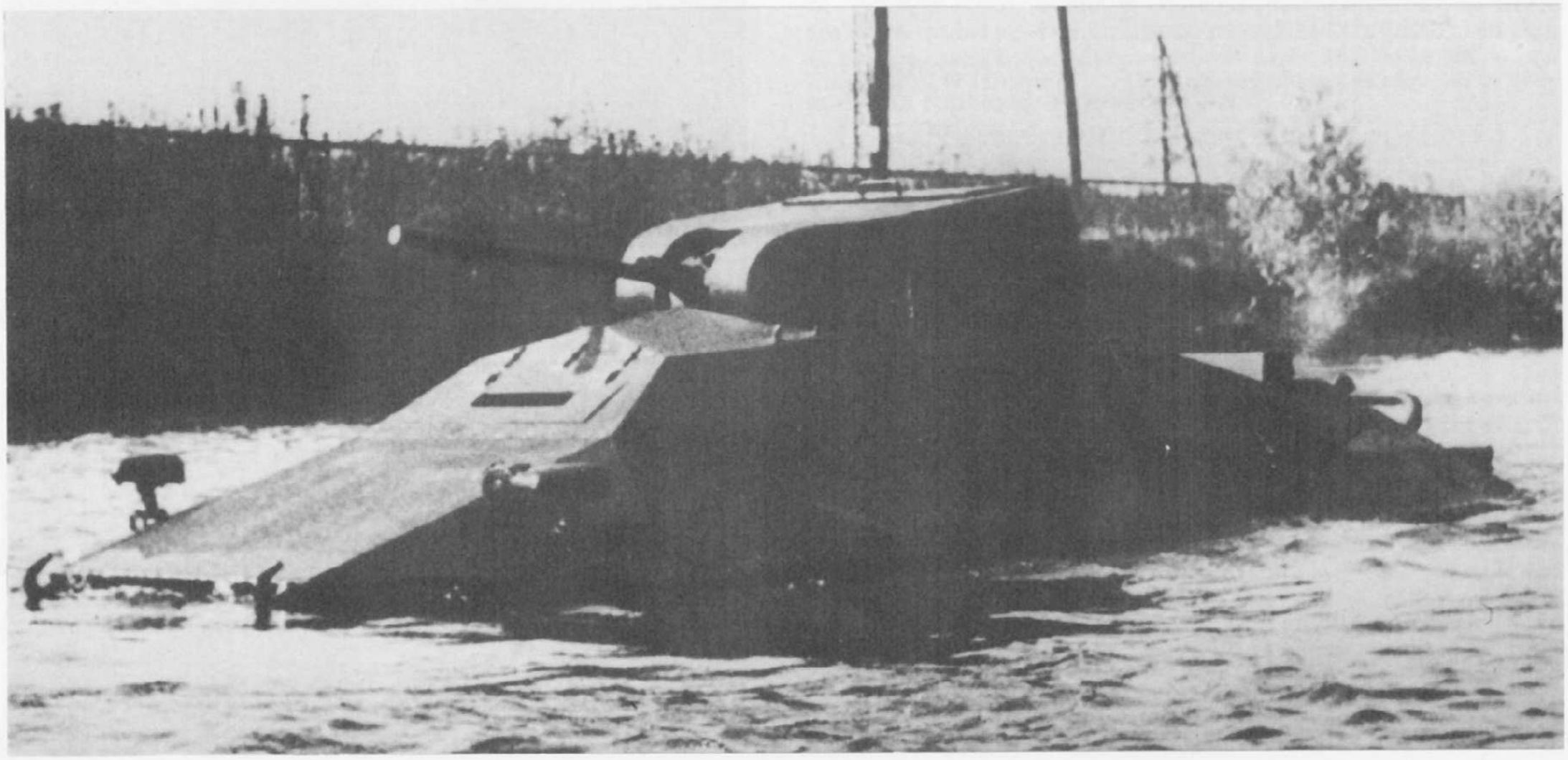


Panzerfunkwagen (8 Rad) Sd Kfz 263 was a specialised wireless armoured car with a crew of five, as against four in the 8 Rad 231 and 232. Its only armament was a 7·92 mm MG 34 in the front plate of the heightened superstructure which formed a rigid turret. Frame aerial had an extra pair of supports compared with the 232's and no arrangement for pivoting in front. Rod aerials replaced frame aerials in 1942. (RAC Tank Museum)



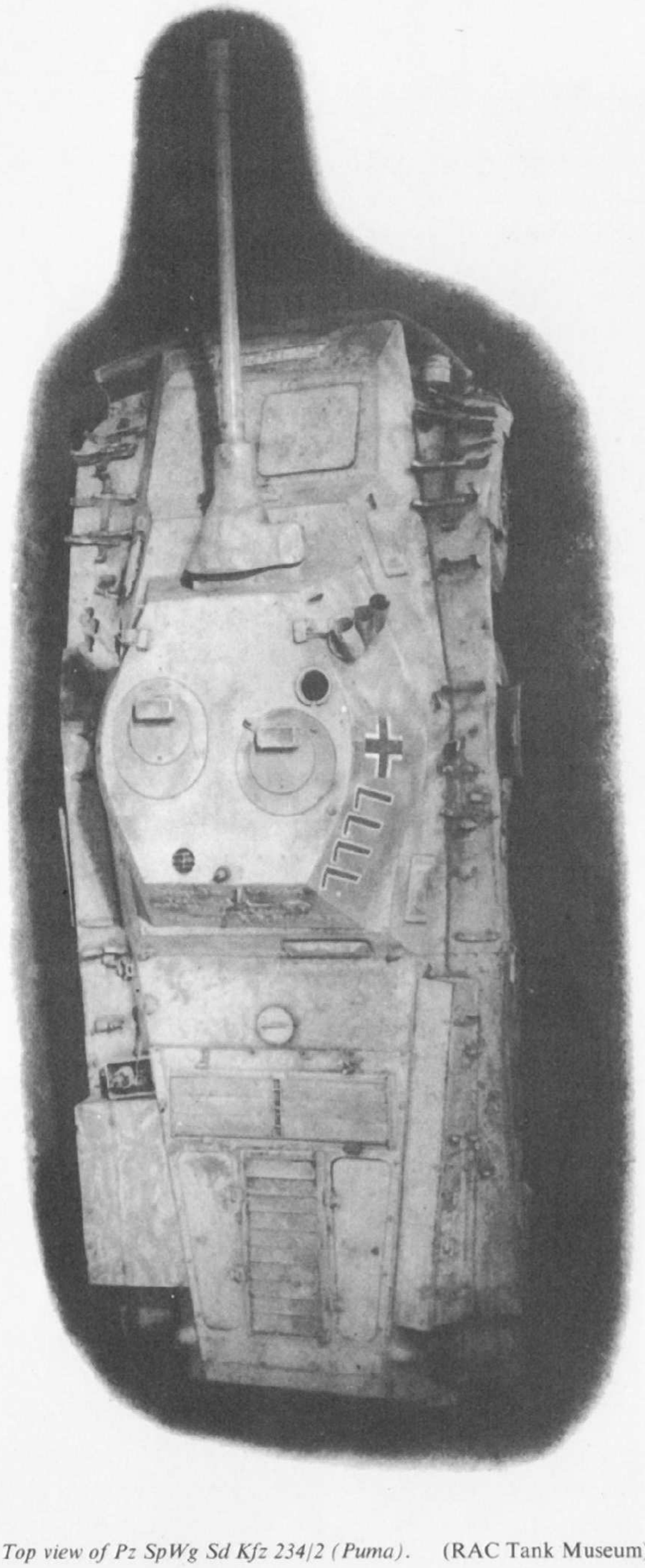
Schildkröte (probably III) in water—front view. The Schildkröte project, begun in 1941, was abandoned in 1942. (Imperial War Museum)

Schildkröte (Turtle) prototype during swimming trials.
(RAC Tank Museum)



Schwerer Panzerspähwagen Sd Kfz 234/2 (Puma) was armed with a 5 cm KwK L/60 and a co-axial 7·92 mm MG in a totally enclosed turret. The 234 series came into service in 1943. It can readily be distinguished from the earlier eight-wheeled armoured cars by the different mudguard arrangement, the earlier cars having a break between the front pair and rear pair of mudguards on each side. (RAC Tank Museum)

Schwerer Panzerspähwagen Sd Kfz 234/3 was a close support armoured car mounting a 7·5 cm StuK L/24 in an open body. (RAC Tank Museum)



Top view of Pz SpWg Sd Kfz 234/2 (Puma). (RAC Tank Museum)

every wheel exactly tracked the one in front of it, in contrast to the conditions obtaining in the usual 6-wheeled model where the middle wheel has literally to be dragged sideways on a curve to follow the track of the steered wheel in front of it.

Sd Kfz 231 (8 Rad) appeared with a 2cm KwK gun and a 7·92 mm MG in the turret which, although larger, resembled that of the 6-wheeled 231 but had a front plate coming down to the hull, thereby eliminating the dangerous re-entrant angle below the gun which was a characteristic feature of the earlier car. Later cars of the 231 (8 Rad) series, built from 1939 onwards, had the engine h.p. increased to 180.

Pz Spw (8 Rad) Sd Kfz 232

This was the same car as the 231 and mounted the same armament but it was fitted with a medium range wireless set. It had a frame aerial with fixed supports at the back of the car: the front end was supported on a central pivot which engaged with bipod legs erected on the turret and allowed this to turn without disturbing the aerial.

Pz Spw (8 Rad) Sd Kfz 233

This car was intended to provide covering fire for the 231-232 cars which only mounted a 2 cm gun. 233 had an open turret in which was mounted a 7·5 cm StuK L/24 gun with limited traverse. The car was open from the top of the superstructure and the low velocity 7·5 cm gun was enclosed in a curious box-shaped mantlet.

Panzerfunkwagen (8 Rad) Sd Kfz 263

The range of 8-wheeled armoured cars was completed by a specialised wireless car, the sides of the crew compartment being built up to provide accommodation for the wireless gear. The superstructure was higher than in the gun cars but the general outline resembled them so that at a distance it was difficult to differentiate between 263 and 232, except for the fact that the frame aerial for 263 was slightly larger. In 1942 the frame aerials on both type of car were abolished and were replaced by a rod pattern. 263 carried one 7·92 mm MG in a ball-mounting in the front plate, but was otherwise unarmed.

Pz Spw Sd Kfz 234 series

The general layout of the (8 Rad) 231 cars was retained in these "Tropical" armoured cars, except for minor alterations and modifications. The thickness of the front armour was increased to 30 mm and a 220 h.p. Tatra V12 air-cooled CI engine replaced the water-cooled Büssing used in the (8 Rad) 231 series. This Tatra engine gave considerable trouble when first installed but this trouble was eventually cured, the 234 series coming into service in 1943. Production models weighed between $10\frac{1}{2}$ and $11\frac{1}{2}$ tons with a consequent reduction of top speed to 53 m.p.h. in place of the 62 m.p.h. of the earlier cars. The general layout of gearboxes, transferboxes and differentials remained the same. The first car to appear, Sd Kfz 234/1, mounted a 2 cm gun and a coaxial MG in an open-topped turret which resembled that of Sd Kfz 222, the earlier 4 × 4 car. For the size of the car the armament appears very inadequate but this was to be rectified with the next model.

GERMAN ARMOURED CARS—LEADING DATA

Type	Weight	Length	Width	Height	Engine bhp/rpm	hp/ton	Transmission	Speed mph	Radius of Action miles	Armament/Main	Amn. MGs	Armour Max/Min mm	Crew	Remarks
Ehrhardt BAK 1906	3·2				Ehrhardt 4 cyl. 60 hp.	18·8		28°	—— 100	50mm/100		3/	5	
Pz Kw Daimler M 1915	9				Daimler M 1464 4 cyl. 80/1200	8·9		23·5	150	—	3 ×7·92mm	7/5	8–9	
M21 Sonderschutz-wagen Benz. 1920	7	19′ 9½″	8′8″	11′2½″	Daimler UT 1574 4 cyl. 100/1200	14·3		31		—	2 ×7·92mm/ 6000	9/7	7–9	Solid tyres. Twin turrets. Similar type of machine was also produced by Ehrhardt and Daimler. Dimensions and performance virtually as for the Benz version.
ARW/MTWI. 1929	7·8	18′2″	7′7″	7′1″	Daimler Benz M36 6 cyl. 105/2350	13·5.		40	150	1 ×3·7cm	1 ×7·92mm	13·5	5	Daimler Benz prototype 8–Wheeler —basis for 231–234 8–Wheelers
6—Wheeled Cars														
Daimler Benz G3a 1929	4·9	18′8″	6′2″	7′10″	Daimler Benz MO9 6 cyl. 68/2900	14	3-speed sliding pinion with addtl. 2-speed box. Separate change direction box. All axles were driven	38	150	—	1 ×7·92mm	14·5/8	4	DB. G3(p)—60hp. DB. engine at 2800 rpm. Wt. 5 5 tons: hp/ton 10·9 Büssing NAG. G31 (p)–4 cyl Büssing-NAG 65 hp at 2000 rpm. Wt. 5 tons: hp/ton 13. These machines and Magirus M206—Magirus 70 hp—were pre-production armd. cars before the issue of Sd Kfz 231 (6 Rad) Büssing-NAG and Klockner-Humbolt also built this car to the same design but using a 4 cyl 60hp Büssing-NAG and a 6 cyl 70hp. Magirus engine respectively.
PzSpw (6 Rad) Sd Kfz 231 1933	5	18′8″	6′2″	7′6″	Daimler Benz MO9 6 cyl. 68/2900	13·6	,,	38	150	1 ×2cm/ 200	1 ×7·92mm/ 2000	14/8	4	
Pz Spw (6-Rad) Sd Kfz 232 (Fu) Panzerfunkwagen (6 Rad) Sd K/3 263		Mechanically these vehicles were the same as Sd Kfz 231. 263 did not have a revolving turret and was purely a wireless vehicle with one mg. for defensive purposes. 232 had a frame aerial and a medium range wireless set. The turret could revolve below the aerial. Some of the 231 range were fitted with belly rollers running across the cars, between the front and back wheels. Dimensions for 232 and 263—as for 231												
4—Wheeled Cars														
Mg-Kw. Kfz 13	2·3	14′0″	6′8″	5′0″	Adler 65—6cyl: 60/2406	26·7	4 ×2	31	150	—	1 ×7·92mm/ 2000	8	3	Sd Kfz 14 was the same car unarmed but carrying a medium range wireless set.
Pz Spw Sd Kfz. 221. 1937	4	16′0″	6′6″	6′0″	Horch 108 V8. 81/3600	20·3	Sliding pinion gearbox. 5FIR Front and rear differential giving 4-wheel drive.	50	200	1 ×2·8cm or	1 ×7·92mm/ 2000	8/6	2	This car had a long cut away turret when the 2·8 cm was mounted.
Pz Spw. (Fu) Sd Kfz 223	4·4	,,	,,	,,	,,	18·4		,,	,,	—	1 ×7·92mm	8/6	3	This was a 221 adapted to take a medium range wireless set.
Kl. Pz. Funkwagen (Sd Kfz 260 and 261)	,,	,,	,,	,,	,,	,,	,,	,,	,,	—	—	8/6	3	Both these machines were unarmed versions of 221 adapted to take a long range wireless set.
Pz Spw Sd Kfz 222 1938	4·8	16′0″	6′6″	6′10″	Horch 108 V8 81/3600	17	As for 221.	50	175	1 ×2cm/ 220	1 ×7·92mm/ 2000	14·5/10/5	3	Redesigned version of 221 with wire enclosed turret and slightly higher superstructure.
8—Wheeled Cars														
Pz Spw (8 Rad) Sd Kfz 231 1938	8·3	19′6″	7′4″	7′9″	Büssing-NAG. L8V–GS 150/3000	18	3 speed Constant mesh gearbox with 2 speed auxiliary box. Separate direction change box. Two transfer boxes each with limited slip differential to four wheels. De Lavaud type differential in each transfer box	62	185	1 ×20mm/ 180	1 ×7·92mm/ 1000	14/10/8	4	WT with rod aerial sometimes fitted Sd Kfz 232 was the same car as 231 but had a medium range wireless and a frame aerial fitted. All the (8 Rad) 231 series had two mudguards each side, each one covering two wheels.

Table continued overleaf

Type	Weight	Length	Width	Height	Engine bhp/rpm	hp/ton	Transmission	Speed mph	Radius of Action miles	Armament/Main	Amn. MGs	Armour Max/Min mm	Crew	Remarks
8—Wheeled Cars (Continued)														
Sd Kfz 233 (8 Rad)	8·3	19′6″	7′4″	7′9″	Büssing-NAG. L8V–GS 150/3000	18	3 speed Constant mesh gearbox with 2 speed auxiliary box. Separate direction change box. Two transfer boxes each with limited slip differential to four wheels. De Lavaud type differential in each transfer box	62	185	1 × 7·5cm/ 85	1 × 7·92mm/ 1000	14/10/8	5	No turret, and no head cover for crew. Limited traverse for gun.
Pz Fu Wg Sd Kfz 263 (8 Rad)	8·1	,,	,,	,,	,,	18·4	,,	,,	,,	—	1 × 7·92mm/ 1000	,,	5	Fitted with long range wireless set. Frame aerial.
Pz Spw (8 Rad) Sd Kfz 234/1	10·5	20′1″	7′10″	7′0″	Tatra 103 12 cyl air cooled V12 C.I. engine 220/2250	21	,,	53	375	1 × 2cm/ 280	1 × 7·92mm 1000	30/15/8	4	6 sided open topped turret. Wire mesh anti-grenade screen. The 234 series have one long mudguard each side covering all four wheels
Sd Kfz 234/2 (Puma).	11	20′1″	7′10″	7′7½″	,,	,,	,,	,,	,,	1 × 5cm/ 55	1 × 7·92mm 1000	100/10	4	Totally enclosed turret—5cm KwK L/60 gun.
Sd Kfz 234/3	10·5	,,	,,	7′0″	,,	,,	,,	,,	,,	1 × 7·5cm/ 60	1 × 7·92mm/ 1000	30/15/8	5	No turret and no head cover for crew. Limited traverse for gun. 7·5cm Stuk L/24 gun.
Sd Kfz 234/4	10·5	,,	,,	,,	,,	,,	,,	,,	,,	1 × 7·5cm/ 60	1 × 7·92mm/ 1000	,,	5	No turret and no head cover for crew. Limited traverse for gun 7·5cm Pak L/48 gun.

Pz Spw Sd Kfz 234/2 (Puma)

234/2 was armed with a 5 cm KwK L/60 gun and a coaxial 7·92 mm MG. These were mounted in a totally enclosed oval-shaped turret with steeply sloping sides, giving a very good ballistic shape. Puma was the most powerfully armed armoured car that the Germans had and was a very formidable weapon. In common with all the 234 range it was fitted with wireless and carried a rod aerial which terminated in three points on the near side mudguard at the back of the car.

Pz Spw Sd Kfz 234/3

This car mounted the 7·5 cm StuK L/24 in an open body of the same pattern as that used in Sd Kfz (8 Rad) 233.

Pz Spw Sd Kfz 234/4

This car owes its existence to a personal order of Hitler's. The 234 body was modified to mount the 7·5 Pak L/48 and in this guise it was really more of an S.P. anti-tank weapon than an armoured car. The HV gun made this car a most formidable weapon.

GUN POWER AND THE GERMAN ARMOURED CAR.

Armoured car production for the German Army was on a relatively small scale: it was not a weapon on which the Army put great reliance, except to back up reconnaissance troops, and consequently it never received anything like the attention that was lavished on the development of German tanks. The cars were soundly constructed, capable of carrying out their appointed tasks, but they relied on speed, manoeuvrability and lightness to achieve their ends: to this end they sacrificed armour protection and, very curiously for the Germans, gun-power. It was not until 1944 that they introduced a 5 cm gun and mounted it in an enclosed revolving turret.

Up till then the heaviest gun mounted in a fully traversing turret—the criterion of the true armoured car—had been the 2 cm. The Puma with its 5 cm gun put the German armoured car on an equality with the British Daimler for the first time. However, in drawing this comparison it must be remembered that both 8-wheeled chassis, the 231 and 234, had been adapted to mount the short 7·5 cm gun StuK L/24, primarily to support the operations of the machine-gun armed cars.

Other variations in armament comprised the 2·8 cm anti-tank rifle which was fitted with a "squeeze" device to obtain higher muzzle velocity against hostile AFVs, and the high velocity 7·5 cm gun Pak L/40 which was mounted on the 234 8-wheeled chassis.

Post-war thinking in the British Army has recognised the need for a good HE and shot firing weapon in armoured cars and this is typified in the 76 mm gun found in the Saladin armoured car. This need was appreciated by the Germans for tanks quite early in World War II: by this standard German wartime armoured car armament falls short.

AFV Series Editor: DUNCAN CROW

AFV/Weapons Profiles

Edited by DUNCAN CROW

Starting with AFV/WEAPONS PROFILE 24 the Publishers intend to step up the frequency of publication. This departure, taken in order to meet the great demand for coverage of more AFVs more quickly than in the programme that has been running for the past two years, has necessitated some further re-arrangement in the list of titles.

34 Scorpion

Britain's new aluminium light tank, weighing eight tons, powered by a conventional Jaguar XK 6-cylinder engine of 4,200 c.c., and mounting a 76-mm. gun, is the first all-aluminium armoured vehicle in the world: BY R. M. OGORKIEWICZ, author of *AFV/Weapons Profile 28*, who is the first non-American and only the tenth person in its 85-year history to be made an honorary life member of the *U.S. Army Armor Association.*

35 Wheels, Tracks and Transporters British Armoured Recovery Vehicles

The problems of getting tanks to the battle and recovering them when they have been disabled are the subject of this Profile, in which MAJOR-GENERAL DUNCAN (author of *AFV Profiles 5, 9, 12, 15, and AFV/Weapons Profile 33*) traces the development in Britain of machines—some like "skyscrapers on roller skates"—to overcome the track wear bugbear until the adoption of wheeled transporters proved a better solution, and Peter Chamberlain describes the armoured recovery vehicles used by British and Commonwealth units in World War II.

36 French H35, H39 and S35

The Hotchkiss and Somua tanks equipped the *brigades de combat* of the French mechanised cavalry's *divisions légères mécaniques*, two of which had been formed before the outbreak of war in 1939, and there was a *demi-brigade* of Hotchkisses in the *divisions cuirassées;* the Hotchkiss was the second most numerous type of French tank, while the Somna was considered by many to be one of the finest AFVs of its day: BY MAJOR JAMES BINGHAM, RTR, who fought in France in 1940 when these tanks were in action.

37 Russian BT

This series of Russian tanks was based on the American Christie design and its final variant was the forerunner of the famous T-34: BY JOHN MILSOM, author of *Russian Tanks 1900–1970* and *AFV/Weapons Profile 22.*

38 Conqueror Heavy Gun Tank

Changes between conception and production are not infrequent in the development of military equipment, yet the history of Conqueror is probably more bizarre than most. Intended originally for the support of infantry it was then adapted to become the so-called Universal tank—only to be superseded by the design it was meant to replace—and finally emerged into service for a short time as a highly specialized tank killer: BY MAJOR MICHAEL NORMAN, Royal Tank Regiment, author of *AFV/Weapons Profiles 17, 18, 19, 23 and 27.*

39 Panhard Armoured Cars

This Profile covers the remarkable eight-wheeled EBR and the compact AML, now used by more than a dozen different countries and both built by Panhards who have a longer connection with armoured car development than any other company in the world still in this field: BY R. M. OGORKIEWICZ, of the Imperial College of Science and Technology, one of the world's leading experts in the design of combat vehicles, author of *AFV/Weapons Profiles 28 and 34.*

40 U.S. Armoured Cars

Although armoured cars, a familiar sight in many countries, have never been popular in the United States, more varieties have existed there than is generally realised. This Profile recounts the whole story of U.S. armoured cars from the Davidson car of 1898 to the XM808 on the Lockheed Twister chassis of today: BY COLONEL ROBERT J. ICKS, the famous American armoured expert, author of *AFV/Weapons Profiles 16, 24, 26 and 32*, and *Profile Book AFV/Weapons Series No. 1 Modern U.S. Armored Support Vehicles.*

41 M103 Heavy + M41 Light (Walker Bulldog)

The Berlin airlift and the beginning of the so-called Cold War placed new emphasis on the U.S. post-World War II tank programme. The result was the emergence of three basic designs, the T41 Light Tank, the T42 Medium Tank, and the T43 Heavy Tank. This Profile deals with the first and third of these—the T41 which was standardized as the M41 and named the Walker Bulldog, and the T43 which became the M103 Heavy Tank: BY COLONEL ROBERT J. ICKS, author of *AFV/Weapons Profiles 16, 24, 26, 32 and 40*, and *Profile Book AFV/Weapons Series No. 1 Modern U.S. Armored Support Vehicles.*

42 Swedish Light Armoured Vehicles

Included in this Profile are the Pbv 302 armoured personnel carrier and its derivatives—the Bgbv 82 recovery vehicle, the ingenious Brobv 941 bridgelayer and the IKV 91 infantry gun intended for operation in the north of Sweden, the Noorland: BY R. M. OGORKIEWICZ, author of *Design and Development of Fighting Vehicles* and *Armoured Forces*, and of *AFV/Weapons Profiles 28, 34 and 39.*

The publishers reserve the right to alter sequence of list without notice.

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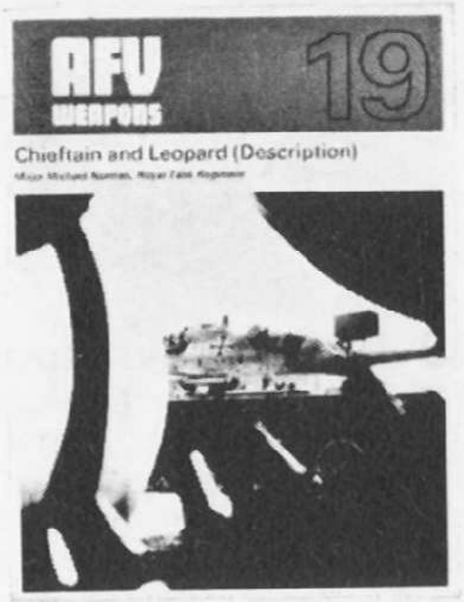

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