

# The Capocaccia-Casci-Funaioli Committee at the Trial against Enzo Ferrari for the 1957 Mille-Miglia Car Accident

Marco Cocconcelli

Department of Sciences and Methods for Engineering, University of Modena and Reggio Emilia, Reggio Emilia, Italy  
Email: marco.cocconcelli@unimore.it

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## Abstract

In 1957, 11 people died in a car crash in the Italian street circuit Mille Miglia. Of course, the car manufacturer Enzo Ferrari was investigated for homicide by negligence. To clarify the dynamics of the car and the root causes, a first committee of technicians and academics was created to prepare an expert report. The report directly pointed to the specific design of the tires used (made by the Belgian manufacturer, Englebert) and, as a result, to the Ferrari team and its owner. The other two reports followed, one provided by the defense and the third to finally resolve the problem. This document will not focus on the media aspects that the personalities involved have stimulated, but on the technical aspects of the reports prepared by the three committees. By accident, these memories differ in the approaches that were taken, allowing comparisons of the best approach to solve technical problems, as well as a memory of an important event in Italy, which saw the technical-scientific arguments as the keys to reaching the truth and eliminating Enzo Ferrari from all accusations.

## Keywords

Ferrari, Mille-Miglia, De Portago, History of MMS, Capocaccia-Casci-Funaioli

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## 1. Introduction

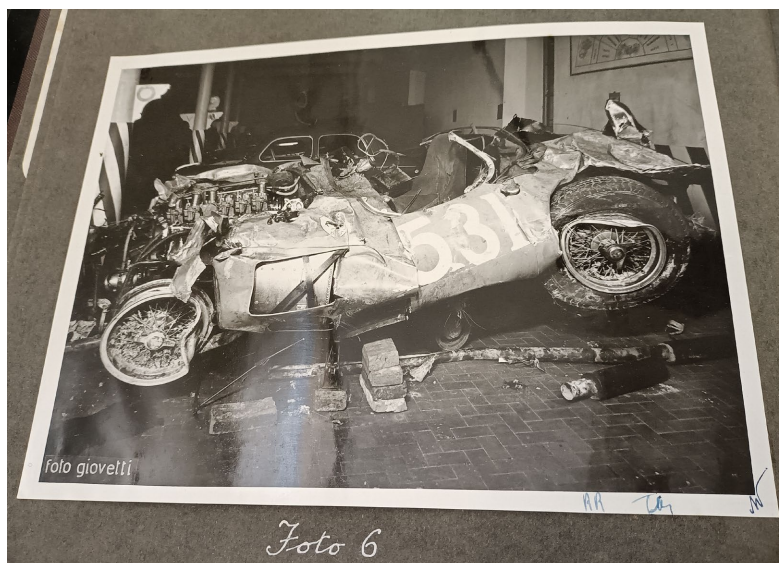
May 12, 1957 is a date in the double track of crime news and Italian sports news. For the latter, it was the “Lethal Epilogue of the Car Championship of Mille Miglia”, for the crime news, it is rather known as the “Guidizzolo Tragedy”, where 11 people died, including 5 children and 2 drivers. In 1957, on the road from Mantua to Brescia, and thus to the finish line of the XXIV Mille Miglia, the Ferrari 335S, driven by Marquis Alfonso de Portago and his co-driver Edmund Nelson,

suffered a flat left tire in Guidizzolo, Cavriana (MN). **Figure 1** shows the Ferrari #531 driven by De Portago at the beginning of the Mille Miglia. For more information on the Mille Miglia competition, please refer to (Acerbi, 2012). In a few seconds, the car—no longer controlled—went out of the road, shooting down nine spectators waiting for the drivers to pass. Subsequently, the car collided violently with a telephone pole, ending the lives of the two drivers and stopping shortly after a collision of several meters. **Figure 2 & Figure 3** show the car after the crash and the dynamics of the accident reconstructed by a car magazine (Tonani, n.d.). In the following days and months, the newspapers investigated the possible cause of the accident, published evidence and reported the bios of the driver and spectators involved. The popular indignation that spread throughout the country declared the end of the Mille Miglia competition. In this case, public opinion left Enzo Ferrari responsible as the manufacturer of the car driven by De Portago. The Office of the Prosecutor, after determining that the cause of occurrence was the rupture of a tire, took measures to understand whether it was simply an accident or whether there had been design negligence or negligence of the pilot himself. A Committee of Official Technical Consultants is responsible for preparing an expert report to determine the dynamics and causes. On 14 January 1958, the Prosecutor received the expert report. The report points to the choices made in the design of the car, as described below. In particular, the tire pressure was considered too low, but also the characteristics of the Englebert tires were considered inappropriate for this type of race. On 24 June 1959, the deputy prosecutor of Mantua informed the investigation judge that he was to continue indicting Enzo Ferrari for murder and negligence.

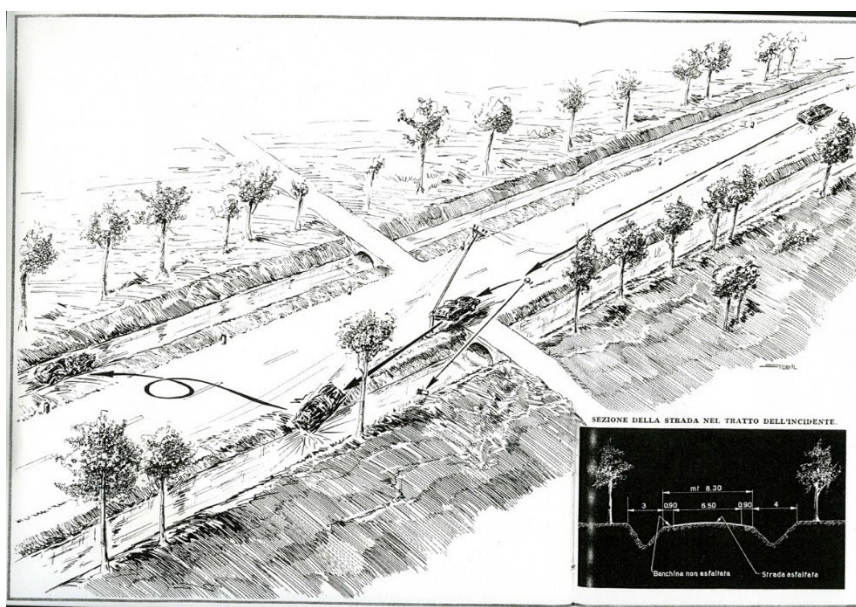
Ferrari, on his part, submitted an expert report by Giovanni Francia, a professor



**Figure 1.** The Ferrari 335-S with the race number 531 driven by Alfonso De Portago at the Mille Miglia race in 1957 (attachment of the first technical report).



**Figure 2.** Photo of the car after the accident as reported in the first technical report.



**Figure 3.** The dynamics of the car accident as reported by a sport journal (Tonani, n.d.).

at the University of Genoa, which was deposited on 14 July 1960 at the Chancellery of the Court of Mantua. The report denied the court experts' statements and proposed a different interpretation of the accident. Both reports are in opposite directions but are based on police findings and technical and scientific considerations of recognized academics. The enquiring judge of the Mantua Court therefore decided to request a final technical report with the aim of determining the dynamics of the car accident. The selected committee consisted of professors Agostino Antonio Capocaccia, Corrado Casci, and Ettore Funaioli. At the end of the work, the committee provided a detailed report on the characteristic features of scientific publications, citing international publications and reporting experimental tests.

On 4 May 1961, the Committee submitted the third final report, concluding that the blast of the tires was not due to an erroneous selection of wheels or the inflation pressure, but reasonably due to the impact against an external obstacle. On 12 May 1961, the Mantua Court ruled that Enzo Ferrari had not been charged, thus closing the legal process relating to this tragic accident. This brief memoir focuses only on the technical and scientific aspects of the three published reports, such as the way in which scientific reasoning, strict formulation of the problem and subsequent deductions could lead to the determination of the truth. All the cited materials—unless otherwise attributed—come from documents kept in the Mantua State Archives (Italy) and made public. The history of this tragic accident is described in a few detailed books (Montagner, 2007; Dolcini, 2009; Ferrari, 2017; Delli Carri, 2019; Dal Monte, 2023) that I invite interested readers to read, in order not to forget that, beyond the technical aspect of determining the truth of the accident, there are still memories of the people involved. Today, a monument commemorates the victims of the accident in Guidizzolo (Mantua, Italy).

The paper continues with a short description of the first technical report prepared by the Speluzzi-Mandella-Rinaldi Committee (Section 2), the second technical report by Prof. Francia (Section 3), and the third technical report of the Capocaccia-Casci-Funaioli Committee (Section 4). Conclusions on the three different approaches used in the reports close the paper. The Appendix reports the technical characteristics of the Ferrari 335 S. This paper is an extension of a previous work (Cocconcelli, 2024) presented at the IFToMM 8<sup>th</sup> International Symposium on History of Machines and Mechanisms in Ankara (Tukey), 18-20 April 2024.

## **2. The 1<sup>st</sup> Technical Report**

The first committee consisted of Mario Speluzzi (1903-1959), professor of mechanical and project design at the Politecnico of Milan, Tarquinio Madella and Rinaldo Rinaldi who were experts in road accidents. The Prosecutor of the Republic of Mantua asked them to comment on seven questions aimed at determining the dynamics and causes of the accident. The first question was the description of the location of the accident. The second is the description of the traces left by the car crash. The third was the description of the accident. The fourth was to describe the current condition of the car. The fifth question was whether the tragic event was the result of construction defects. The sixth was the report of other factors that might have determined the accident, even if only in part. The seventh was to collect any other technical information they deemed useful in the interests of justice. Due to their importance in the rest of the trial, the results of questions three, five and seven are briefly reported.

### **2.1. The Description of the Accident (Q3)**

The committee considered that the last part of the Mille Miglia race, especially the Cremona-Mantua-Brescia interval (approximately 165 km), contributed to the

awarding of the Tazio Nuvolari speed prize, created to commemorate Tazio Nuvolari (1892-1953), one of the most influential drivers born in Mantua. Consequently, the committee believed that all drivers must run at the maximum speed allowed to win the trophy. Furthermore, the accident occurred on a long line. Considering the ratios of the bevel gears and the likely speed of the engine (rpm), experts suggest that the car must have driven 270 - 280 km/h, and a view of the left front tire: “It is clear that this tire explosion must have been preceded by a part of the track detachment (usually referred to as ‘Dechappage’), which is determined suddenly and violently”.

## 2.2. Possible Construction Defects (Q5)

Question five, whether the tragic event was caused by construction defects. During the analysis of the exploded tire, experts noted irregular wear of the rubber with a higher height in the outer surface due to the type of rubber used and the inflation pressure of the surviving wheel of 2.5 kg/cm<sup>2</sup>. A consideration of the wheel rotation mechanics on the asphalt leads experts to believe that the tires used can only be considered safe at a speed of 220 km/h, much less than the estimated speed at the time of the accident.

## 2.3. Other Technical Information (Q7)

Question 7: Collection of any other technical information they consider useful in the interests of justice. A few days after the accident, newspapers collected and published opinions from persons involved and experts. Many of the participants suggested that the cause of the tire explosion was an obstacle, such as a reflective sign placed on the road, called “cat eye”. The members of the Committee highlighted the absence of signs on the outside and inside of the tires and proved that these obstacles had not been hit. **Figure 4** shows the committee’s report’s “Photo 24” showing the tire failure. The tread detachment and diagonal tears that reach the side walls of the tires are obvious.

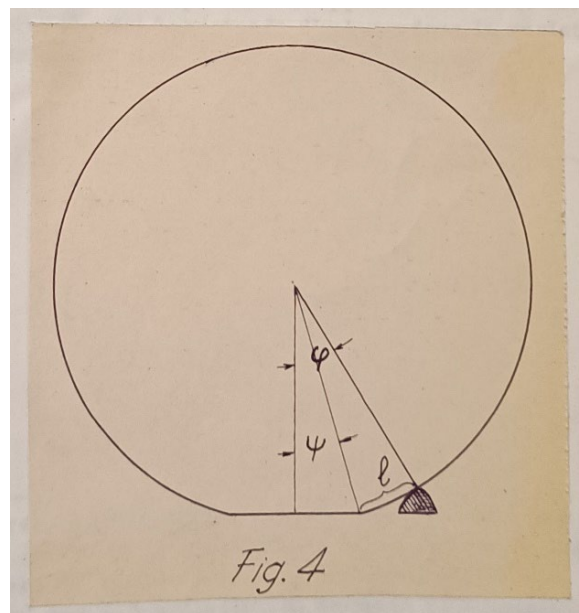


**Figure 4.** Picture number 24 contained in the committee’s report: the broken tire.

## 3. The 2<sup>nd</sup> Technical Report

The expert report was drafted by Giovanni Francia (1911-1980), full-time professor of machine and project design at the University of Genoa. The final report,

through theoretical and analytical analysis of the problem, contradicts the previous point-by-point conclusions. The dechappage phenomena can occur on driving wheels and in new tires only. The removal of the tread from the pile is a combination of the increase in temperature due to the hysteresis of rubber deformation during rolling and the results of the engine torque. The division is subsequently promoted by centrifugal force acting on the ground and proportional to its mass. Therefore, it is more likely to occur in a new tire than a worn one. The removal of rubber at high speeds would have caused obvious marks on the metal sheet guard. The car body was made of light sheet metal to contain weight and that, as a result, the impact on the rubber launched at high speed would certainly have left marks on the mudguard. About low tire pressure, Francia notes that the measurement was made cold and that a working pressure of  $2.7 \text{ kg/cm}^2$  should be estimated using the ideal gas law as the first approximation, according to what was declared by the manufacturer. Higher tire pressure leads to lower deformation during driving and the vehicle's acceptable speed that is compatible with the cruise speed estimated by the previous committee. The report concludes by suggesting a plausible hypothesis of the cause of the accident. **Figure 5** shows the draft document included in the report, using the formula used by Francia to estimate the force of the tire impact on the obstacle. In terms of the standard size of the "cat's eye" and the driving speed of the car at  $270 \text{ km/h}$ , Francia calculated the force of a small contact area of  $2172 \text{ kg}$  ( $21.3 \text{ kN}$ ) for  $1.5$  milliseconds, sufficient to cause a tear on the canvas.



**Figure 5.** A scheme of the tire hitting an obstacle, as reported in the work of Francia.

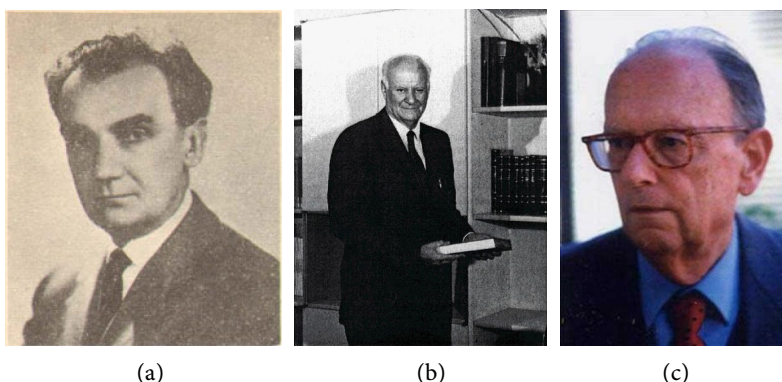
#### 4. The 3<sup>rd</sup> Technical Report

Both the first and the second reports were produced by well-known academics and the considerations included were supported by equations and mathematical

models. However, the conclusions were contrary to each other. As a result, the judge demanded a third technical report, which aimed specifically to resolve any doubts about the correct interpretation of the dynamics of the car accident.

#### 4.1. Capocaccia-Casci-Funaioli Committee

The third committee was composed of Antonio Agostino Capocaccia (1901-1978) and Ettore Funaioli (1923-2006), full professors of mechanical engineering at the University of Genoa and Bologna, respectively, and Corrado Casci (1917-1999), full professor of aircraft engineering at the University of Milan. Starting with experimental evidence and scientific literature, the final report rigorously revised the results of the first report. **Figure 6** shows a picture of the three professors.



**Figure 6.** The members of the third technical committee: a) Prof. Antonio Agostino Capocaccia; b) Prof. Corrado Casci; c) Prof. Ettore Funaioli.

##### 4.1.1. Antonio Agostino Capocaccia (1901-1978)

After graduating in Naval Engineering and Mechanics in 1923 from the Scuola Superiore Navale in Genoa, he became assistant lecturer in Applied Mechanics of Machines in 1925 and at the same time was entrusted with the course in Machines at the said Scuola Superiore Navale, subsequently entrusted with the course in Applied Mechanics of Machines and then in Machine Design. He was awarded a professorship in the first of these two subjects in 1934. In 1939, he won first place in a competition for the chair of Applied Mechanics of Machines announced by the University of Cagliari. For thirty years, he held the chair of the Institute of Applied Mechanics of Machines at the University of Genoa. Since 1950, he has been Dean of the Faculty of Engineering at the University of Genoa. His scientific work has been carried out in the different branches of Applied Mechanics of Machines and Machine Design, with a particular focus on the study of kinematics and the problems of friction and lubrication. He developed a theory of fluid-uncertainty, backed up by experimental research. Member of the Higher Council of Education for two terms. Gold Medal of Merit for School, Culture and Art by the Minister of Education. He was 56 at the date of the Mille Miglia accident.

##### 4.1.2. Corrado Casci (1917-1999)

Corrado Casci was born in Pavia during World War I, on 19 February 1917. In

1938, having completed the introductory two-year course at the Faculty of Engineering in Pavia, he enrolled in the third year of Applied Engineering at the University of Pisa, graduating at the end of June 1941 with honors in Mechanical Engineering. Having won a ministerial bursary, he attended the School of Aeronautical Engineering at the Politecnico in Turin, directed by Prof. Modesto Panetti, where Casci obtained his second degree, in aeronautical engineering, again graduating with honors. In the period between 1946 and 1952 he was an assistant at the Politecnico in Turin, first of air propulsion and subsequently of heat engines. In 1951 he obtained a Ph.D. in Heat Engines and in 1954 a Ph.D. in Propulsion Systems. Since 1947 he has been in charge of the course on engine construction for aircraft at the same Politecnico. In 1951, he was put in charge of aircraft engines at the Politecnico in Milan. He devoted part of his research, theoretical as well as experimental, to the study of internal combustion engines, thermodynamics, combustion, and fluid dynamics. He was 40 at the date of the Mille Miglia accident.

#### **4.1.3. Ettore Funaioli (1923-2006)**

Ettore Funaioli was Professor of Applied Mechanics of Machines at the University of Bologna from 1958 to 1995. He graduated in Engineering from the University of Pisa. In 1954 he was awarded a professorship in Applied Mechanics of Machines, and in 1956 he won the competition for the chair of the same subject at the University of Cagliari. In 1958, he was called to Bologna to hold the Chair in Applied Mechanics of Machines at the Faculty of Engineering, retaining this title until his retirement, when he was awarded the title of Professor Emeritus. He was Director of the Institute of Applied Mechanics of Machines until it merged into the Department of Mechanical, Nuclear, Aeronautical Engineering and Metallurgy (DIEM), of which he was the first Director. His scientific works initially covered topics in aeronautics and aerodynamics. Subsequently, he dealt with lubrication, mechanisms and their components, and machine dynamics. He was 34 at the date of the Mille Miglia accident.

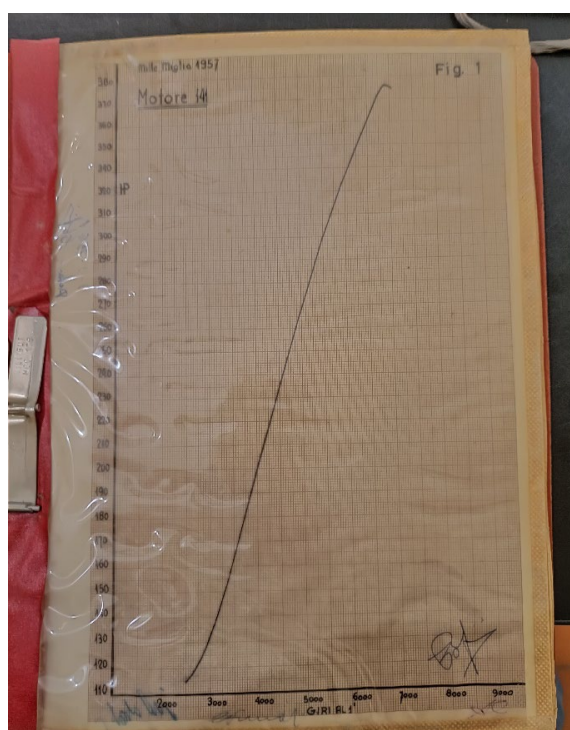
## **4.2. The Final Report**

On the 29<sup>th</sup> of April 1961, the Capocaccia-Casci-Funaioli committee filed a 35 pages technical report at the court of Mantua, starting with an anticipation of their judgement on the matter: “Since the conclusions reached in this report are not in agreement with those reached by the experts appointed immediately after the accident by the Mantua Public Prosecutor’s Office, the undersigned deem it indispensable to precede their conclusions with a commentary on said report, in order not to criticize the work of their colleagues but to justify their own.”

### **4.2.1. Speed of the Car at the Time of the Accident**

With reference to the first report, the first committee believed that the estimation of the car’s speed was the value reported by the tachometer (7350 rpm) in the crashed car. In their opinion, the indication was erroneous since the car’s engine,

which rose during the accident, became “crowded” to an even higher value and then decreased in the impact against the ground until it stopped. The speed should therefore be calculated based on the engine characteristic at full throttle, which can be obtained from a brake bench. The committee asked the motor characteristic to Ferrari company and **Figure 7** shows the results obtained from experimental tests in Maranello at the Ferrari’s facility. Some members of the commission participated personally in the tests (Montagner, 2007). The peak of the curve in **Figure 7** corresponds to the optimal working condition of the engine. Therefore, the committee estimated that a realistic speed was 250 km/h, corresponding to a 6800 rpm of the engine speed. This value was comparable with the average speeds in the Cremona-Brescia stretch of the other Ferrari drivers in the race (199.4 km/h for Olivier Gendebien and 197.2 km/h for Wolfgang Von Trips).

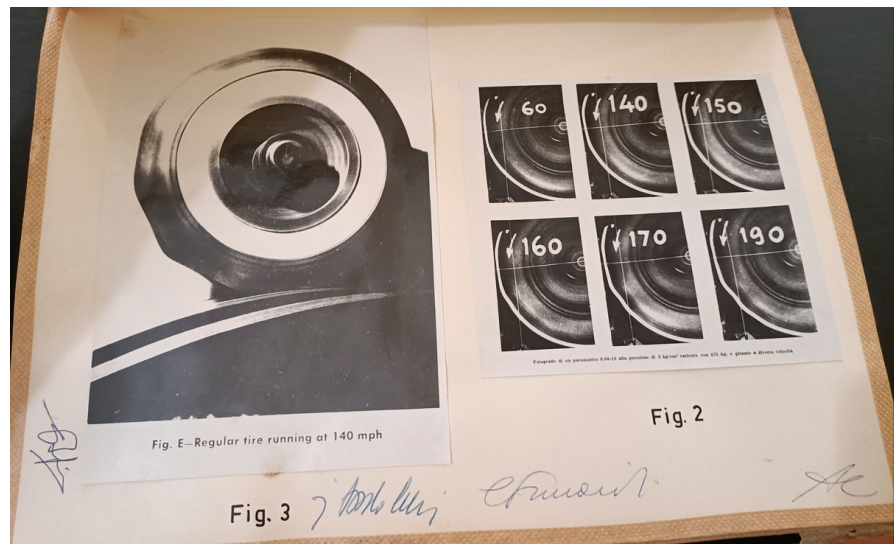


**Figure 7.** Horse Power (HP)/rpm characteristic curve for the Ferrari’s engine included in the technical report.

#### 4.2.2. Tire Pressure

The committee agreed with the first report that the choice of a proper tire depends on the working speed, to avoid overheating and other dangerous phenomena. A publication by Lugli (Lugli, 1948) is cited which shows how beyond a certain critical speed, wavelets appear on the tire just downward the contact point with the ground. From the same paper, a couple of pictures are included in the report showing the effect of wavelets on the tires at different speed, as reported in **Figure 8**.

The consequence of this effect is that the power absorbed by the tire is transformed into heat (due to the hysteresis of the rubber) which can deteriorate the



**Figure 8.** Pictures taken from scientific literature (Lugli, 1948) and included in the report.

rubber. The value of the speed corresponding to the beginning of the wavelet phenomenon is called critical speed. The committee also reports a qualitative figure of the power dissipated on the tire as a function of the car speed. From zero to the critical speed the relation is linear, with a modest coefficient of proportionality. Corresponding to the critical speed, there is an elbow of the curve that starts to increase non-linearly for speeds higher than the critical one. The value of the critical speed is linked to the inflation pressure of the tire according to a quadratic law (Lugli, 1948) as reported in Equation (1):

$$v_c = k\sqrt{p}. \quad (1)$$

Meaning that higher the pressure ( $p$ ) of tire, higher the value of the critical speed ( $v_c$ ). The committee agreed with second report that the inflation pressure cannot be taken cold and considered the indication of  $2.7 \text{ kg/cm}^2$  provided by Englebert's engineers plausible. The committee also observed that the tire has a certain thermal inertia (Powell, 1957), meaning that the tire takes time to increase its temperature. Higher speed for a very short time does not compromise the tire. As a consequence, in steady condition the estimation of the reference temperature should not be computed based on the maximum speed reached by the car, but more realistically on a value halfway between mean and maximum speed during the race.

Starting from the results of Joy, Hartley and Turner (Joy, Hartley, & Turner, 1956), the commission calculates the critical speed for the Englebert's tire using Equation (2):

$$v_c = \sqrt{\frac{a \cdot p \cdot g}{\gamma \cdot b \cdot \tan^2(\alpha)}}. \quad (2)$$

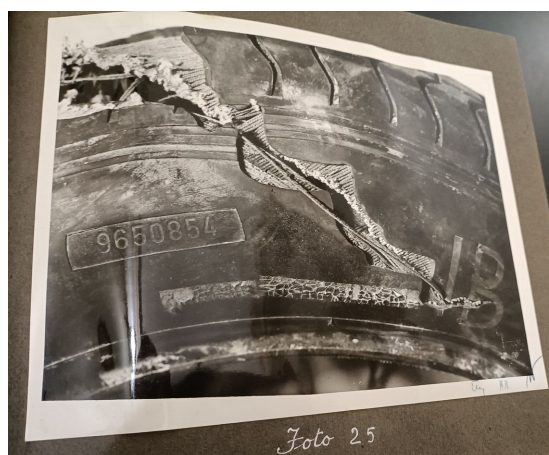
where  $v_c$  is the critical speed,  $a$  is the average curvature radius of the tire section (with respect to a plane passing through the axle),  $p$  is the pressure of the tire,  $g$  is

the gravity acceleration,  $\gamma$  is the average specific weight of the tire,  $b$  is the average overall thickness of carcass and tread and  $\alpha$  is the angle formed by the threads of the plies with the average plane of the tire. With reference to the Englebert's tire, Equation (2) returns a critical speed of 275 - 285 km/h, that was much higher than that of De Portago's car. As a consequence, the tires were used in complete safety.

#### 4.2.3. Dechappage (Tread Separation)

The committee moves on to the analysis of the tread separation “dechappage”, which was highlighted as the main cause of the accident in the first technical report.

They observed that the dechappage occurs almost exclusively on the driving wheels, for the reasons also detailed in the second report: in the driven wheel the contact forces between the street and the rubber are orthogonal to the street floor, while in the driving wheel the motor torque induces tangential components acting on the external layer of the tires. In case of a tread separation, it occurs on the side of the tire: cracking of the rubber is generated from the inside, which gets wider and wider. The middle part of the tire is no longer bound to the underlying plies, remaining attached only to the sides of the wheel. During rolling, the centrifugal force acting on the detached material stresses the tire sidewalls to the point of cracking. Subsequently, there is a sudden detachment of the entire outer part of the tread, but the trigger point is the sidewalls. A second observation is that during the development of the dechappage, the centrifugal force is proportional to the mass of the detached material (at the same speed). Worn wheels have a reduced tread height and in fact a lower mass than a new wheel might have. For this reason, the phenomenon of tread separation occurs mainly in new tires and hardly at all in worn tires. **Figure 9** shows the picture of the worn tire as attached to the first technical report. It is evident that the break started from the tread of the wheel and successively continued on the sidewalls.



**Figure 9.** Pictures of the worn tyre after the crash, as included in the first technical report.

#### 4.2.4. Condition of Shock Absorbers

Another issue raised by the first report was the state of the shock absorbers that

would have presented inefficiencies in operation that would have led to the tire touching the fender during the race. Such a hypothesis is discarded by the committee, since this is only possible if the car body was found to be deformed due to the ride limiters that must be installed on the car. Any deformation is not apparent from the pictures taken during the competition. Any rubber marks on the fender can be attributed to normal tire wear, with small rubber elements coming off the tread and being thrown against the fender.

#### **4.2.5. Last Remarks and Conclusion of the Report**

The final part of the report analyses other technical characteristics of the Englebert's tires, like the angle of inclination of the tire plies (the  $\alpha$  parameter in Equation (2)) or the connection between tires and tread. The commission considered the construction features of the tires correct and suitable for the sporting use. The authors finally reach two conclusions: "the explosion was due to a collision with an unspecified obstacle" and "the tires were suitable for the type of car and the type of racing in which they were used and were inflated to a pressure believed to be adequate".

### **5. Conclusion**

The Capocaccia-Casci-Funaioli Committee's report was presented on 29 April 1961. Two months later, on 29 June, the prosecutor formally asked the judge not to prosecute Enzo Ferrari, who had been released from all charges. The difference between the three technical reports is clear and symbolic: in the first report, the aim is to reconstruct facts that start with objective data but which do not have critical and objective explanations. It will be highlighted from many points of view how frequently the truth of a hypothesis is assumed to be known in the first report without examining the sources. The result is a description that, although correct in subsequent deductions, distorts reality from incorrect hypotheses. The second report is purely theoretical and formally perfect. Once the problem is defined in its initial conditions, the problem is developed by reason and equation, but perhaps what is missing is comparing with experimental data. The third report is rigorous and balanced: the theoretical part is based on international scientific literature, but there is continuous experimental evidence in the testing room and on the field. An engineering approach that led to an appropriate determination of the events that occurred and ultimately prevented a man from being unfairly convicted.

Concluding remarks are about the context in which this tragedy occurred: car racing and particularly on city routes. The Guidizzolo accident had a great impact on public opinion, which called for the discontinuation of the Mille Miglia. For twenty years, the Mille Miglia was suspended, only to resume in 1977 but as a regularity race and no longer a speed race. Still today, it is a historic re-enactment event, in which only historic cars that were entered in at least one edition of the original race can participate. Tragedies such as the one described led over the years to the study and improvement of the safety conditions of the circuits and cars, think of the introduction of disc brakes (1953), the monocoque chassis (1962),

slick tires (1969), the 6-point seat belt (1972) and traction control (1987), continuing with similar examples till today. Due to their dangerous proximity to the public, the number of city car races has decreased considerably. Nowadays, the few that have taken on a fascination associated with the golden age of racing survive, for example the Monte Carlo Circuit in F1 or the Tourist Trophy at the Isle of Mann in UK. Open questions remain, the simplest of which is whether the Guidizzolo tragedy could have been avoided. The Mille Miglia had already been suspended in the past due to an accident. On 3 April 1938, during the 12<sup>th</sup> edition of the race, the Bologna disaster occurred, where 10 people were killed and 24 injured. Departing from a race checkpoint, the Lancia Aprilia 101 driven by Magnanego and Bruzzi lost control of the car as it crossed the rails of the tram line, which were considerably higher than the road surface. In the same edition, there were two other accidents involving spectators. As a result, Benito Mussolini decided to ban the Mille Miglia on ordinary roads, but the ban lapsed after the war and the Mille Miglia resumed until the Guidizzolo tragedy. Finally, it must be considered that the most serious motor racing accident—albeit on a circuit—was relatively recent. On 11 June 1955 on the Circuit de la Sarthe during the 24 Hours of Le Mans, the Le Mans Disaster occurred, which claimed 84 lives and injured 120 people. Following the accident, many races of the season were cancelled. Switzerland banned motor racing on its territory by law until 2015. At the end of the season, after winning the Formula One championship, Mercedes withdrew from racing as a mark of respect for the victims and did not return until 1987. The accident gave strong impetus to research into systems to make circuits safer for spectators and drivers alike. In the United States, the American Automobile Association, the nation's largest automobile club, decided to close all sporting activities. It is now clear what could have been the media and emotional burden on the members of the committee who were supposed to seek the truth and not a scapegoat as demanded by public opinion. Unfortunately, we have no information on how this experience influenced, if it did, the members of the committee, but there is no doubt that the scientific rigor demonstrated in the expert report has always been a salient characteristic in their academic careers.

### Acknowledgements

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### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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## Appendix

The Ferrari 335 S was a sports racing car produced by Ferrari between 1957 and 1958. Only four cars were produced: two original 335 S and two 315 S converted later into the 335 S. In 2016, a 1957 Ferrari 335 Spider Scaglietti sold for €32.1 million (US\$35.1 million), making it the most expensive car to be sold at an auction so far. With respect to the previous model – the Ferrari 315 S – the engine displacement was increased from 3783.40 cm<sup>3</sup> to 4023.32 cm<sup>3</sup>, as a direct response to the Maserati 450S with its 4.5-litre engine. **Table A1** reports the main mechanical characteristics of the Ferrari 335 S as reported on the manufacturer website (Ferrari SpA, n.d.).

**Table A1.** Mechanical characteristics of the Ferrari 335 S (Ferrari SpA, n.d.).

Engine	Type	front, longitudinal 60° V12
	Bore/stroke	77 × 72 mm
	Unitary displacement	335.27cc
	Total displacement	4023.32cc
	Compression ratio	9.2: 1
	Maximum power	287 kW (390 hp) at 7400 rpm
	Power per litre	97 hp/l
	Valve actuation	twin overhead camshaft per bank, two valves per cylinder
	Fuel feed	six Weber 44 DCN carburettors
	Ignition	twin plugs, four coils
	Lubrication	dry sump
	Clutch	multi-plate
	Chassis	Frame
Front suspension		independent, unequal-length wishbones, coil springs, hydraulic shock absorbers
Rear suspension		de Dion, twin radius arms, transverse leaf spring, hydraulic shock absorbers
Brakes		drums
Transmission		4-speed + reverse
Steering		worm and sector
Front tyres		6.00 × 16
Rear tyres		7.00 × 16
Bodywork	Type	two-seater spider
	Wheelbase	2350 mm
	Front track	1296 mm
	Rear track	1310 mm
	Weight	880 kg (dry)
Performance	Top speed	300 km/h