Introduction

This is a book about all things automotive and how they work. The root of the word automotive is "self-moving" or self-propelled. That covers every non-living thing that moves under its own power. The word automobile was coined in 1897. We will focus on the technology of the automobile in particular, but sometimes will stray into related areas such as aircraft or locomotives. The explanations attempt to be technically correct without resorting to the often complicated mathematics that underlie them. We will address the major systems and subsystems that make up an automobile or light truck, which are very similar, and **explain** how they work. Combustion cycles, chassis layouts, engine types and designs, valve trains, transmissions, drive lines, suspension, steering, brakes, and body design—all will be discussed in some detail. We must necessarily use a number of technical terms in these discussions, some of which may not be familiar to you. We provide a glossary with definitions of these terms, and on first use, a word that is in the glossary is shown in **bold** and in color

We start with the earliest vehicles. The saying, *There is nothing new under the sun* is quite applicable to automotive technology. Even now, well over a century since the first self-propelled vehicles appeared, inventors are proposing novel engine designs. If one checks, one can usually find that these novel ideas (or ones very similar) were proposed in the early 20th century, tried and abandoned. Nevertheless, just because an idea was abandoned so long ago, does not mean it is a bad idea today. Technology has advanced so much in that time, particularly in respect to material science and digital electronics, that something which could not be made to work back then, now can be. Several companies are actively working to perfect variants on existing engines or totally new engines to achieve the holy grails of better economy and better power-to-weight ratio. Venture capitalists and the U.S. government have put multiple millions of dollars on the table, betting that these new ideas will work.

An example: electric cars, now all the rage, were first invented over a century ago but were abandoned because battery technology of the day could not provide sufficient range. Now, with new types of batteries available, you can buy a new, pure-electric car (not a hybrid) capable of traveling more than 250 miles on a single charge (the Tesla S). Hybrid automobiles, which typically combine gasoline engines and electric motors, reappeared on the scene quite recently (e.g., Prius: 1997 in Japan, 2000 in the U.S.), and all are variants of a transportation system that has been around a long time. The diesel-electric locomotive uses diesel engines turning generators to supply electric current to electric traction motors at the wheels. WWI submarines were diesel-electric. On the surface, diesels charged batteries used for electric propulsion when submerged. Modern luxury liners also use diesel-engine generators to drive electric motors on the propeller shafts. Electric motors offer speed control and quick reversing. The generators also power "the hotel," as the ship's engineers call the systems used by the passengers. But, Ferdinand Porsche helped develop a hybrid automobile in 1898 that used a 2-cylinder gasoline engine to drive a generator that powered electric motors mounted in the wheel hubs. Nothing new under the sun, indeed! The history of the technological development of the many systems that comprise a modern automobile and how they work is quite interesting. Let's explore it.