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The Art and Materials Physics of the Motorcycle

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In 1871 Louis Guillaume Perreaux installed a compact steam engine in a commercial bicycle, and thus produced the world's first motorcycle. A steam engine was a logical choice, having steadily developed from the work of Savery and Newcomen in the 17th century to the point where Perreaux was able to make one small enough to use for this purpose. Unfortunately, it was a technological dead-end the moment it was created, since nine years earlier Alphonse Beau de Rochas had published the description of the four-cycle internal-combustion process. Significantly, the Michaux-Perreaux engine produced 1-2 hp in an overall machine that weighed 88 kg, whereas modern motorcycles produce 100 times more horsepower while weighing only twice as much. Examples I will show illustrate that developments in materials science over the past century are almost entirely responsible for making this possible. After a period of extraordinarily-rapid technological advance, by 1903 essentially all the components of a modern motorcycle were in place, and changes since then have been largely the result of evolutionary refinement in step with advances in materials science, rather than further revolutionary invention. Also, like many other objects of industrial design, motorcycles have played a variety of roles in society over the 137 years since the Michaux-Perreaux. I will discuss the interrelationship of the relevant technological, cultural, and aesthetic factors over the past century that have, amongst other things, resulted in standard production motorcycles – incorporating such materials as carbon-fiber composites, maraging steels, and “exotic” alloys of magnesium, titanium and aluminum – that can exceed 190 mph straight from the show room floor. For more information see <http://www.optics.arizona.edu/ssd/aotm.html>. Acknowledgment: I am grateful for the contributions of Ultan Guilfoyle to our joint work on the Solomon R. Guggenheim's “The Art of the Motorcycle.”