

# SCIENCE

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## THE FACTORS OF SAFETY IN ANIMAL STRUCTURE AND ANIMAL ECONOMY<sup>1</sup>

THE living animal body is like a machine in action. Like a machine its structures are subject to a variety of stresses, and like a machine the work is accomplished by an expenditure of energy derived from a supply of fuel. I intend to discuss in this lecture, whether, as in the human-made machines, the structures and functions of the animal mechanism are provided with factors of safety. The term 'factor of safety' is employed in engineering to designate the margin of safety required in the building of engines, bridges, houses, etc. For instance, in designing a boiler, if the tensile strength of the steel of which the plates and stay-bolts are made, is 60,000 pounds per square inch, the actual stress which is allowed for the work of the boiler should not be more than 10,000 pounds per square inch for the plate and not more than 6,000 pounds per square inch for the stay-bolts; that means the stress to which the plates or the bolts may be exposed in the boiler should only be one sixth or one tenth of the actual strength of the steel. The factors of safety are said to be here six for the plate and ten for the bolts. In some instances the required factors of safety may be as low as three, in other cases again they may be as high as twenty and even forty. The character of the stress to which the structures might be subjected is an important point in deciding upon the

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<sup>1</sup>Harvey Society lecture, delivered at the New York Academy of Medicine, December 15, 1906.