

Health Bulletin *for* Teachers

Factors of Safety in Body Structure and Function

“**F**ACTOR of safety” is a term used by engineers to designate the margin of safety required in building engines, bridges, houses, and other structures. It is not enough to make a structure strong enough to bear expected maximum loads. It must be capable of withstanding stresses several times the size of such loads. In a paper read before the Harvey Society of New York in December 1906, Dr. S. J. Meltzer first drew attention to the fact that the human body is provided with factors of safety on a lavish scale. Since then several other physiologists have developed this theme.

The remarkable thing about many of our factors of safety is that they are so seldom called upon. Barcroft cites as an example of a factor of safety always available, but never used by the great majority of mankind, the duplication of mechanism associated with the initiation of the heart beat. The electrical impulses which set off each contraction of the heart originate in a little node of nerverlike material located in the wall of the right auricle. The impulses are conducted from the auricle to the ventricle by a bridge of nerve and muscle fibers called the bundle of His. However, if this bundle ceases to conduct in its upper portion, a new rhythm arises lower down and causes the ventricles to beat but with a slower rhythm than before. Thus “if the normal machinery is wrecked, the heart does not on that account cease to beat, as the beat is initiated elsewhere.” And then Barcroft goes on to ask: “Is it a happy accident? Are we to suppose that all of us carry an accident so happy in our hearts, that it will save the lives of a few persons whilst functionally it never enters the economy of more than a negligible proportion of the race? Are there such accidents?”

Barcroft himself believes, and many other scientists agree with him, that duplication is so frequent that it can scarcely be accidental. It is a definite feature in the architecture of the body, “the more impressive because it is achieved in such different ways . . .” So many ways indeed that Barcroft concludes wistfully, “It is always surprising to me that there is only one heart!”*

Factors of Safety in the Circulatory System. We have only one heart, it is true, but that single heart has a superabundance of volume and force. At any moment it is able to beat twice as fast as it ordinarily does, and put forth twice the usual amount of blood at each beat against an

*JOSEPH BARCROFT. *Features in the Architecture of Physiological Function.* Cambridge, at the University Press. 1934. Chapter XIV.