



## Hans Selye, Hungarian, Canadian Endocrinologist, 1907-1962

In 1926, while Hans Selye was still in his medical residency, he noticed that patients in the early stages of infectious diseases described a similar set of symptoms regardless of the type of disease they had. These symptoms included a general feeling of being ill, diffuse pains in joints and muscles, and intestinal disturbances leading to appetite and weight loss. Almost ten years later, Selye was working as a lab assistant at McGill University's biochemistry department in Montreal and he observed a similar phenomenon that sparked a line of thought that would ultimately lead him to uncover a syndrome so general in nature that it affects the health and performance of every human being.

He was conducting a fairly straightforward experiment that required him to inject mice with a variety of toxins. Selye was surprised to find that each of the mice developed a common set of symptoms regardless of which toxin he injected. These symptoms included an enlarged adrenal gland, swelling and subsequent shrinking of lymph nodes and other white blood cell producing organs, and bleeding in the stomach and intestines. Selye further observed that this set of symptoms increased and decreased in direct relationship to the dosage of the substance administered. His experience ten years earlier gave him the insight to suspect that this set of common symptoms was unrelated to the specific toxins and was instead the body's response to a 'noxious input from the outside environment.' It is from here that Selye set out to confirm whether the 'stereotyped syndrome of response to injury' produced in the lab was the clinical equivalent of the common set of symptoms he observed in patients ten years earlier, which ultimately led Selye to uncover a syndrome so general in nature that it affects the health and performance of every human. (Selye, *The Stress of Life*, 1956, p. 29),

Selye, like Cannon before him, had "serendipitously" stumbled upon findings that would shape the rest of his career. Selye defined the 'noxious input from the outside environment' as *stress*. Early into his research Selye broadened the definition of *stress* to include the "nonspecific response of the body to any demand, whether it is caused by, or results in, pleasant or unpleasant conditions. Selye's work revealed that stress, like temperature, as an all-inclusive concept, embodies both positive and negative aspects. Selye further distinguished negative and positive stress, using the term *distress* (dis- from the Latin "bad") to refer to the impact of negative stressors and *eustress* (eu- from the Greek "good") to refer to the impact of positive stressors. He stated that "During both eustress and distress the body undergoes virtually the same nonspecific responses to the various positive or negative stimuli acting upon it. However, the fact that eustress causes much less damage than distress graphically demonstrates that it is "how you take it" that determines, ultimately, whether you can adapt successfully to change." (Selye, *Nature of Stress*).

In 1936 Selye published *A Syndrome Produced by Diverse Nocuous Agents* in the British Journal *Nature*, in which he first introduced the General Adaptation Syndrome model. Selye built on the earlier work of Walter Cannon, regarding homeostasis, to reveal that various internal organs (especially the endocrine glands) help our body adjust to the constant changes that occur in and around us. Selye's research uncovered a typical process through which the body attempts to adapt to the impact of a 'stressor', advancing progressively through three response phases until the stressor is either eliminated or the body advances to debilitating exhaustion. **The G.A.S. model is still in use today and can be summarized as follows:**

1. Alarm Stage: the body's first reaction is to elicit the fight or flight response (Cannon). Body reactions can include (a) shock and a discharge of adrenaline, corticotrophin, and corticoids as early defense mechanisms; and (b) counter-shock as a defense against shock, including enlargement of the adrenal cortex with signs of increased activity, rise in blood pressure, and a range of other bodily reactions. Counter-shock phase of the alarm reaction represents a transition to the stage of resistance.
2. Resistance Stage: with prolonged exposure to the stimuli, the body adapts and increases its resistance to the stressor. The greater demands that are placed upon the immune system decreases resistance to other stimuli.

3. Exhaustion Stage: Selye found that even a perfectly adapted animal could not indefinitely maintain itself in the stage of exhaustion. Adaptation eventually wears out and further resistance becomes impossible.

As Selye's investigations progressed, he revealed that animals "exposed to non-specific damaging agents respond with a discharge not only of adrenaline, but also of adrenal cortical hormones." Selye discovered that these discharges, in addition to the previous set of symptoms noted, are the body's natural defense against stress. Selye's work revealed that if noxious stress is allowed to persist, this 'natural defense against stress' can become harmful to the body and result in hypertension, arteriosclerosis, diabetes, gout, myocarditis, and various other rheumatic-allergic conditions (Selye, 1960). Selye's research also helped to reveal the role hormones play in the development of diseases such as high blood pressure, kidney failure, arthritis, peptic ulcers and cancer.

While most people think of stress as only negative, Selye's work regarding eustress helped to demonstrate that positive stress is the basis for general motivation, exhilaration, and as long as managed appropriately can lead to creative and successful work. While most people understand what the negative stressors in their lives are, few understand the biological impact that prolonged stress can have on their long-term health and well-being. Stress is not just something that wears us down psychologically, it also has physiological manifestations, and debilitating long-term consequences if not addressed and managed -- the symptoms of which are indirect signals from the body to slow down and recover.

Selye's research on stress demonstrated the corrosive effects of prolonged exposure to negative stressors and articulated the many external symptoms readily observable in people. He also demonstrated that stress can be positive and plays a role in allowing us each to achieve peak performance. Selye importantly pointed out that what leads to negative stress for one person may lead to exhilaration and elation for another (e.g., a wild roller coaster ride). A stressor, in and of itself, can be neutral. What matters most is to understand how our body or our children's bodies react to a particular stressor and how to lessen or eliminate its impact.

In his lifetime, Selye authored and co-authored over 1,700 articles and 40 books, inspiring a generation of scientists to elaborate upon his framework. His insight has resulted in clinical solutions for people suffering from the emotional and physical toll of prolonged exposure to negative stressors as well as for those leveraging positive stressors to achieve peak performance.