THE POIKILOTHERMIC TYPE OF BODY TEMPERATURE REGULATION: 
PHYSIOLOGICAL EVIDENCE FOR THERMOEFFECTOR INDEPENDENCE

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The thermoregulatory system is a distributed multi-sensor, multi-processor control system that recruits autonomic and behavioral effectors to maintain a relative constancy of deep body temperature (T_b), or to change it as needed, while experiencing diversified thermal and nonthermal influences typical for a living organism. A crucial feature of this system is that thermoeffectors are controlled independently, which explains why a thermoregulatory response can have different effector patterns, or why thermoeffectors are recruited in a certain order. Independent control of thermoeffectors becomes evident when the so-called threshold dissociation occurs. In such responses, autonomic heat-defense effectors (e.g., tail skin vasodilation in the rat) are activated at a normal (or slightly decreased or increased) deep T_b, while the threshold T_b for activation of autonomic cold-defense responses (e.g., nonshivering thermogenesis in brown adipose tissue) decreases drastically. This dissociation results in the poikilothermic type of T_b regulation: in a wide range of T_b, deep T_b becomes the result of passive heat transfer between the body and the environment. Within the same T_b range, autonomic effectors are not recruited, while behavioral effectors are readily used and, without being counteracted by autonomic ones, become highly effective. The poikilothermic type is widely spread in the animal kingdom: the vast majority of ectothermic animals are also bradymetabolic (equivalent to having a very low threshold T_b for activation of thermogenesis), and consequently, poikilothermic. The transition to homeothermy (a feature of endothermic, tachymetabolic animals) is associated with the emergence of thermogenesis (equivalent to increasing the threshold T_b for activation of thermogenesis). Heterothermic animals switch between poikilothermy and homeothermy by turning thermogenesis on and off. Homeothermic animals use the same mechanism to regulate T_b during hibernation, REM sleep, starvation, hypoxia, shock, and intoxications: they shut down thermogenesis and become poikilothermic. Because the thermoregulatory system is not a unified control system, as it is clearly seen in poikilothermic responses, the term set point should be avoided in favor of balance point.