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## THE TEMPERATURE INTERVAL IN THE GEOGRAPHICAL DISTRIBUTION OF MARINE ALGÆ[1]

THE idea of geographical distribution came as a new and inspiring, although rather indefinite, concept to the German fathers of botany in the latter portion of the fifteenth and earlier portion of the sixteenth centuries. The attempt to explain geographical distribution according to the influence of environmental factors began, practically, with Alexander von Humboldt in 1805. Since his time, temperature has generally been regarded as the chief limiting factor in climatic distribution. In 1893, I called attention to the relationship existing between the position of the isotheres (mean maxima for the hottest month) of 10°. 15°, 20°, and 25° C. of the surface waters of the oceans and the limits of distribution of certain groups of kelps (Laminariaceæ). In 1894, and again in 1898, C. Hart Merriam proposed dividing the United States into certain "life-zones" or "crop-zones" according to the "summation-indices" of the temperature of the frostless season and showed the close relation of the boundary lines of these "zones," or belts as they may be more distinctly designated, to the isotheres (isotherms of mean maxima for the six hottest weeks of the season) of 18°, 22°, and 26° C. In 1913, Livingston and Livingston proposed a series of "efficiency indices" for use in plant distribution and climatology, presumably resting upon more of a physiological basis than the summations of temperature or statistical relations to various isotherms. The efficiency basis of their system is founded upon the application of the van't Hoff-Arrhenius principle as to the velocity of vital activities at different temperatures. In

[1] Delivered before the Princeton Biological Seminary on April 6, 1920.