1. HISTORICAL PERSPECTIVE

As the industrial revolution swept across northern Europe in the 18th and 19th centuries, masses of people began to congregate in the cities. Coincident with the industrialization of northern Europe and North America and this mass migration was the rapidly increasing occurrence of a bone-deforming disease known as rickets. In 1550 this malady had been recognized and reported as a clinical entity that usually affected small children and was characterized by bowed, weak, and flabby legs, knuckle-like projections along the costochondral junctions of the rib cage (commonly referred to as the rachitic rosary), and deformities of the pelvis (1). For the next 250 years this disease plagued the children who lived in the industrialized cities of northern Europe and later in North America.

Although several theories had surfaced regarding the etiology of this devastating disease, including infection, lack of activity, and inheritance, little was known about its cause or its cure. As early as 1822, Sniadecki was aware of an association between the high incidence of rickets in the poor who lived in the overcrowded industrial cities of Poland and the lack of adequate exposure to sunlight (2). In 1889, the British Medical Society noted that the incidence of this disease was highest in children who lived in heavily populated industrialized cities in the northern latitudes (3). The next year, Palm (4) reported the data from an epidemiologic survey that provided strong evidence that the single common denominator that prevented rickets was adequate exposure to the sun. He noted that in the poor and hungry populations in the Orient and India where malnutrition, syphilis, tuberculosis, and unsanitary living conditions prevailed, rickets was a clinical rarity, whereas, in Great Britain, one of the wealthiest countries in the world,
rickets was endemic among the working classes living in the crowded cities. By the process of exclusion he concluded that exposure to sunlight protected children in India and the Orient from rickets. He encouraged the study of the therapeutic and beneficial effects of sunlight and urged the systematic use of sunbaths to prevent and cure this crippling disease. His study, however, essentially was unnoticed because it then was inconceivable that such a simple remedy as exposure to sunlight could cure this bone-deforming disease.

It was common folk practice in the 19th century, especially on the coasts of England, Holland, and France and in the Scandinavian countries, to use cod-liver oil to prevent and cure rickets. In 1918 Mellanby (5) produced rickets in dogs by dietary manipulation of calcium and phosphorus in combination with a lack of exposure to sunlight. He demonstrated that cod-liver oil contained a fat-soluble substance that prevented and cured the disease. Because vitamin A was present in cod-liver oil, he had presumed that this vitamin and the antirachitic factor were the same. However, McCollum and colleagues (6), by heating aerated cod-liver oil, destroyed the vitamin A activity, and showed that the antirachitic factor was different from vitamin A. They named this newly discovered nutrient vitamin D.

At the same time that Mellanby and coworkers were demonstrating that rickets was caused by the lack of an essential antirachitic factor in the diet, Huldschinsky (7) demonstrated complete resolution of the bone disease in four rachitic children who had been exposed to radiation from a mercury-arc lamp. Huldschinsky also demonstrated that exposure to this radiation was not just a local effect, inasmuch as exposure of one rachitic arm to the radiation healed the rachitic lesions in both arms. Two years later, Hess and Unger (8) exposed eight children with rickets to natural sunlight and unequivocally demonstrated, for the first time, that exposure to sunlight alone could cure this disease. These apparently disparate observations that a dietary factor and sunlight had the same curative effect on rickets caused much confusion about the etiology of rickets. Finally, Hess and colleagues (9) demonstrated that extracts of rat skin exposed to ultraviolet radiation possessed antirachitic activity, which suggested to them that radiation energy induced antirachitic activity in the skin, and Powers, et al. (10) showed that the curative effects after exposure to ultraviolet radiation and after ingestion of cod-liver oil