INTRODUCTION

Among the most significant of the factors modifying the life-span of organisms is the nutritional component of the environment. The adequacy of the level and balance of intake of essential nutrients provided by the maternal diet affects the growth and development of the fetus (1). Furthermore, throughout post-natal life the health and well-being of the offspring depends upon the nature of the diet consumed earlier in life as well as the current dietary intake. Thus, nutrition is an important key to a healthy, long life and it seems obvious that adequate nutrition throughout the life-span would be an effective way of minimizing the development of degenerative changes in body and organ function that characterize progressive aging. However, a precise or quantitative definition of adequate nutrition cannot be given, at least in terms of longevity, with our present state of knowledge. Nevertheless, there is now abundant information to indicate that diet can exert a dramatic influence on the life-span of the mammalian organism and on the type and severity of age-associated diseases. Thus, we will consider here some of the dietary variables that appear to be important in this context.

Because a number of reviews have already dealt in detail with the topic of nutrition and aging, this chapter will not attempt to provide an exhaustive account of the published literature and the reader is referred to these earlier reviews (eg. 2-5) for a more complete coverage of the relevant studies. Rather, the purpose will be to consider the dietary variables that have been shown to have important influences on the life-span of experimental animals.
and the possible mode(s) of action of nutrition in determining or modifying life-span. Because most of the available information concerning nutrition and aging is based on studies in experimental animals, the significance of such findings should be considered in relation to problems of practical nutrition and longevity in human subjects. Finally, the importance of an adequate diet once old age has been reached will be discussed briefly.

INFLUENCE OF TOTAL FOOD INTAKE

The effect of the level of total food intake on life-span was clearly demonstrated more than 40 yr ago by McCay et al. (6-8), who carried out a series of three studies on the effects of dietary restriction on growth and survival in rats. These workers observed that by restricting food intake sufficiently to retard growth there was a significant increase in mean life-span of rats, relative to that for animals fed ad libitum. However, in these experiments there were high losses in the restricted group during the first year of the experiment whereas the number of deaths in ad libitum controls were negligible during this period (Table 1).

Confirmation of the effects of a dietary restriction upon life-span in rats was obtained by Berg and Simms (9). They found that a decrease in intake of a standard laboratory diet, begun early and continued throughout life, increased life-span by about 25%. Furthermore, rats given the unrestricted diet (with a life-span averaging 800 days) showed a 40% incidence of kidney disease by 500 days of life. In contrast, it was at about 1000 days before a comparable incidence of kidney disease had developed in rats fed the restricted diet.

Similar studies have been conducted in mice (10), guinea pigs (11), non-mammalian species, including fish (12), daphnia (13), drosophila (14) and rotifers (3). In general, all studies point to the fact that the life-long ad libitum feeding of diets capable of promoting rapid growth in the young is not optimum for long-term survival in these species.

Ross and coworkers (15) have been able to nearly double the life expectancy of male rats by life-long, severe underfeeding. Furthermore, as shown in Figure 1, there is a strong negative correlation between mean life-span and the amount of food consumed throughout post-weaning life in the rat.

Although these studies reveal that a restriction in total food intake below that of ad libitum feedings brings about an increase in life expectancy, the higher rates of juvenile death noted above and the marked reduction in growth and in the rates of biochemical,