may minimize the amount of research effort required to investigate a research hypothesis.

Another important consideration in selecting a dependent variable is whether the observations within each treatment level (or combination of treatment levels in the case of multitreatment experiments) would be normally distributed. The assumption of normality, discussed in Chapter 2, is required for the experimental designs described in Chapters 4 through 12. In some cases it may be possible to *transform* nonnormally distributed observations so that the resultant distributions are normal. This procedure is described in Chapter 2. If theoretical considerations do not dictate the selection of a dependent variable and if several alternative variables are equally sensitive and reliable, in addition to being normally distributed, an experimenter should select the variable that is most easily measured.

SELECTION OF INDEPENDENT VARIABLE

The independent variable was defined earlier as the presence or absence of radiation. Such a treatment is described as having two treatment levels. If the experimenter is interested in the effects of different radiation dosages, he can employ three or more levels of radiation. The levels could consist of 0 microwatts, 20,000 microwatts, 40,000 microwatts, and 60,000 microwatts of radiation. This particular treatment is an example of a *quantitative* independent variable in which different treatment levels constitute different amounts of the independent variable.

In general, when the independent variable is quantitative in character there is little interest in the exact values of the treatment levels used in the experiment. In the radiation example, the research hypothesis could also be investigated, using three other levels of radiation, say, 25,000, 50,000, and 75,000 microwatts in addition to the zero-microwatt control level. The treatment levels should be chosen so as to cover a sufficiently wide range to detect effects of the independent variable if real effects exist. In addition, the number and spacing of the levels should be sufficient to define the shape of the function relating the independent and dependent variables. This is necessary if an experimenter is interested in performing a trend analysis as described in Chapter 4.

Selection of appropriate levels of the independent variable may be based on results of previous experiments or on theoretical considerations. In some research areas, it may be helpful to carry out a small pilot experiment to select treatment levels prior to the main experiment.

Under the conditions described in Chapters 2 and 4, the levels of a quantitative independent variable may be selected randomly from a population of treatment levels. If this procedure is followed, an experimenter can extrapolate from the results of his experiment to treatment levels that are not included in the experiment. If the treatment levels are not randomly sampled, the results of an experiment are applicable only to the specific levels included in the experiment.