data is the same as for a double-classification factorial experiment as described in Chapter 16. Four sums of squares are obtained. Given k treatments and B blocks the degrees of freedom associated with treatments, blocks, interaction, and within-cells sums of squares are $k-1$, $B-1$, $(k-1)(B-1)$, and $N-Bk$, respectively.

What is the purpose of a randomized block experiment? The primary purpose is to reduce the size of the error term used in the denominator of the F ratio, which for the fixed model is the within-cells mean square. The relative efficiency of the experiment is thereby increased in relation to the one-way classification experiment. If the blocking variable has a substantial correlation with the dependent variable, the sums of squares associated with blocks may prove to be of some appreciable size; also an interaction term of some magnitude may be found. The effect of this will be to reduce the size of the within-group sum of squares and the within-group mean square and, thereby, increase the likelihood of obtaining a significant difference for the main effect.

The reader should note that in the one-way classification experiment the number of degrees of freedom associated with the error term, the within-groups mean square, is $N-k$, whereas in the randomized block experiment the number of degrees of freedom associated with the error term is $N-Bk$. Thus in the randomized block experiment a loss in degrees of freedom associated with the error term occurs, which must be compensated for by the sum of squares associated with blocks and interaction. An informative discussion of this point will be found in Myers (1972). Myers' treatment of the subject shows that the relative efficiency of the randomized block experiment in relation to the usual one-way classification experiment will be greater than 1 whenever the F test of the combined block and interaction effects exceeds 1. The relative efficiency will increase as the sum of squares associated with blocks and interaction effects increases.

Because the degrees of freedom associated with the error term in a randomized block design are $N-Bk$, the power of the F test will decrease as the number of blocks increases. Also, as the number of blocks increase the within-cells sum of squares decreases. These are opposing effects which suggest that in a randomized block experiment some optimum number of blocks exists. This topic has been investigated by Feldt and Mahmoud (1958). The reader will find Myers' (1972) discussion of this topic helpful. The gist of the matter is that the optimum number of blocks is related to the correlation between the blocking variable and the dependent variable, sample size N, and the number of treatment levels k. The optimum number of blocks increases with increase in the correlation and sample size N and decreases with increase in the number of treatment levels. In the design of a randomized block experiment investigators should inform themselves of these matters and keep them in mind.

The blocking variable is usually a classification variable which is characteristic of the subjects and is in no way under the control of the inves-