A NOTE ON WEIGHING DESIGN

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1. Efficiency of weighing designs given by a three-fourth replicate. In the June issue of the *Annals*, Kempthorne [1] approached the construction of the orthogonal matrix X through fractional replicates, the original treatment of which was given by Finney [2]. Reference has been made to the use of a three fourth replicate for weighing designs. Details for such designs have not been furnished as their efficiency is lower than for the designs given by the completely orthogonal matrix X. In a three fourth replicate the treatment combinations have to be chosen in a particular manner for a comparatively easier analytical treatment both from the point of view of agrobiological experiments as well as weighing designs. The variance of each of the estimates in such a case will be $\sigma^2/2^{n-1}$. As a matter of fact, in a weighing design given by a fractional replicate of the type of $(2^\beta - 1)/2^\beta$, $(\beta = 1, 2, \cdots n)$, of 2^n experiments, the estimate of the variance of each object is independent of the fraction used and is equal to $\sigma^2/2^{n-1}$, the same as above.

2. Construction of a three fourth replicate. Kempthorne mentions that a factorial design of fraction $\frac{3}{4}$ could be taken to consist of a $\frac{1}{2}$ replicate on the identity $I = ABC$ and a quarter replicate based on the identity

$$I = A = BC = ABC.$$

If the half replicate based on the identity $I = ABC$ be taken to consist of all the treatments corresponding to the minus signs of the treatment contrast ABC [3], the additional quarter replicate can be chosen in two different ways. When however the treatments corresponding to the minus signs of both A and BC are kept, omitting the treatments corresponding to the plus signs of A and BC, the three fourth replicate so obtained will have certain advantages, which will not be available if the quarter replicate to be added is chosen to consist of the treatments corresponding to the plus signs of A and BC.

3. Behavior of the contrasts in a three fourth replicate and the efficiency of the weighing designs. In general, if there are n treatments giving rise to 2^n treatment combinations and if the defining contrasts be chosen as

$$I = ACD = BDE = ABCE,$$

it will be necessary to omit the treatment combinations corresponding to the plus signs of both ACD and BDE, which will be 2^{n-2} in number. In the three fourth replicate so obtained, 2^n treatment effects (inclusive of the mean) will divide themselves into sets of 4 treatment contrasts each. One of the sets will be I, ACD, BDE and $ABCE$ and any other set will be formed by multiplying any treatment contrast by the defining set namely, I, ACD, BDE and $ABCE$. Only three contrasts out of four in a set will be independent, so that only one of