1. $P_1 \times P_2$ vs. $P_1 + P_2$ as a criterion of overdominance in corn.

Overdominance may be due to heterozygosity per se, a divergent allele mechanism as postulated by East, an intermediate optimum, repulsion linkages and other hypothetical suppositions. If such gene actions are of importance at numerous loci certain breeding methods may be more effective than others. Hull (Jour. Amer. Soc. Agronomy 37:134-145, 1945) outlined a selection method for specific combining ability based on the occurrence of overdominance. The common observation of corn breeders that many single crosses exceed the sum of the two inbred parents in yield is, according to Hull, indicative of many heterotic loci for yield. If the effects of alleles are strictly additive then the sum of the two homozygous lines which make up the F_1 can not be smaller than the single cross.

It is rather easy genetically to design cases in which the fallacy of the above argument becomes obvious. Say for example line A carries a homozygous recessive pale green allele and line B is homozygous for recessive sugary. Both alleles depress yield markedly. The F_1 will exceed the sum of the two parents not because of overdominance but simply because each line possesses the dominant allele to the other lines' recessive. If these two lines were also available without the pale green and sugary alleles one could produce the two identical single crosses except for the two mutant loci and compare them with the sum of their respective parents.

Such a situation was provided by two dwarf mutations in unrelated long time inbred lines. The inbreds denoted by ID_1 and IID_2 and the mutated lines denoted by Id_1 and IId_2 were intercrossed in the following manner: $ID_1 \times IID_2$, $Id_1 \times IID_2$, $ID_1 \times IId_2$ and $Id_1 \times IId_2$. These four entries were grown in randomized blocks with 16 replications. Data were collected on plant height, kernel row number, ear length and weight of shelled grain. Seed counts were made on seven replications only. Orthogonal partitions of the three treatment degrees of freedom were chosen according to pertinence of comparisons. The means and variances for the four parents were obtained in an experiment grown next to the above described test and reported on in Genetics 39:908-922, 1954. Table 1 contains the means. The first six rows of the table are reproduced from the afore mentioned publication. The corresponding F-values are summarized in table 2, again the first two rows are a duplication from the paper in Genetics 39. Hull restricts his reasoning to yield only, but there seems to be no apparent reason to place limitations on his argument because heterosis is not confined solely to yield. In table 3 a number of comparisons for the different attributes are set out. The table is self explanatory. For example for yield the single cross $ID_1 \times IID_2$ when compared with the sum of the two parents gives an excess of three percent. This amount according to Hull must be due to overdominance. However, if the homozygous dwarf lines $Id_1 \times IId_2$ are added up and contrasted to the hybrid $Id_1 \times IId_2$ heterosis due to overdominance would jump to 131 percent. But since the difference between the normal inbreds and their dwarf counterparts is known to be due to mainly the strong effect of the recessive dwarf allele, the case for overdominance breaks down and resolves into a simple dominant-recessive relationship. It is not denied that some forms of overdominance, on whatever scale of observation it is measured, exist but simply to say that the excess in yield of a single cross over the sum of the two parents is attributable to overdominant loci is, as shown here, in many cases an unrealistic and unnecessary postulate.