Although the main aim of this experiment, namely the comparison of different varieties with respect to their dominant and additive variance components, was not achieved satisfactorily, the data did allow a comparison of the two methods which seem to be in fair agreement with each other. Estimates of D for individual varieties using either method seem to fluctuate around a positive value quite small when compared to that of G. Differences between varieties are not consistent over different methods but are probably due to sampling errors (as indicated by the negative values which by definition are impossible.)

The high G:D ratio obtained agrees with the results of Robinson et.al. (Genetics 40:45) and the same conclusion may be drawn, nl. that true overdominance can hardly explain the amount of hybrid vigour commonly found in maize.

An assumption to which the theory employed in the above studies was subject is the lack of epistasis. Cockerham (Genetics 39:859) indicated that correlations between relatives contain only small proportions of the existing epistasis. Epistasis, therefore is not expected to bias the estimates of D and G much unless the amount of epistasis is considerable. Available data (Comstock, C. S. H. Symp. Quant. Biol 20:93) give little evidence for epistasis. Jinks (Her. 9:223) by means of the diallel method concluded that epistasis was important only in those maize inbreds that showed outstanding combining ability. The use of non-selected material to avoid upward bias of dominance estimates as a result of epistasis seems advisable.

Genotype-environment interaction could very well be an important source of error or bias in the above experiments. An extensive study with local maize variety crosses by van Schaik et.al (S. A. J. Agr. Sci. 1:423) stressed the importance of environmental interaction with heterosis. Rojas and Sprague (Agron. J. 44:462) found a large amount of environmental interaction with the specific combining ability for yield variance in maize.

In conclusion it may safely be stated that in non-selected open pollinated material of the type used in the experiments reported here the assumptions of no effective linkage or epistasis are plausible but that genotype-environmental interaction may have a pronounced effect on the results.

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5. Effect of inbreeding on variability of yield.

An extensive experiment was carried out to examine the effect of inbreeding on the variability of yield of five South African open pollinated varieties (Sahara, Teko, Anveld, American white flint and Robyn). Twenty of each of the following strains were developed from each variety:

1. Half-sib matings, F = 0.125
2. Full sib matings, F = 0.25
3. S_1-full sib mating, F = 0.375
4. S_1, F = 0.50
5. S_2, F = 0.75.

The experimental field was subdivided into 20 blocks. One strain taken at random from each of the five different degrees of inbreeding of each of the five varieties was grown in two separated replications within each of the twenty blocks. Two replications of each of the open pollinated (S_o) varieties and a single cross (F_1 of the two homozygous strains A441-5 and A 272) were included in each block as well. The 31 strains within each replication were allotted positions at random (total no. of plots was 1240). Table 1 shows the mean yields per plot of the twenty strains replicated twice for each variety for the different inbreeding coefficients.

Table 1. Mean yields per plot in lbs.

F	Variety				
	Sahara	Teko	Anveld	Am. W. F.	Robyn
0	10.7	8.2	8.1	7.6	7.2
0.125	8.5	8.5	6.1	7.0	7.4
0.25	7.3	7.9	6.6	5.7	6.5
0.375	3.9	5.1	3.3	3.3	5.9
0.50	3.5	4.0	2.2	2.7	3.9
0.75	2.5	3.1	1.4	2.0	4.0

It appears that yield is not exactly proportional to 1-F or the amount of heterozygosis. Four of the varieties show very slight decline in yield until F is 0.25. Then in all five varieties there is a quick decrease in yield until F is 0.50 followed by a slow decrease beyond that.

Variability of yield totals of the twenty strains for each variety and all varieties combined is shown in Tables 2 and 3.

Table 2. Coefficient of variability of strain yields.

F	Variety					Comb. vars.
	Sah.	Teko	Anv.	AWF.	Rob.	
0	9.1	12.4	8.0	9.5	13.5	22.0
.125	18.7	24.3	23.6	15.2	19.9	19.7
.25	19.2	19.2	22.0	16.2	13.5	39.6
.375	41.8	29.0	29.9	38.8	38.6	37.0
.50	42.9	23.0	32.7	38.0	38.3	55.0
.75	72.7	30.3	42.9	58.8	42.1	

Variability estimates at F = 0 represent variability between different random samples taken from a variety plus between block differences. Variability is expressed in terms of coefficient of variability. Variability in four of the varieties shows an irregular but distinctly upward trend with increase in F while the fifth variety, Teko, shows this trend to a slight degree only. Variability between strains was also determined in terms of variance as presented in Table 3.

Table 3. Variances of total strain yields.

F	Variety					Comb. var.
	Sah.	Teko	Anv.	AWF	Rob.	
0	3.80	4.12	1.67	2.06	3.81	10.9
.125	10.10	16.90	8.28	4.51	8.68	7.2
.25	15.47	9.24	8.44	3.32	3.12	11.9
.375	10.65	8.94	3.99	6.78	21.12	5.8
.50	8.79	3.37	2.08	4.36	8.73	8.2
.75	12.71	3.53	1.45	5.52	11.39	

There appears to be no consistent change in variance as F increases beyond 0.125. Teko and Anveld show some decline while Sahara and Robyn show a slight increase with increasing F.

Both estimates of variability are subject to certain biases when used for the material concerned. The upward trend shown in Table 2 could be explained in part by the downward trend of the means in Table 1 since the mean is inversely proportional to the coefficient of variability. Van Schaik (Proc. I Cong. S. A. Genet. Soc. 1:66) obtained an overall correlation coefficient of -.69 between coefficient of variability and mean yield for a number of nonsegregating inbred and F_1 strains chosen in such a way that the whole yield range was represented as well as possible. Re-examination of this data gave a highly significant overall positive correlation of .51 between variance and yield. If the factors responsible for this relationship were operative also in the material presented in this paper, which seems likely, a downward trend would be expected in Table 3 unless other factors interfere.

In conclusion it would seem that the truth must be found somewhere between the trends shown in Tables 2 and 3. This would mean that the data indicate an increase in variability between strains with inbreeding. No exact quantitative estimate of this increase can be given, however.

It is interesting to note the contrasting behaviour of the varieties Teko and Sahara. While the former showed hardly any inbreeding effect until F = .25, the Sahara strains on the average had lost about a third of the yield capacity of the open pollinated variety at this stage of inbreeding. In Table 2 Teko shows little if any increase in variability between strains with inbreeding beyond F = 0.125 while Sahara shows a steep incline in variability. In Table 3 Teko again behaves exceptionally in that it indicates a slight decrease in between strains variance as F increases from 0.125. Sahara shows a gradual but fairly regular upward trend. It would appear, therefore, that Teko in contrast to Sahara and the other varieties does not show some of the typical effects of inbreeding. This characteristic could be explained by assuming that Teko is more homozygous than the other varieties. As reported in last year's newsletter there was little difference between the number of visible seedling abnormalities segregating from nonselected self-pollinated ears of the two varieties, so this would seem not to be the case. Indeed with continued inbreeding, Teko does lose its vigour to almost the same extent as the other varieties. It also shows more variability from F = 0 to F = 0.125 than the other varieties.

Another prominent feature of the data is the distinct and consistent peaks at F = 0.125 and 0.375 in the variability data. No satisfactory explanation can be offered for this phenomenon. Graphs showing the effect of inbreeding on yield were straightened out by the method of least squares and new coefficients of variability were determined but the characteristic peaks remained approximately the same indicating that they have no relation with the irregularities in inbreeding depression.

The surprisingly gradual yield decline at early stages of inbreeding of some varieties is of practical importance. Many inbred strains (up to F= 0.375) yielded considerably more than the parental open pollinated variety within the same block. These observations have renewed interest in the possibility of selecting for yield during mild inbreeding.

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6. Maize uniformity trials.

A series of uniformity trials was carried out on the experimental farm of the University of Pretoria to determine the minimum plot size and shape for lattice experiments for the testing of lines in