in view of the unconformity that de Terra presumes to exist between the Boulder-Conglomerate and the Pinjor stage. It is very important that both de Terra and Pilgrim make no mention of any evidence of glaciation in the Pinjor or the Tatrot stages. Hopwood and Lewis[3] consider the Pinjor zone as lower Pleistocene on fossil evidence alone.

I have studied the Pinjor zone where it is exposed near the village of Khanpur, close to Jammu, latitude 33° N. and longitude 75° E. approximately. The basal clayey bed of the zone is overlain by a fairly thick conglomerate bed. The conglomerate consists mostly of pre-cambrian quartzitic pebbles and boulders, a few pebbles and boulders of the Panjal trap, Permian limestone and the Murree sandstone, all held together by a coarse arenaceous matrix, containing undecomposed grains of felspar. The peculiarity of most of the pebbles and boulders in the conglomerate is that they possess a fairly high degree of surface-polish, unlike other pebbles and boulders in the beds below or above. The Panjal trap boulders also exhibit good faceting and fine glacial striations. The high degree of polish of the quartzitic boulders seems to indicate what might be termed 'silt-polishing'. This term has been used by Grinlinton[4] during his researches in the Liddar valley. I am thus led to conclude that the Pinjor zone belongs to the first interglacial period and the underlying Tatrot zone to the first glacial period. On glacial evidence, therefore, the Tatrot and Pinjor zones are of lower Pleistocene age.

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[1] de Terra, *Rec. Geol. Soc. Ind.*, **73**, *Pt.* 4.
[2] Pilgrim, *Rec. Geol. Soc. Ind.*, **73**, *Pt.* 4.
[3] Hopwood and Lewis, *Rec. Geol. Soc. Ind.*, **73**, *Pt.* 4.
[4] Grinlinton *Geol. Surv. Ind. Mem.* 49, *Pt.* 2.

AGRICULTURE

Influence of Site and Season on Agricultural Variety Trials

In recent work at the National Institute of Agricultural Botany[1] the variation between centres and seasons has been studied in large numbers of cereal variety trials. It was found that the standard deviation of relative yields for wheat, barley and oat varieties in England and Wales is of the order of 10 per cent, when based on results from several centres in one or more seasons, but may be influenced by the actual varieties in trial. Comparable figures for this between trials 'error' have now been obtained for relative yields of roots and dry-matter in fodder beet (12 per cent), dry-matter yields of lucerne from single cuts (11 per cent), yields of maincrop potatoes (14 per cent), and of marketable heads of winter cauliflowers (16 per cent). In the absence of clear guidance from plant physiologists as to the critical conditions determining yield in each crop, attempts to relate these differences in relative varietal performance to particular environmental factors have not often been successful with the 20–40 results usually available for each pair of varieties. There is at present, therefore, little practicable alternative to basing varietal advice to farmers on national average results, although the search for environmental adaptation continues.

The differences in error according to the particular varieties in trial confirm Salmon's finding[2] for wheat in America that year-variety interactions are not always homogeneous and imply the need for caution in using the analysis of variance for variety trial series. Such caution is also necessary for physiological considerations do not necessarily support the underlying mathematical assumption of the analysis of variance that varietal differences are additive: it seems perhaps more probable that differences between varieties will be, for example, greater where the general level of yield is high.

There are other important implications for agricultural variety testing procedures. At least 20 trials over a representative range of centres and seasons are thus usually necessary to obtain significance at P 0·05 for a 5 per cent difference in yield between two cereal varieties. A lower between-trials error, leading to significance from fewer trials, is not necessarily a matter for congratulation, but suggests that the trial centres or seasons may not have been sufficiently representative.

If yield results from single cereal trials are to be considered as having validity beyond the particular field and season of the trial, the standard error of the mean variety yields from that one trial should not be considered as less than about 10 per cent. Much greater internal precision within individual trials is, therefore, uneconomic. Engledow and Yule[3] have pointed out that it is "no use spending great pains on the endeavour to reduce the effects of one sort of error (within trial) when another is left uncontrolled". They were discussing seasonal differences: differences between centres are no less important. To illustrate this, a series of 21 spring oat trials with 6 replications of 4 varieties in 1/48-acre plots at 7 centres over 3 years has been analysed to study the effect of reducing numbers of replications as follows:

No. of replications in each of 21 trials	6	5	4	3	2	1
Standard deviation of variety yield as percentage mean plot yield	11·5	11·3	11·2	11·1	11·2	12·4

Varietal differences were significant at P 0·001 with only one replicate at each centre. Similarly my colleague, C. G. Finch has recently undertaken four trials of summer cauliflowers in one season, each with single plots of 101 varieties: the significant difference between the proportions of perfect heads was 17·8 per cent, compared with figures of between 12·8 and 20·0 per cent from the means of five trials each with 6 replications in earlier years.

In variety trials adequate and substantial replication between centres and seasons is therefore essential, and 2 or 3 replications within each of the centres is likely to be sufficient for yield assessment. The long-established practice of testing varieties at representative centres for several seasons is thus amply justified. The results now reported emphasize that when seed or facilities are limited, it is more important to cover the main environmental conditions than to achieve high accuracy in individual trials.

Similar conclusions may well apply to other types of agricultural investigation for which it might also be profitable to examine the variation between centres and seasons under British conditions.

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[1] Sandison, A., and Bartlett, B. O., *J. Nat. Inst. Agric. Bot.*, **8**, 351 (1958).
[2] Salmon, S. C., *Agron. J.*, **43**, 562 (1951).
[3] Engledow, F. L., and Yule, G. V., "Principles and Practice of Yield Trials" (Empire Cotton Growing Coporation, London, 1930).