fertiliser firms, the latter having been recently granted a five-year monopoly in Malawi. The major industrial development is expected to be related to agricultural processing and machinery production in partial association with the Lilongwe Land Development Project, but production is unlikely to meet more than a regional, or at best national, market. Even the Master Plan admits that the development of new export industries in Malawi is 'unpromising'.

The Lilongwe Plateau area is the major area of undeveloped agricultural potential in Malawi; the World Bank financed Land Development Project is designed to improve agricultural practice and raise production in an area of 500,000 acres west of Lilongwe. The twelve year project, which started in 1967, is aimed at increasing production especially of maize (using new hybrid maize from Kenya), groundnuts and tobacco. During this period, the local population should increase from 190,000 to 270,000 to create a demand on the new capital for the provision of services and secondly to provide a surplus, estimated at 120,000 tons of maize, 16,000 tons of groundnuts and 5,000 tons of tobacco (Hupkes, 1968). However, it is only for maize that this represents a greater than 50% increase on current surplus, hence the processing significance of this increase is likely to be relatively slight, whilst the spin-off effect in neighbouring agricultural areas is unlikely to be great in the near future. Lilongwe will only play an important servicing and marketing role, but this could be more important if relations with Zambia continue to improve, since this would result in large maize exports and despite Zambia's commitment to the Tan Zam Railway (Connell, 1971), it is possible that Malawi's railway could be extended through Lilongwe to Zambia.

On balance, however, it seems that, unlike the other new Southern African capital, Gaborone (Best, 1970), Lilongwe has much less social or economic rationale and probably much less chance of success. The scale of development is extremely optimistic and it is unlikely that industrial and commercial expansion will justify the Government's faith. The next decade will indicate to what extent the new capital will become a rather expensive white elephant for a poor country or whether it becomes a massive vindication of the growing links between South Africa and Malawi.

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# Topography and surface winds at Muguga

John Tyrrell

Muguga is situated in the Kenya Highlands, some 15 kilometres to the north-west of Nairobi. It is located on the slopes of the Tertiary-Recent Volcanic Highlands and Plateaus[1] which have been considerably dissected by eastward flowing rivers. The surrounding area is fairly densely populated, but large areas of agricultural smallholdings are broken by areas of afforestation. The latter are composed of several hardwoods of economic importance, including pinus patula and pinus radiata. In recent years these species have suffered from the attacks of pineus spp.[2] It was in relation to the spread of this aphid that the study outlined below was conducted. Some of the work was also carried out as part of the undergraduate field training programme.

The first study of the relationship between wind direction and topography was carried out in December 1969 and repeated in November 1970. On both occasions the main regional airflow was between the north-east and east-north-east and air temperatures reached their maximum about 1600 hrs. (E.A.S.T.) between 13.44°C and 13.61°C on each occasion at the E.A.A.F.R.O., meteorological station.[3]

## Observations

Observations of wind direction were made at 8 sites in 1969 and 12 sites in 1970. On the latter occasion the sites were chosen to test the wind patterns observed in 1969 and to extend the area of observation. The location of these sites is given on the map in Fig. 1. The choice of sites was partly governed by the distribution of infected trees and partly by the nature of the topography. As seen in Fig. 1 a narrow north-south valley dominates the eastern side of the area, while the west is more open. In the centre and extreme east and west the ground rises above 6,800 ft. (1873 metres). The observations were made simultaneously at each site at 15 minute intervals at a height of 2 metres. This height was selected since pineus infestations seemed to occur initially in the lower branches of the windward sides of

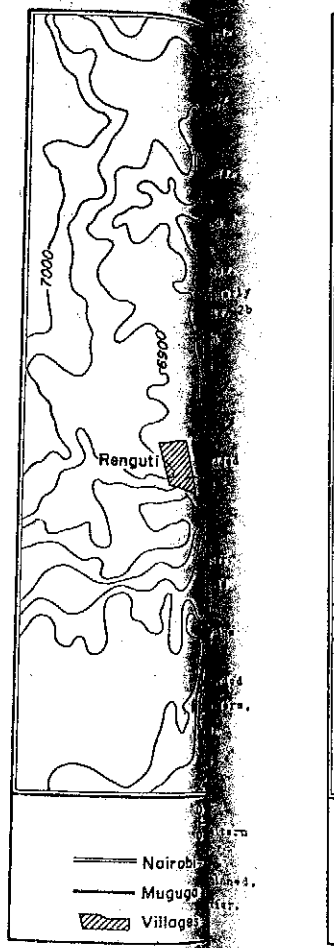
trees. The period of observation for most sites was from 1000 to 1700 hours. After the data had been collected it was mapped for each time interval, to give an indication of the wind field. Two basic patterns emerged from the 1969 data. These are described in figs. 2(a) and 2(b). Minor variations of up to 22½ degrees did occur at sites within the time periods described.

The morning pattern was dominated by easterly and north-easterly winds. The only exception to this was site 1 where the wind tended to follow the contour across the valley shoulder and along the valley side. A tall stand of eucalyptus situated in the loop of the Muguga road (fig.1) appeared to deflect this airflow across the valley where it became a north-easterly flow, similar to the rest of the area. This pattern persisted ever after a southerly component dominated the air flow of the eastern valley after 1400 hrs. Fig. 2b shows that this new pattern was only recorded in sites within the northern section of the valley. The more open sites, including the meteorological station, experienced no change.

In 1970, these patterns were tested on two occasions when similar general weather conditions prevailed in the area. Seven new sites were added to the observation network, four of them further to the north of the 1969 study area. The change in wind direction during the afternoon was again noted. But this change was not observed at the new northerly stations. Fig. 3 shows the afternoon airflow between 1500 and 1600 hrs., for November 7th (this was almost identical to that of November 2nd when the airflow was also studied). South of Ngoriundito in the eastern valley wind direction was consistently south-easterly. Where the valley broadened slightly at the village itself considerable fluctuation occurred between S.E., and N.E., except to the west of the village where easterlies were consistently recorded in a small saddle. To the north, both within the valley and on its shoulders, air flow was consistently in harmony with the general N.E. regional flow. These four features of wind direction appeared to be persistent from approximately 1430 to 1700 hrs.

One further feature of interest concerns site 2. The afternoon pattern on both occasions in 1970 differed from that recorded in the 1969 survey. Between the two surveys the stand of eucalyptus had been considerably thinned, sufficiently it seems, to eliminate the deflection effect mentioned earlier.

In the 1970 survey air temperatures were measured using a whirling psychrometer. Again, a distinct pattern emerged. Table 1 shows that the sites with the greatest fluctuation in wind direction (and lowest wind speeds) - in the central zone of the valley - experienced the highest temperatures. The temperatures for 1600 hrs. in this table were approximately the maximum temperatures for the day.

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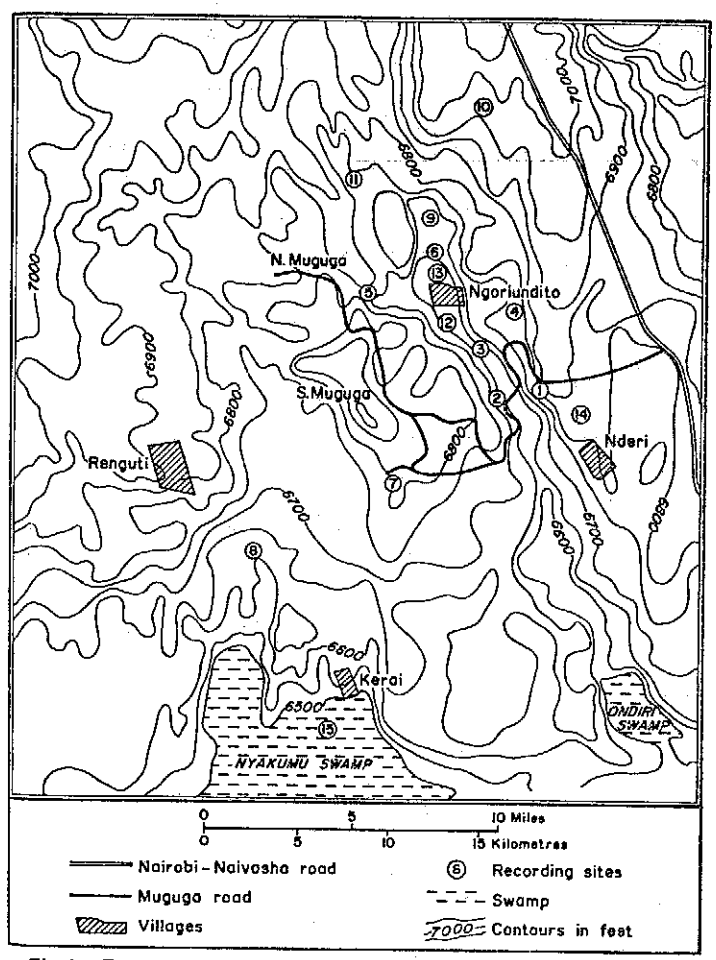


Fig. 1 The distribution of observation sites in the Muguga area

Discussion

The higher afternoon temperatures around Ngoriundito are probably the major factor producing the afternoon wind veer in the valley, the higher temperatures setting up a movement of air towards Ngoriundito and the valley

above it. A measure of shelter from the prevailing easterly winds is provided by the valley sides; thus permitting the establishment of a different flow within the valley and beneath the prevailing wind. Since the valley widens in the vicinity of the village the valley airstream will diverge, until this airstream which is ascending the valley meets the descending air from further

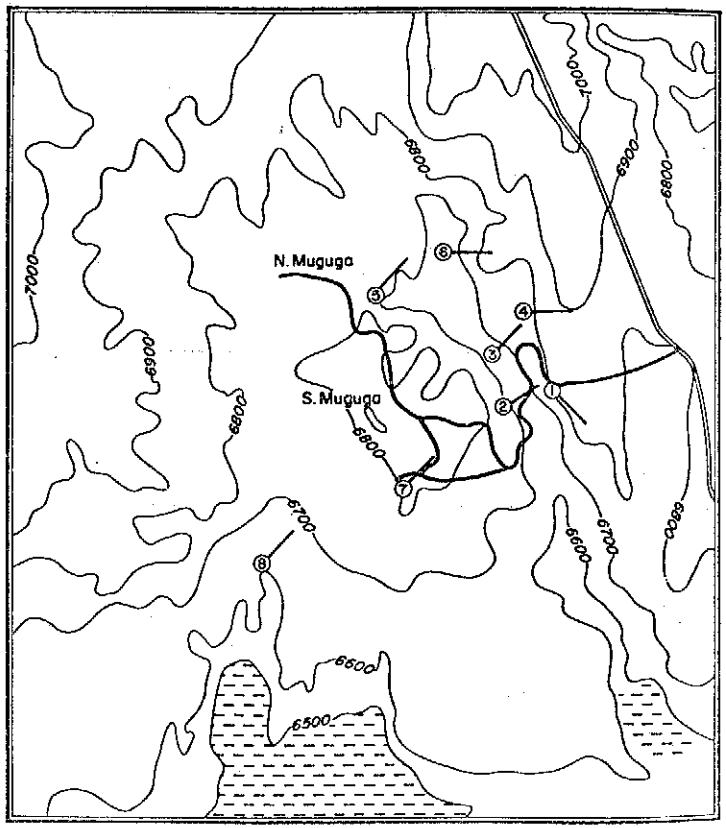


Fig. 2(a) Wind direction at Muguga, 1969 study, 12.00 hrs. E.A.S.T.

up the valley. The resultant local convergence appears to produce an easterly movement over the coll on the Muguga side of the valley. The alternating dominance of the north and south currents is reflected in the wide variation in wind direction near to Ngoriundito village.

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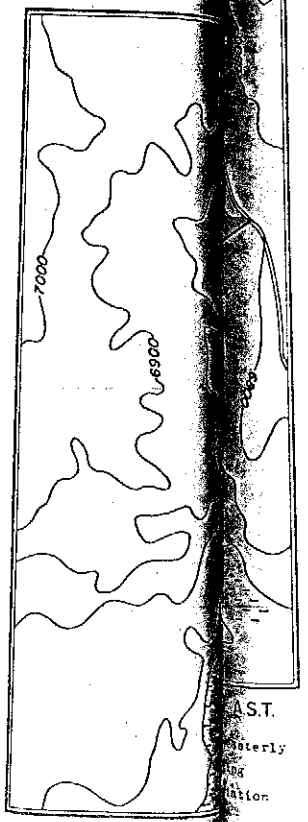


Fig. 2(b) Wind dire…



The significance of this local wind pattern, which had not been identified until the study was made, is illustrated by its role in the spread of pineus spp. This is a wind borne aphid. However, it had failed to spread to certain plantations in the Muguga area up to the end of 1969, e.g., a plantation in the bottom of the valley, close to site 3. This was situated on the northern flank of the eucalyptus stand to which reference has already been made. After the latter was thinned and the wind pattern changed the aphid infested the plantation. There are also known cases of the aphid being transported to a

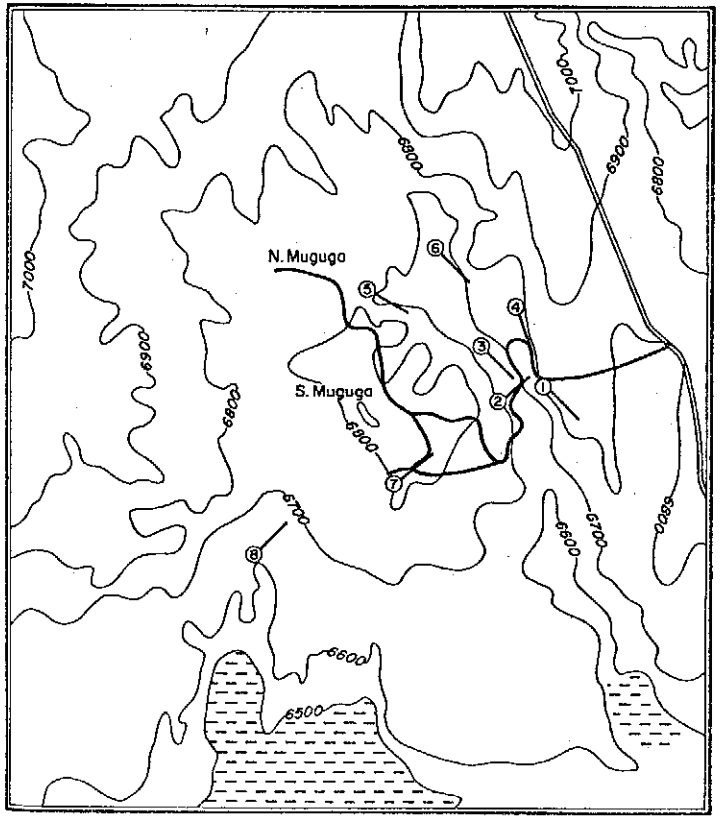


Fig. 2(b) Wind direction at Muguga, 1969 study, 15.00 hrs. E.A.S.T.

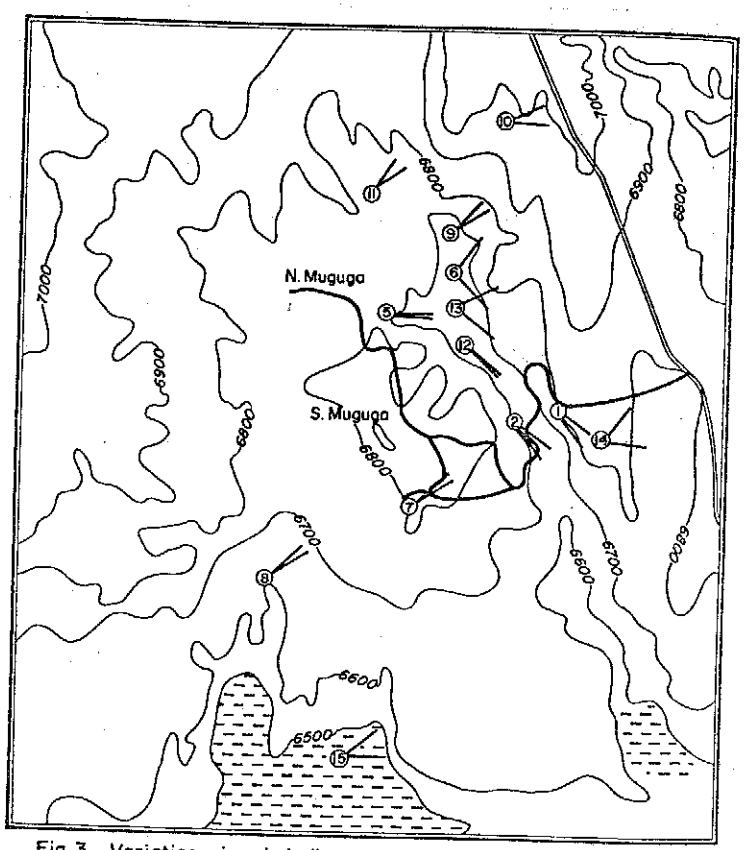


Fig. 3 Variations in wind direction 14.00-15.00 hrs, Nov. 7 1970

plantation by man. It may or may not be significant that a village is located at the centre of what was the most infected area and at the point of local convergence of valley airstreams which provide a major transport mechanism for the aphid.

1. Ojany, F.F. (1966) 'The physique of Kenya: a contribution in landscape analysis.' A.A.A.G. Vol.56, No.2, pp. 183-196.

2. Brown, K.W.

3. Data collecte

In studying th importance to estima suppliers. The patt extent of the trade a distinct hierarchical centres are dependent the same time Marshall of a set of centres i centres with regard to that the spatial link achieved.

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Figure 1 indicates centres. The hierarchical procedures. It is evident to those places which have associated with Mbale. It District as such but lies



2. Brown, K.W. (1970) 'Tests of insecticides against pineus spp., in East Africa.' E.A.A.A.F.J. Vol. XXXVI No. 2, pp.200-201.

3. Data collected by the Army Worm Division, E.A.A.F.R.O.

## Patterns of spatial linkage in Teso District

Donald Funnell

In studying the spatial organization of retail outlets it is of particular importance to estimate the relationships between any given enterprise and its suppliers. The pattern of dependence thus found also assists in demarcating the extent of the trade area of suppliers. According to central place theory, a distinct hierarchical pattern of dominance should be found whereby the lowest centres are dependent upon the suppliers in the next highest level for goods. At the same time Marshall[1] has pointed out that a prerequisite for adequate analysis of a set of centres is the provision that this set comprises the total system of centres with regard to a pre-determined highest order place. This then requires that the spatial linkages should be determined, and closure of the system of places achieved.

In the course of a wider survey of retail and service provision in Teso District, Eastern Uganda,[2] an attempt was made to build up a pattern of spatial linkages between the centres studied. Each enterprise visited was asked to rank the places supplying its goods in order of importance. To facilitate data analysis, six alternatives were presented: Kampala, Jinja, Mbale, Soroti, External (direct import) and Local (to be specified). The data are presented in Table 1. The replies for each establishment were aggregated to produce an overall ranking for the centre as a whole. Unfortunately there were often considerable discrepancies between the numbers of actual replies received for each place. These did not necessarily relate to the number of establishments in a place, so that the results may have to be carefully considered. Some of the linkages are based upon only a few replies. The distortion caused by this is difficult to assess. It may be that the pattern of primary (most important) linkage is not much affected but other linkages may be misleading.

Figure 1 indicates the major suppliers (primary linkage) of second order centres. The hierarchical organisation has been determined elsewhere[3] by grouping procedures. It is evident that there is a basic division between the centres as to those places which have their major contacts with Soroti and those more closely associated with Mbale. It should be pointed out that Mbale is outside Teso District as such but lies only a few miles to the south. With the exception of