V. DISCUSSION

Most of the salting on agricultural land within the region is activated by seepage of rainwater or of water from earthen channels. Reduction of seepage from channels is an engineering rather than an agronomic problem, and is not discussed further here. Control is being investigated by the State Rivers and Water Supply Commission.

The most hazardous land for seepage of rainwater is that containing E-W dunes, and these are dominant land forms on approximately 6,000 square miles of cleared country within the 15,000-square-mile region (see map). Sufficient data are available to understand the broad dynamics of salting in such landscapes.

The dynamics of salting – Almost all rain falling on dunes infiltrates and penetration is relatively deep because of the low water-holding capacity, particularly on the southern slopes where the upper horizons of sand texture are deep and the underlying more compact layers are of relatively light texture. There are no records of soluble salt contents deep within cleared dunes, but the chloride values in the upper part of the compact layers shown in Table 2 attest to the considerable ability of the native vegetation to minimise seepage. Under mallees it is likely that seepage water left the dunes only during prolonged heavy rains, and that it moved mainly in an upper sandy layer (layer *b*) after salts had been leached to less permeable layers below.

Seepage has increased since clearing of the native vegetation because of the slower evapotranspiration and shallower rooting of crops and pastures on dunes, combined with the practice of fallowing designed to accumulate moisture (Table 6). The salinity of flats has increased, the degree depending on the amount of seepage water received, its content of salts, and the extent to which salts are retained in the soils through transpiration or evaporation before percolating to groundwaters. The practice of fallowing and the use of shallow and medium-rooted agricultural species on the flats encourages deep percolation, and this is further promoted by declining ability of roots to extract moisture because of increasing salinity.

The development of saltpans – Saltpans have developed since settlement on only a small proportion of the region at sites where evaporation has occurred from shallow water tables. In the 6,000 square miles of cleared E-W dune country about 2,000 square miles consists of sites topographically suitable for the accumulation of seepage water, that is interdune flats and broad plains situated on swales between N-S ridges. Up until 1963-64 less than one per cent of these 2,000 square miles had developed saltpans, some 3,000 acres being affected at the base of dunes and 6,000 acres on broad plains.

Groundwaters as distinct from soil waters promote salting on broad plains, and waters from both sources are frequently involved at the base of the dunes. In the centre most saltpans occur in regionally low areas where the depth to groundwater was shallow before settlement.

In the south such shallow groundwaters did not occur before settlement, as evidenced by the lack of halophytic native vegetation in the lowest parts of landscapes, except possibly around Lake Hindmarsh, and the development of saltpans has undergone two phases. In the first, only soil water were involved, and damage was concentrated in several N.N.W-S.S.E elongated areas where the oldest aeolian clay layer appears to have been of particularly low permeability. Even though damage is spreading rapidly in the relatively moist south, two-fifths of the pans had remained static between 1946 and 1963 (Table 3). At these sites expansion appears to have been limited by the volume of water available from the dunes. The size of these static pans is likely to have been reached during unusually wet years prior to 1946, and a perusal of yearly rainfall totals suggests a likely wet period to have been the years 1915 to 1917. It is interesting to note that the static pans did not enlarge during the 1950's in which there was several wet years, including the particularly wet year 1956.

The potential for expansion of many of these static pans cannot be rated as slight, however, because a second stage is now developing, involving rising groundwaters. Topographic and field evidence of this is supported by the data in Table 3 in which it can be seen that the pans which did enlarge between 1946 and 1963 were the larger ones, suggesting volumes of water greater than could be provided by dunes. The relatively large saltpans developing on broad plains are more evenly spread than those at the base of dunes, and are not confined to areas with dense dunes.

Regional observations on the placement and movement of groundwaters are urgently needed to assess the salting hazard on low plains.

Undetected deterioration – Seepage from dunes is general but the development of saltpans is sporadic, being related to the occurrence of groundwaters or relatively impermeable clays unusually close to the surface. This raises the question of the extent to which production has declined through increasing salinity of subsoils beneath interdune flats.

Being shallow-rooted, the pastures in general use on flats are not noticeably affected, for example as at sites 11 and 12 where salinity was high beyond a depth of 2 feet. Under crops, indication of increasing salinity may be masked by receival of relatively fresh seepage water.

Cross-sectional sampling of interdune flats is required on farms and in timbered reserves to assess the deterioration of subsoils in various parts of the region.

Prevention – Full reclamation of saline soils is not possible because of the limited penetration of scant rainfall, low permeability at depth and the tendency for plants to maintain salinity at their limits of tolerance.

Seepage must be minimised by drying out the dunes with deep-rooted species. More radical changes in land use are required in districts with numerous saltpans where vegetation must be retained in low sites to limit evaporation. At present bare fallows are prepared even around expanding saltpans. Where rising groundwaters are causing damage the stage has been reached where soils on all parts of the landscape need drying out to a depth of many feet on a district rather than a farm basis.

At present heavy reliance will have to be placed on lucerne which is the only deep-rooted agricultural species of proven ability to produce well on the dunes and to dry them out. If well topdressed with superphosphate lucerne thrives on the dunes until they are dried out to great depth. It also grows well on ridges and hummocks, but not so well in the lower, more saline positions in spite of its moderate tolerance of salinity. Fortunately suitable highly tolerant grasses with a moderate depth of rooting such as *Agropyron* spp. and *Puccinellia* spp. are becoming available (Zallar, priv. Comm.), although there are difficulties with establishment in relatively dry years.

Soil Conservation – It is difficult to farm without waste or deterioration in this semi-arid region, particularly on undulating landscapes.

At present soil conservation practices are designed mainly to prevent wind erosion, and this can be achieved effectively only by keeping a cover on the land at all times.

It is evident that, even in the historically short period since settlement, salting has become an even more serious problem in many districts where not only a permanent cover is required, but a deep rooted cover. To combat salting there is a need to return more closely to the conditions afforded by the native vegetation.