III. INCIDENCE OF SALINE SURFACES

All saline surfaces which could be detected on aerial photographs taken in 1963-64 are shown on the map (see back cover). Interpretation of patterns was supplemented by examination of photographs taken in the 1940's by inspection from a light aircraft, by field checking in the south where patterns on gilgaied clay plains are difficult to interpret, and by the comments of officers of the Soil Conservation Authority stationed in the region.

Recent aerial photographs could not be obtained for the Millewa settlement in the north, and here detection was confined to noting the approximate location of saltpans along the central part of the settlement from the air in June, 1966.

Saline surfaces were classified according to situation as follows :

Saltpans at the base of E-W dunes.
Saltpans beside channels.
Saltpans on broad plains.
Saline surface on red clay plains (not localised in pans).

The surfaces of saltpans which develop on agricultural land set hard on drying, and lose strength markedly on wetting. In paddocks under pasture, affected sites are bare or partially covered by salt-tolerant species such as curly ryegrass (*Parapholis incurva* L), Mediterranean barley grass (*Hordeum hystrix* Roth), sandspurry (*Spergularia rubra* L) and small saltbushes (*Atriplex* spp.). Saltpans are usually cultivated and sown to cereals when the paddocks are cropped, but little or no crop is harvested from them. Germination occurs after good autumn rains, except perhaps in the lowest parts, but the cereals die back progressively towards the margins with the onset of moisture stress in spring. Only rarely is special treatment given in an attempt at reclamation.

The smallest pans recognisable on the photographs covered 0.2 acre, and only areas which included bare ground were mapped, many dark patterns suggestive of incipient surface salinity being excluded. In addition, the areas of pans with indistinct outlines were estimated conservatively. The greatest source of error in detecting pans and estimating their areas was caused by bare fallowing which masks the patterns. Even with ground inspection it may be difficult to see that a fallowed surface is saline.

The surfaces mapped in the above four situations are permanently saline except possibly for brief periods after rains. Other surfaces may become temporarily saline in dry seasons, particularly on the puffs of gilgaied clays which are inherently saline at shallow depth (Table 2). Gilgaied clays are the dominant soils on broad, heavily-cropped plains in the south, and the surfaces on the puffs sometimes become sealed, hindering germination and growth. Although no analyses have been reported, the likely cause is temporary salinisation of surfaces which results in a more permanent rise in the proportion of sodium on the exchange complex. The deterioration in structure of surfaces in similar situations in the Wimmera was mentioned by Sims and Rooney (1965) in commenting on the recent widespread use of gypsum on heavy plains.

Saltpans at the base of E-W dunes.

These are the most numerous saltpans, and they occur most commonly along flats beside E-W dunes situated on swales between N-S ridges. They are also found beside E-W dunes situated on swales between N-S ridges. They are also found beside dunes located well up the ridges, and on the lower slopes of dunes above the break in slope. The distribution relative to land forms in the southern part of the Hopetoun land system (Rowan and Downes 1963) in shown in Fig.1. Saltpans are found in similar situations further north in the Central Mallee, Tempy and Millewa land systems where landscapes are similar but for a stronger development of dunes.

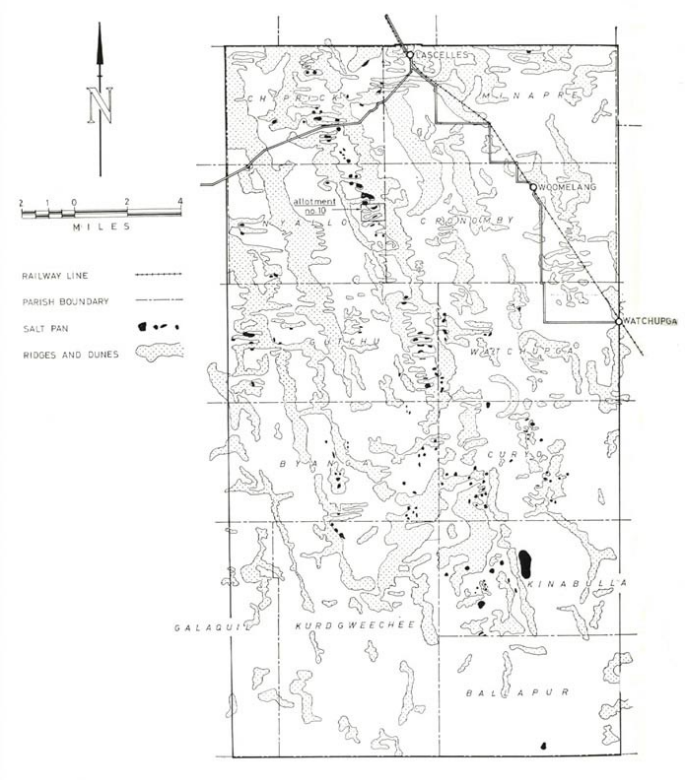

Fig.1. Example of location of saltpans relative to E-W dunes and N-S ridges, depicted following stereoscopic interpretation. E-W dunes are more numerous than shown, and only the larger dunes on plains are shown. Saltpans beside channels are not shown. Most of the saltpans are associated with seepage from E-W dunes, but those well away from dune or plains are associated with rising groundwaters.

Over 900 pans were detected at the base of dunes with an aggregated area of 3,110 acres and an average of 3.3 acres. An aerial check showed that three-quarters of the pans along the line of flight had been detected, and on this basis it is estimated that the total area affected was approximately 4,000 acres in 1963-64.

Saltpans at the bases of E-W dunes are scattered throughout the cleared parts of the region, except in the south-east where the dunes are rare. Relatively few pans and found in the north, and in the centre and south the distribution is irregular, with several severely-affected areas. The most notable of these is a strip of land extending S.S.E from Lascelles for some 40 miles whilst others with the same trend occur to the east of Rainbow and to the north of Danyo. There are also several non-elongated areas with numerous saltpans, the most notable occurring along the southern part of the Ouyen-Murrayville settlement and around the margins of the Big Desert.

Plate 2 - Three saltpans at the base of E-W dunes, east of Ouyen.

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From a study of aerial photographs it is evident that saltpans are associated with seepage from the dunes, and that important factors affecting the incidence are the frequency of dunes, declining rainfall from south to north, vegetative cover on the dunes and height above sea level. The effect of vegetative cover on the dunes can best be seen where numerous saltpans occur around the cleared margins of the Big Desert. Here desert sandhills overlap clays of the Woorinen Formation, and it has been particularly difficult to maintain vegetation on the infertile sands. As regards height above sea level it can be seen that the non-elongated areas with numerous saltpans along the Ouyen-Murrayville settlement occur in regionally low areas near large naturally saline plains from which regional groundwaters have evaporated in recent times. It would seem that deep percolation of seepage water from E-W dunes near these plains has been hindered by relatively shallow depth to regional groundwater.

There must be additional factors to explain the occurrence of numerous saltpans in the abovementioned N.N.W-S.S.E strips of land because these do not occur in regionally low areas. Indeed the saltpans to the south of Lascelles occur on ridges as well as inter-ridge swales, and those to the east of Rainbow are confined to a ridge. The most plausible explanation is that Pliocene-Pleistocene streams in the swales between N-S ridges were relatively saline in these localities, and that salts were blown up to adjacent ridges. Subsequent climates have been pluvial and most of these salts would have been removed from the soils, but they could have modified the soils in some way, rendering landscapes prone to salting.

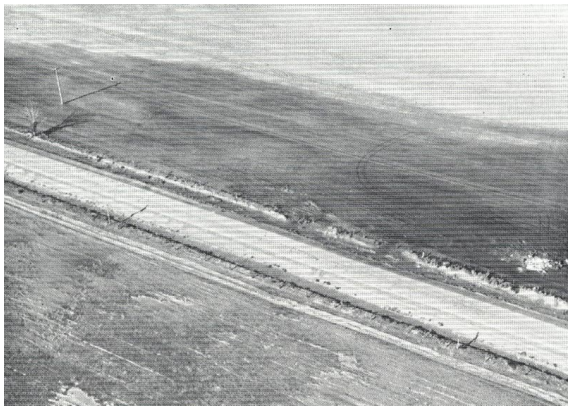

Plate 3 - Saltpan on interdune flat crossed by Woomelang-Hopetoun Road. Background – lower northern slopes of E-W dune on Allot 10, Parish Nyallo. Middle – saltpan obscured by bare fallow (Site I). Foreground – saltpan with alternate patches of bare ground and salt-tolerant pasture.

An estimate of the spread of saltpans beside dunes was made by comparing sites on aerial photographs taken in 1946 and 1963. This is a tedious procedure because most saltpans do not have clear outlines on both photographs, and it is frequently not possible to be sure that a pan present in 1963 was absent in 1946. However, sufficient sites were obtained for comparison, and it can be seen in Table 3 that the affected area at the sites examined in the south had doubled over the 17 years, and that the increase by development of new pans was slightly higher than by enlargement of old ones. Two-fifths of the pans present in 1946 had remained static, ranging in size from 0.6 to 12.4 acres. It is significant that pans which had enlarged were invariably large in 1963, and this point is discussed in the final chapter.

Along the Ouyen-Murrayville settlement the increase in area had been less than one-third, and three-quarters of the pans had remained static. Only one pan in six on the 1963 photos was new.

Saltpans beside channels

Reticulated water contributes to seepage water accumulating beneath saltpans beside channels, on plains or on any undulating land forms crossed by the stock and domestic water supply scheme. In this scheme water is delivered via several thousand miles of earthen channels serving most districts except those to the west of Underbool.

Pans are relatively common beside the main channels which run N-S in the south and E-W eastwards from Ouyen, and they are also relatively frequent within the N.N.W-S.S.E elongated areas severely affected by salting at the base of the dunes.

On the 1963-64 aerial photographs 416 sites were detected, with a total area of 2,180 acres, averaging 5.2 acres. Again this is an underestimate because of masking by cultivation, and the area affected is likely to be at least 3,000 acres. A comparison of aerial photographs indicated relatively little expansion between 1946 and 1963.

Table 3 – Acreage of 82 saltpans in 1963 versus 1946 in the southern and central parts of the region.

–	South (50 pans)*					Centre (32 pans) **				
	Enlarged (11)			New (20)	Static (19)	Enlarged (3)			New (5)	Static (24)
	1946	1963	Increase	1963	'46 & '63	1946	1963	Increase	1963	'46 & '63
	8.1	19.2	11.1	1.7	6.2	3.7	21.8	18.1	14.0	6.8
	5.0	6.5	1.5	0.6	4.3	8.7	10.9	2.2	11.3	1.9
	2.5	15.7	13.2	2.1	3.1	1.9	7.0	5.1	4.8	3.1
	3.1	5.7	2.6	1.7	6.2				3.0	1.2
	6.2	7.0	0.8	2.6	3.1				3.9	2.5
	3.1	8.7	5.6	2.2	4.3					1.2
	11.8	19.2	7.4	12.2	3.1					7.4
	5.0	25.3	20.3	16.6	1.2					3.7
	9.9	14.0	4.1	6.1	0.6					21.7
	3.1	6.5	3.4	1.7	9.9					5.6
	1.9	8.3	6.4	1.7	11.2					14.9
				11.3	8.1					8.7
				3.9	6.2					22.9
				1.7	5.6					3.1
				0.9	1.9					4.3
				0.6	12.4					10.5
				7.4	3.1					8.1
				3.0	8.7					6.8
				5.2	2.5					2.5
				2.2						21.1
										7.4
										14.3
										11.2
										8.7
Total	59.7	136.1	76.4	85.4	101.7	14.3	39.7	25.4	37.0	199.6
Average	5.4	12.4	7.0	4.27	5.4	4.8	13.2	8.5	7.4	8.2
Range			0.8-20.3	0.6-16.6	0.6-12.4			2.2-18.1	3.0-14.0	1.2-22.9
	Total area in 1963 323 acres " " " 1946 161 " Increase 162 " (100 per cent)					Total area in 1963 276 acres " " " 1946 214 " Increase 62 " (29 per cent)				

* Parishes of Gutyu, Byanga, Curyo, Wirmbool, Pullut, Carori, Nyallo, Chiprick.
** Parishes of Bunuruouk, Daalko, Boinka, Duddo, Ouyen, Woornack.

Plate 4 - Crushed surface under failed wheat crop on saltpan beside an E-W dune. Note dark organic stains to the left and above matchbox. The main salt-tolerant grass is Mediterranean barley grass.

Saltpans on broad plains

In the central and northern parts of the region there are several large basins at elevations less than 200 feet above sea level, in which regional groundwaters evaporated before settlement (Lawrence 1966). Bare saltpans predominate in some basins, for example the Tyrell basin near Sea Lake, whilst in others most parts are vegetated. Species range from the highly salt-tolerant samphire through bladder saltbush (*Atriplex vesicaria* Heward ex Benth) and bluebush (*Kochia pyramidata* Benth) to dense mallee scrub, indicating that the surfaces may be non saline but variably prone to salting upon disturbance. Low mounds containing powdered gypsum (copi) are interspersed on the plains, most of which are held by the Crown, totalling 154,000 acres. Saline surfaces have spread widely, as evidenced by the replacement of species such as bluebush or saltbush by samphire, and by the death of mallees (usually *E. gracilis*). In several localities saline surfaces have spread beyond the plains to adjacent cropping land. Much of the degeneration has undoubtedly been caused by cultivation and overgrazing and by seepage of soil waters from adjacent cleared land.

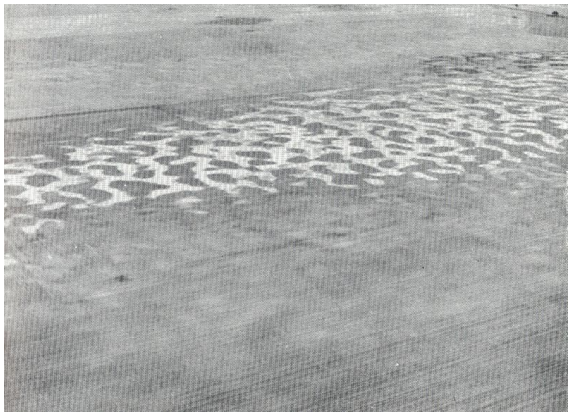

Plate 5 - Large saltpan in south associated with rising groundwaters. The soil is gilgaied clay, and the mounds are bare. Note masking of salting pattern by cultivation on near side of pan.

There are also many small depressions recognisable as the beds of former lakes by the presence of lunettes to the east. One of these can be seen in Fig.1 on the southern boundary of the Parish of Watchupga. Many of these former lake beds have become saline at the surface following clearing, particularly those clustered about the larger saline plains in regionally low basins. On the 1963 aerial photographs 121 saltpans were detected totalling 4,660 acres and averaging 39 acres, and considerable expansion since 1946 was noted.

Saltpans on broad plains without lunettes to the east have also developed since settlement in the centre and south. Sixty-four such pans were noted on the aerial photographs, totalling 990 acres and averaging 15.4 acres. In the centre these pans again occur near regionally low, large plains where regional groundwaters have evaporated. In the south they occur in locally low parts of swales between N-S ridges, and tend to be circular in outline or broadly elongated north-south. Their topographic situation, large size (up to 180 acres) and the fact that E-W dunes and channels are well distant or absent indicate that deterioration is associated with rising groundwater as distinct from soil water. These waters were observed beside the Henty Highway on Allot 28, Parish of Chiprick, where a catchment dam permanently contains saline water (see Table 5, next chapter). Inspection of aerial photographs shows that surfaces were not saline in 1946 but in 1963 the dam was surrounded by a 6-acre saltpan.

Plate 6 - Groundwater saltpan expanding and being colonised by samphire, east of Ouyen.

Saline surfaces on red clay plains

Saline surfaces beyond the influence of seepage from undulating land forms and not affected by groundwater occur on broad red clay plains from which shallow loamy topsoils have been removed by erosion. The original soils were red brown earths which were relatively saline at shallow depth before clearing (Rowan and Downes 1963). The high salinity relative to other soils in the Mystic Park district has been noted by Skene and Sargeant (1966).

In the south, scalded red clays occur beside the few creeks slightly above flood level. Here only occasional patches of the original loamy surfaces remain, and almost the entire area hatchured on the map (59,000 acres) is likely to be saline at the surface. In the north the scalded plains are mixed with other land-forms, and would occupy less than one-quarter of the hatchured area which covers 400,000 acres.

Being somewhat saline and heavy, the red clays have unsatisfactory moisture characteristics under the semi-arid climate, and are not regarded as cropping soils. However, in the relatively moist south reasonable crops can be obtained in years of favourable rainfall, particularly when gypsum is applied. Aspects of reclamation near Mystic Park and Ned's Corner have been discussed by Cope (1958) and by Mitchell and Farrington (1966).