tail or some way down, the outlets above will draw off most of the extra supply.

As regards *(a)* it may be stated that if reclamation is undertaken at an early stage of the formation of thur very small additional supplies may be necessary for the existing thur areas and for the prevention of the formation of thur in other areas.

As regards *(b)* it will be necessary to introduce rigid modules, such as the Gibb Outlet, above the area to be reclaimed.

With the increase of thur the intensity of *rabi* cropping on the rest of the area has been increased by the zemindars. This practice probably continues for a number of years before any attempt at reclamation is made. When, however, land is reclaimed on an extra water supply in the *kharif*, difficulties have some times been experienced in getting back from the zemindars the *rabi* supply allotted for the area that had gone thur. As the result of earlier experiments the growing of *berseem* and *senji* following rice has been recommended. Attempts are now being made to substitute gram after rice, gram being sown on *wadh-wattar* and with normal winter rains matured as *barani* crop. It is, therefore, possible that the difficulty of the *rabi* water supply for the growth of a leguminous crop may be overcome.

It will be of interest to examine the conditions with regard to water supply and cultivation on a holding in which deterioration due to thur formation is taking place. Take for example, the tract near Jaranwala where deterioration is taking place at a fairly rapid rate. The average intensity in this area is 106%, *i. e.*, 42 in *kharif* and 64 in *rabi*. If 20 per cent. of land goes out of cultivation then water for at least 12 acres per every 100 acres block in the *rabi* remains available with the zemindars for the cultivation of *rabi* crops. Government could, therefore, supply water for the cultivation of rice on an area of 12 acres total which if the two varieties of rice are grown would be six acres each. During *rabi* water would be available for the growth of 6 acres of wheat and for 6 acres of *berseem* or other leguminous crops.

In the following table, assuming an intensity of 100 per cent, is shown *rabi* water available per 100 acre block for different percentages of deterioration assuming the *kharif* — *rabi* ratio of 1 : 2.

Deterioration	Area under reclamation for which water is available in the *rabi* for growing wheat and leguminous crops.
10%	6 acres
20%	13 acres
30%	20 acres
40%	26 acres
50%	34 acres

Complaints of the deterioration of land are received as a rule when the damage exceeds 10 per cent. of a holding.

The leaching of thur land and the planting of the 'Sathra' variety of rice comes on at a time when the zemindars are busy with the harvesting of the wheat crop. In big landlords' estates this difficulty has been overcome by employing outside labour for the transplanting of rice. At Sukheki, however, all ploughing and most of the transplanting was done by the zemindars in spite of the fact that the harvesting of wheat was also in progress. It is always advisable to employ paid labour for the night and day irrigation of fields.

There have been instances where reclamation has been attempted by landlords with the help of their tenants. In such cases unless liberal concessions are allowed the tenants do the work very unwillingly and make reclamation less successful.

In the case of the absentee landlord, our experience has been that their agents take but very little interest in reclamation in the first year or so. When, however, they see the crops growing in the land, formerly thur, they begin to follow seriously the instructions issued.

If reclamation is undertaken in villages where large areas of crown waste have become thur and where no field bunds exist the run-off from this thur land into areas under reclamation interferes with the progress of reclama-

tion. For the prevention of run-off from such areas entering into areas under reclamation it is necessary to dig surface field drains and connect them with the main drain. The programme of the construction of branch drains, therefore, needs to be hastened.

8. Water Requirements during the Process of Reclamation.

In the Punjab, for leaching and for the growth of the first rice crop a depth of 5 to 5·5 ft. of water appears ample. In terms of area, approximately 50 acres of 'Thur' land can be put under reclamation on one cusec of water. The introduction of the 'Sathra' variety which has enabled two rice crops to be grown on the same water supply has resulted in considerable savings being made in the amount of water used.

In soils whose salt content is high and the degree of alkalisation low leaching is very rapid. Water, therefore, cannot stand in the rice fields and consequently the yields of rice are low. Although reclamation is more readily affected under these conditions, the low yield of rice reduces the profit on reclamation. Further, the amount of water used under these conditions is considerably in excess of that required for reclamation and is, therefore, wasted from the reclamation point of view. In order to obtain normal yields of rice under these conditions and to limit the amount of water used to that required for the actual removal of salts, the *barani* hill varieties of rice have been introduced. These *barani* varieties of hill rice are grown in the Kulu Valley where, naturally, they receive only intermittent irrigation in the form of rain which quickly drains off. As conditions in land under reclamation where leaching is very rapid are similar to those of the *barani* areas of the hills it was expected that these varieties would be successful during reclamation. An experiment in this direction was carried out at the Chakanwali Reclamation Farm where the yield of hill rice under intermittent irrigation was approximately 35 maunds per acre.

At Renala these hill varieties made very successful growth with a total irrigation of only 33 inches but on account of the severe attack of the borer it was not possible to obtain the yields which might be expected.

9. Prevention of the Formation of Thur at the Soil Surface.

Two types of areas have to be considered, *viz.*, new project areas where irrigation is introduced for the first time and the areas already irrigated where the salt bearing layer of soil lies at some depth below the surface.

In the case of the new project areas, if a soil survey indicates that a salt bearing layer is present within the top 10 feet of the soil crust, it is advisable to start with rice irrigation until the salts are removed to the water-table or are depressed to a depth lower than 10 feet from the surface. This presents little difficulty as, in the beginning of the development of a new project area, ample supplies of water are available.

In the past, in considering the financial aspects of new project areas, no account has been taken of the deterioration of land that takes place as a result of the introduction of irrigation. Some idea of the heavy losses involved can be obtained from the fact that in the Rechna, Chhaj and Bari Doabs approximately 5 lakhs of acres have already gone out of cultivation and the present rate of deterioration is 25,000 acres per annum. Capitalised at the rate of Rs. 200/– an acre land worth Rs. 10 crores has already been lost. Further loss is taking place at the rate of approximately half a crore of rupees every year. If soil surveys are carried out before the development of any new project is taken in hand and danger areas are marked it is possible to avoid such heavy losses by the adoption, in the initial stages, of rice irrigation or what is correctly termed by Dr. McKenzie Taylor as the 'Basin System of Irrigation'. The main advantage of the basin system of irrigation is the washing of the salts to the underlying sand layers.

For areas already under cultivation the first step to be taken is to conduct a soil survey to examine if and at what depth the salt layer exists in the soil profile. If it is within 10 feet from the natural surface the land should be considered as a danger area where salts are likely to come up to the surface. Under these conditions efforts should be made to reduce the intensity of irrigation and

increase the delta. If on account of the increase in population and the uneconomic size of the holdings this step cannot be taken, the area should be considered for inclusion in a reclamation scheme and salt removed from the soil profile.

A subject which is now receiving considerable attention and which is very closely connected with the prevention of land deterioration is the water requirements of crops. The object of the Irrigation Branch, being a Revenue Department, is to secure the maximum out-turn of crop per cusec day of water. The experiments carried out in connection with the water requirements of crops have been made with the object of securing the maximum out-turn of crop per acre sown. In neither of these cases has any consideration been given to the relation between the irrigation load and the deterioration of soil due to the movement of salt to the surface. From the data presented in this paper it is clear that the greater the area upon which a given amount of water is spread, in order to mature crops such as cotton and wheat, the less will be the downward movement of salts. It is suggested, therefore, that in all future work on the water requirements of crops, while the maximum out-turn of crops per acre and maximum revenue per cusec of water should continue to be considered, a further point for examination should be the possibility of the deterioration of land due to salt accumulation on account of light irrigations. On account of the increase in rural population and the fragmentation of holdings a much larger area has to be cultivated now than formerly to support the family. As the water supply cannot increase to correspond with the increase in population, deterioration of land under the present system of agriculture must, therefore, be inevitable where salt occurs in the soil crust.

The experiments on reclamation described in this paper have shown that salt can be removed from the soil crust by the growth of rice and that the reclaimed land can produce excellent crops of cotton, wheat, sugarcane, etc., for a period of 8 years without showing signs of deterioration. It is suggested, therefore, that the agricul-

tural system of deteriorated and danger areas should be altered temporarily so that rice can be included in the rotation. The evidence at present available shows that the introduction of rice should not be necessary more than once in 9 years and possibly for a much longer period. The difficulties in the introduction of rice into areas now under perennial irrigation have been described. If either new *kharif* channels can be specially constructed or the present ones enlarged to carry increased summer supplies as a temporary measure then a remedy for deterioration becomes available.

10. General.

The main object of this paper has been to discuss the problem of salt in soils with reference to land deterioration as it affects the Government revenue and the zemindar's income.

The effects of the presence of salts in soils on the metal pylons and the underground cables laid in thur lands and the effect of salt laden dust on the alluminium-steel core cables are problems which concern the Hydro-Electric Branch most vitally. At certain seasons of the year the atmosphere may be laden with salt bearing material which may have a similar effect on the corrosion of metals as the atmosphere in coastal regions.

The attack of salts in the soil, particularly sodium sulphate, on the foundations and brickwork of bridges and buildings is a problem in which probably all branches of engineering are interested. Some of these problems have been under investigation in the Irrigation Research Institute.

In all areas taken up for reclamation since 1930 it has been observed that the yields of crops on reclaimed land are higher than those of the adjoining lands still growing normal crops. No experiments have been made to ascertain directly if the quality of the food produced on reclaimed land is of greater nutritive value and disease resisting qualities than that grown before reclamation. A very large number of observations made by Doctors Lal and Shah (10) of the Punjab Public Health Department showed that, at Chakanwali as reclamation progressed the spleen index and the malaria decreased in the population at the farm in spite of an increase in the number of malarial

mosquitoes. This they ascribed to better feeding following the reclamation of thur and waterlogged land. Diseases are now mainly traced to malnutrition through faulty diet, which, in turn are due to the diseased condition of the soil. The progressive deterioration due to thur is one of the greatest ills of the Punjab soils and the time has come when the study of this problem should be the first concern of Government.

SUMMARY.

1. From the thur surveys carried out it is known that over 5 lakhs acres of cultivated land have become thur in the canal irrigated tracts of the province and that the rate of increase is approximately 25,000 acres per annum.

2. The factors operative in the formation of thur at the soil surface have been discussed. It has been shown that the upward movement of the zone of accumulation of salts in the soil crust due to lighter irrigations than formerly is at least partially responsible for the accumulation of salts at the soil surface.

3. The chemical reactions involved and the physical changes produced in the soil during the process of the deterioration of land have been described and it has been shown that the damage is attributable largely to the conversion of the anhydrous salt to the crystalline form under humid atmospheric conditions.

4. The methods for the reclamation of thur lands in different stages of deterioration have been given. Costs have been worked out. These indicate that reclamation is a paying proposition if it is taken up at an early stage of deterioration.

5. From the data obtained it has been shown that land once reclaimed has not evidenced any signs of deterioration for a period of seven years. The examination of soil profiles of reclaimed land indicates that a return to the deteriorated condition is unlikely.

6. Suggestions have been made to modify temporarily the agricultural practice of the country so that further deterioration due to thur formation can be prevented. Methods for the prevention of deterioration in the case of new irrigation projects have been put forward.

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TABLE No. 1.

Summary of Results of Special Thur Girdawri December, 1938.

No.	Name of village and district.	Depth to water-table in feet.	Conditions regarding Thur.
1	Talab (Chiniot, Jhang) ...	9·0	Thur appearing.
2	Chak 570 (Jaranwala, Lyallpur) ...	10·0	Do
3	Mahranwala, 61 G. B. (Jaranwala, Lyallpur) ..	12·0	Do
4	Chak 559 G. B. (Jaranwala, Lyallpur) ...	12·5	Do
5	Chak 560 G. B. (Jaranwala, Lyallpur) ...	14·0	Do
6	Sarab Kalan and Naurang Di Jhugian (Nankana Sahib, Sheikhupura) ...	15·0	Do
7	Chak No. 126, G. B. (Jaranwala, Lyallpur). ...	16·0	Do
8	Kotla Sant Singh Wala Chak 43, R. B. (Sheikhupura). ...	18·0	Do
9	Chak 5 (Sheikhupura) ..	20·0	Do
10	Chak 11 G. B. Masanda and Lalke (Sheikhupura) ...	20·5	Do
11	Karyal Chak 17 G. B. (Sheikhupura)	21·0	No thur at the surface yet. Zone of accumulation or salts below the surface.
12	Chak 370 G. B. (Sheikhupura) ...	21·0	
13	Chak 126 J. B. Kokrian Da Chak (Chiniot, Jhang). ..	23·5	Thur appearing.
14	Chak 187 Baloana Jhumra (Lyallpur) ...	23·5	...
15	Chak 41 Marar Khurd (Sheikhupura)	23·5	Thur appearing.
16	Chak 110 Babewala (Lyallpur)	24·5	...
16 (*a*)	Kariwala Chak 49 R. B. (Sheikhupura) ...	25·5	...

No.	Name of village and district.	Depth to water-table in feet.	Conditions regarding Thur
17	Raipur, Chak 658 G.B. (Jaranwala, Lyallpur) ...	26·0	Thur appearing.
18	Chak 102 G.B. (Jaranwala, Lyallpur) ...	26·5	Do
19	Chak 84 R. B. (Sheikhupura) ...	27·0	...
20	Chak 103 G. B. (Jaranwala Lyallpur) ...	30·0	Thur appearing.
21	Chak Gerri, 189 R. B. (Jaranwala, Lyallpur) ...	35·0	Do
22	Khurarianwala Chak 266 R.B. (Jaranwala, Lyallpur) ...	37·0	Do
23	Phulaiwala, Chak 103 R. B. (Jaranwala, Lyallpur) ...	40·0	Do

TABLE No. 2.

Showing the yields of crops grown on Zemindari water supply in land reclaimed in Chak 188 N.B., Lower Jhelum Canal.

Field No.	*Rabi 1935-36*		*Kharif 1936*		*Rabi 1936—37*		*Kharif 1937*
	Crop.	Yield per acre in maunds.	Crop.	Yield per acre in maunds.	Crop.	Yield per acre in maunds.	Crop. Yield per acre in maunds.
1	Wheat	7·6	...	...	Turnips	160	... ...
2	Wheat	7·6	...	...	Wheat	19·5	... ...
3	Wheat	18·0	...	...	Gram	Failed	Maize sold at Rs. 64 per acre
4	Gram	19·1	...	...	Wheat	18·0	... ...
5	Wheat	14·0	...	...	*Toria*	9·3	Maize sold at Rs. 64 per acre.
6	*Berseem*	520·0	...	...	*Berseem*	960	... ...
7	Wheat	13·0	...	...	Wheat	16	... ...
8	*Berseem*	864·0	Cotton	12·1	*Berseem*	800	... ...
9	*Berseem*	748·0	Rice	17·3	*Berseem*	960	... ...
10	Wheat	13·4	...	...	Gram	Failed	Due to the attack of gram blight.
11	Wheat	11·0	...	...	Gram	Do.	
12	*Berseem*	480·0	Cotton	10·4	*Berseem*	800	
13	*Senji*	Ploughed in for preparation of sugarcane crop.	Sugarcane	76·0 (*Gur*)	...	...	Sugarcane sold at Rs. 240, per acre.
14	Wheat	19 5	...	...	...	...	Cotton 10·75
15	Gram	17·0	*Guara*	220	...	..	Sugarcane sold at Rs. 240 per acre.
16	Turnips	240·0	*Guara*	160	...	...	Cotton 9·75
17	Wheat	9·3	...	...	Wheat	18·7	... ...
18	Wheat	11·5	...	...	Gram	Failed	*Chari Guara* 320

Field No.	*Rabi 1935-36*		*Kharif 1936*		*Rabi 1936-37*		*Kharif 1937*	
	Crop.	Yield per acre in maunds.	Crop.	Yield per acre in maunds.	Crop.	Yield per acre in maunds.	Crop.	Yield per acre in maunds.
19	Wheat	20·6	...	...	*Toria*	11·0	...	...
20	*Senji*	160·0	*Chari Guara*	340	Wheat	5·5	...	...
21	*Berseem*	448·0	Cotton	12·0	...	...	...	...
22	Gram	18·3	...	...	Wheat	18·7	...	...
23	...	...	Melons	Failed	Wheat	14·5	...	...
24	Gram	12·5	...	...	Wheat	13·5	...	...

TABLE No. 3.

Data showing progress of reclamation in 187 N. B., Lower Jhelum Canal.

Crop.	*Kharif 1932*		*Kharif 1933*		*Kharif 1934*		*Kharif 1935.*		REMARKS.
	Area in acres.	Average yield of rice in maunds per acre.	Area in acres.	Average yield of rice in maunds per acre.	Area in acres.	Average yield of rice in maunds per acre.	Area in acres.	Average yield of rice in maunds per acre.	
Rice	66	1·0	65	16·5	41	15·0	30·5	13·5	Low yield of rice in 1935 is due to the introduction of finer varieties.
Cotton	8	...	6·0	...	17	...	25·0	...	
Millet	1	...	3·0	...	6	...	6·0	...	
Sugar-cane	...	...	2·0	...	1·2	...	12·0	...	

TABLE No. 4.

Statement showing probable expenditure for the reclamation of 1,000 acres of which 250 acres will be taken up every year.

	1st year 250 acres.	2nd year 500 acres.	3rd year 500 direct 250 tenants.	4th year 500 direct 500 tenants.	5th year 250 direct 700 tenants.	6th year 100 acres tenants.	7th year 1000 acres tenants.	8th year and onwards 1000 acres with tenants.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. Drains and water courses lay out, etc. ...	1,000	500	500	500	...	...	...	...
2. Maintenance of drains ...	100	200	300	400	400	400	400	400
3. Rent of buildings and new buildings ...	1,000	700	200 for tenants	200	200	200	200	200
4. Live-stock 20 pairs ...	2,500	2,500	...	...	...	...	...	...
5. Water rate ...	1,625	3,250	4,060	4,880	4,060	3,250	3,250	3,250
6. Seed ...	350	700	700	700	350	...	...	...
7. Cultivation expenses (Table No.5)	2,000	4,000	4,000	4,000	2,000	...	...	...
8. Pay of establishment (Table No.6)	5,160	8,520	9,120	7,440	5,760	2,400	2,400	2,400
9. Tools and Plants ...	1,000	500	100	100	...	...	...	...
10. Maintenance of live-stock (Table No. 7) ...	2,500	5,000	5,000	3,750 20 pairs will be kept for 6 months.	1,250 The 20 pairs will be fed for 6 months.	...	...	...
Total ...	17,235	25,870	23,980	21,970	14,020	6,250	6,250	6,250

TABLE No. 5.

Cost of Raising Rice in 250 Acres.

		Rs.
(1) Cost of irrigating land 15 men at Rs. 13 per month for 4 months	...	780
(2) Preparation of fields for sowing rice at Re. 1 per acre	...	250
(3) Transplanting of rice at Rs. 3 per acre	...	750
(4) Weeding at Re. 1 per acre	...	250
Total	...	2,030
Say	...	2,000

TABLE No. 6.

		Rs.
	1st Year.	
(1)	One Manager at Rs. 100 per mensem ...	1,200
(2)	One Moqaddam at Rs. 50 per mensem ...	600
(3)	20 Ploughmen at Rs. 14 per mensem ...	3,360
	Total ...	5,160
	2nd Year.	
	20 more Ploughmen at Rs. 14 per mensem ...	3,360
	Total ...	8,520
	3rd Year.	
	One more Moqaddam at Rs. 50 per mensem ...	600
	Total ...	9,120
	4th Year.	
	20 Ploughmen will be kept for 6 months ...	1,680
	Balance ...	7,440
	5th Year.	
	20 Ploughmen will be kept for 6 months ...	1,680
	Balance ...	5,760
	6th Year and Onwards.	
	The only establishment would be one Manager and two Moqaddams.	

TABLE No. 7.

Showing Cost of Upkeep of one Pair of Cattle for one Year.

	Rs. A. P.
(1) *Bhusa* at 10 seers per head per day—182 maunds at Re. 0-4-0 per maund ...	45 8 0
(2) Gram at 2 seers per head per day for 6 months—18 maunds at Rs. 2-8-0 per maund ...	45 0 0
(3) Establishment at Rs. 3 per pair per mensem ...	36 0 0
Total ...	126 8 0
Say ...	125 0 0

TABLE No. 8.

The reclaimed area, which would be on Batai with Tenants would grow crops per rectangle of **25** *acres on the following cropping scheme.*

	Kharif.		*Rabi.*
	Acres.		Acres.
Rice ...	2·5	Wheat ...	9·0
Fodders ...	2·0	*Berseem* ...	2·5
Maize ...	1·0		
Cotton ...	2·0		
Sugarcane ...	1·0	Total ...	11·5
Total ...	8·5		

	Rs. A. P.
(1) 2·5 acres rice at 20 maunds per acre = 50 maunds at Rs. 2-5-0 per maund. ...	112 8 0
(2) 2·0 acres cotton at 8 maunds per acre = 16 maunds at Rs. 5-8-0 per maund. ...	88 0 0
(5) 1 acre of sugarcane = 40 maunds of *Gur* at Rs. 3-8-0 per maund. ...	140 0 0
(4) 9 acres wheat at 15 maunds per acre = 135 maunds at Rs. 2-2-0. per maund. ...	286 14 0
(5) Wheat *Bhusa* 140 maunds at Rs. 0-4-0 per maund. ...	35 0 0
Total ...	662 6 0

Government's share $\frac{1}{2}$ = Rs. 331 say Government's share from 250 acres, Rs. 1,300.

TABLE No. 9.

Scheme for the Reclamation of 1,000 acres of Thur Land of which 250 acres will be taken up every year.

Probable Income :—The following figures have been worked out on the assumption that when land is taken up for reclamation it is capable of giving a four anna crop :—

	Rs.
1st year :—250 acres of rice at 15 maunds per acre=3,750 maunds at Rs. 2-4-0 per maund	8,440
2nd year :—250 acres reclaimed in the first year would yield 20 maunds of rice per acre=5,000 maunds. 250 acres put under reclamation in the 2nd year would yield 15 maunds of rice per acre=3,750 maunds. Total quantity of rice =8,750 maunds at Rs. 2-4-0 per maund	19,690
Net income from *Rabi* crops	1,000
Total income	20,690
3rd year :—250 acres reclaimed in the first year would be given to tenants on *batai*. The half water rate and supervision charges for this area have been included in the expenditure. The 250 acres brought under reclamation in the 2nd year and 250 acres brought under reclamation the 3rd year would yield income equivalent to that in the 2nd year, *i. e.*, Rs. 20,690. The income to Government from 250 acres given to tenants on *batai* would be Rs. 3,310 (Table No. 8). Therefore total income during the 3rd year would be Rs. 20,690 plus Rs. 3,310	24,000
4th year :—250 acres reclaimed in the 1st year would continue to remain with tenants on *batai*. In addition, the 250 acres reclaimed in the 2nd year would be given to tenants on *batai*. Total income would, therefore, be from 500 acres reclaimed in the 3rd year and 4th year and farmed direct and the 500 acres given to tenants. This would mean Rs. 20,690+Rs. 6,620=Rs. 27,310. Out of 40 pairs of cattle, 20 pairs would become available for sale. This would bring approximately Rs. 800. Therefore total income in the 4th year would be Rs. 27,310+Rs. 800	28,110
5th year :—During the 5th year, the third block of 250 acres would be handed over to tenants on *batai*. This means 750 acres will be with tenants which will bring an income of Rs. 9,930. The 250 acres farmed direct would give an income of approximately Rs. 11,250. If this area is given to tenants on *Rabi*, an additional income of Rs. 200 may be counted.	
Sale of 20 pairs of buffaloes still left would bring Rs. 600. Total income, therefore, will be Rs. 9,930+Rs. 11,250 +Rs. 200+Rs. 600	21,980
6th year :—This year the whole of the area will be with tenants. Therefore income to Government will be Rs. 13,240+Rs. 400 from the sale of Tools and Plant.	13,640
7th year :—Income will be Rs. 3,310×4 and so on	13,240

TABLE No. 10.

1. For 1,000 acres.	Rs.	
Income	5,081	
Interest on income at 4 per cent.	1,000	
Total ...	6,081	
Expenditure:—		Rs.
Management ...		1,20,000
Interest at 4 per cent. on the sum ...		24,000
Interest on Rs. 20,000 at 4 per cent. for 10 years ...		8,000
Total Expenditure ...		1 52,000
Less Income. ...		6,081
Total ...		1,45,919
Therefore land must appreciate to cover expenses by Rs. 146 per acre		
	Rs.	Rs.
2. For 2,000 acres block :—		
Total Income.	12,162	
Expenditure :—		
Management ...		1,20,000
Interest at 4 per cent. on this sum ...		24,000
Interest on Rs. 40,000 at 4 per cent. ...		16,000
Total.		1,60,000
Less income.		12,162
Total.		1,47,838
Therefore land must appreciate, to cover expenses by Rs. 74per acre.		
3. For 5,000 acres.	Rs.	
Income.	30,405	
Expenditure :— ...		Rs.
Management ...		1,20,000
Interest on Rs. 1,20,000 at 4 per cent. ...		24,000
Interest on Rs. 1,00,000 at 4 per cent. for 10 years. ...		40,000
Total Expenditure.		1,84,000
Less Income.		30,405
Total.		1,53,595
Therefore land must appreciate to cover expenses by Rs. 31 per acre		
Cost of land if 5,000 acres are taken for reclamation :-	Rs.	
Price of land before reclamation = 5,000 × 80 =	4,00,000	
Cost of Reclamation ..... =	1,53,595	
Total cost. =	5,53,595	
Price of land after reclamation = 5,000 × 9 × 200 =		9,00,000
Profit on reclamation of 5,000 acres. =		9,00,000
Minus. =		5,53.595
Total.		3,46,405
From Table No. 11 cost of reclamation is Rs. 1,20,000 + Rs. 1,900 = Rs. 1,21,900. Therefore total cost = Rs. 5,21,900. Therefore profit on reclamation of 5,000 acres = 9,00,000 - 5,21,900 = Rs. 3,78,100.		

TABLE No. 11.

Showing the Opening and Closing Balance after each harvest.

Year.	Crop.	Opening Balance.	RECEIPT.		Total columns 3,4, & 5.	Working expenses.	Supervision.	Interest.	Total columns 7, 8 & 9.	Closing Balance	AMOUNT PAID BACK.	
			Supervision Grant.	Income for the crop.							Interest.	Principal.
1	2	3	4	5	6	7	8	9	10	11	12	13
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	*Kharif.*	1,00,000	6,000	42,200	1,48,200	75,000	6,000	2,060*	83,060	67,200*	...	...
	Rabi.	67,200	6,000	...	73,200	11,175	6,000	2,180*	19,355	56,025*	...	...
2	*Kharif.*	56,025	6,000	98,450	1,60,475	1,11,075	6,000	2,300*	1,19,375	43,400*	...	...
	Rabi.	43,400	6,000	5,000	54,400	18,275	6,000	2,420*	26,695	30,125*	...	...
3	*Kharif.*	30,125	6,000	1,06,725	1,42,850	90,200	6,000	2,540*	1,07,740	37,650*	...	...
	Rabi.	37,650	6,000	13,275	56,925	20,700	6,000	2,660*	29,360	30,225*	...	...
4	*Kharif.*	30,225	6,000	1,19,000	1,55,225	88,900	6,000	2,786*	97,686	60,325*	...	...
	Rabi.	60,325	6,000	21,550	87,875	20,950	6,000	2,900*	29,850	60,925*	...	...
5	*Kharif.*	60,925	6,000	84,075	1,51,000	56,100	6,000	3,020*	65,120	88,900*	...	...
	Rabi.	88,900	6,000	25,825	1,20,725	14,000	6,000	3,140*	23,140	1,00,725*	...	...
6	*Kharif.*	1,00,725	6,000	35,100	1,41,825	18,625	6,000	3,260*	27,885	62,940	29,260	25,000
	Rabi.	62,940	6,000	33,100	1,02,040	12,625	6,000	1,560	20,185	56,853	1,560	25,000
7	*Kharif.*	56,855	6,000	33,100	95,955	18,625	6,000	1,060	25,685	45,270	1,060	25,000
	Rabi.	45,270	6,000	33,100	84,370	12,625	6,000	560	19,185	40,185	560	25,000
8	*Kharif.*	40,185	6,000	33,100	79,285	18,625	6,000	60	24,685	54,600	60	...
	Rabi.	54,600	6,000	33,100	93,700	12,625	6,000	60	18,685	75,015	60	...
9	*Kharif.*	75,015	6,000	33,100 1,500**	1,14,115 1,500**	18,625	6,000	60	24,685	90,930	60	...
	Rabi.	90,930	6,000	33,100 18,00**	1,30,030 1,800**	12,625	6,000	60	18,685	1,18,145	60	...
10	*Kharif.*	1,18,145	6,000	33,100 22,60**	1,52,245 2,260**	18,625	6,000	60	24,685	1,29,820	60	...
	Rabi.	1,29,820	6,000	33,100 2,600**	1,68,920 2,600**	12,625	6,000	60	18,685	1,52,835	60	...

*Interest shown as expenditure will not be paid till the 6th year. Interest on this interest has been allowed in working out the amount by which the land must appreciate at the end of 10 years.

** Interest on balance.

Providing interest on interest, the closing balance will be Rs. 1,52,835—Rs. 2,663=Rs. 1,50,172. The above balance of Rs. 1,50,172 will be obtained if there are no calamities to crops or drop in prices beyond those assumed. For safety it is proposed to decrease crop income figures by 10 per cent. and to increase expenditure by 10 per cent. Making these allowances the balance at the end of operations is lowered by Rs. 1,52, 072 and becomes—Rs. 1,900. To pay supervision charges amounting to Rs. 1,20,000 land must appreciate in capital value by Rs. 24-8-0 per acre.

TABLE No. 12.

Showing Costs of Reclamation at the Military Farm, Okara.

Dr.			Cr.		
		Rs. A. P.			Rs. A. P.
Pay	...	230 2 0	Sathra rice 102 mds. at Rs. 2-2-6	...	219 15 0
Bullock ration	...	119 0 0	Straw	...	30 0 0
Bullook fodder	...	91 7 0	*Jhona* estimate 70 mds.	...	157 8 0
Half pay of Munshi	...	60 0 0	Straw estimate	...	25 0 0
Shoeing	...	17 11 0			432 7 0
Water-tax	..	547 0 0			
Seed	...	15 1 0			
		1,080 5 0			
Harvesting	...	35 1 0	*Loss*	...	682 15 0
Total	...	1,115 6 0	Total	...	1,115 6 0

On 50 acres the loss is Rs. 682-15-0, thus the loss per acre is Rs. 13-10-7.

TABLE No. 13.

Showing the results of analysis of soils from Chak 188 N. B. seven years after reclamation and the cultivation of land on normal water supply.

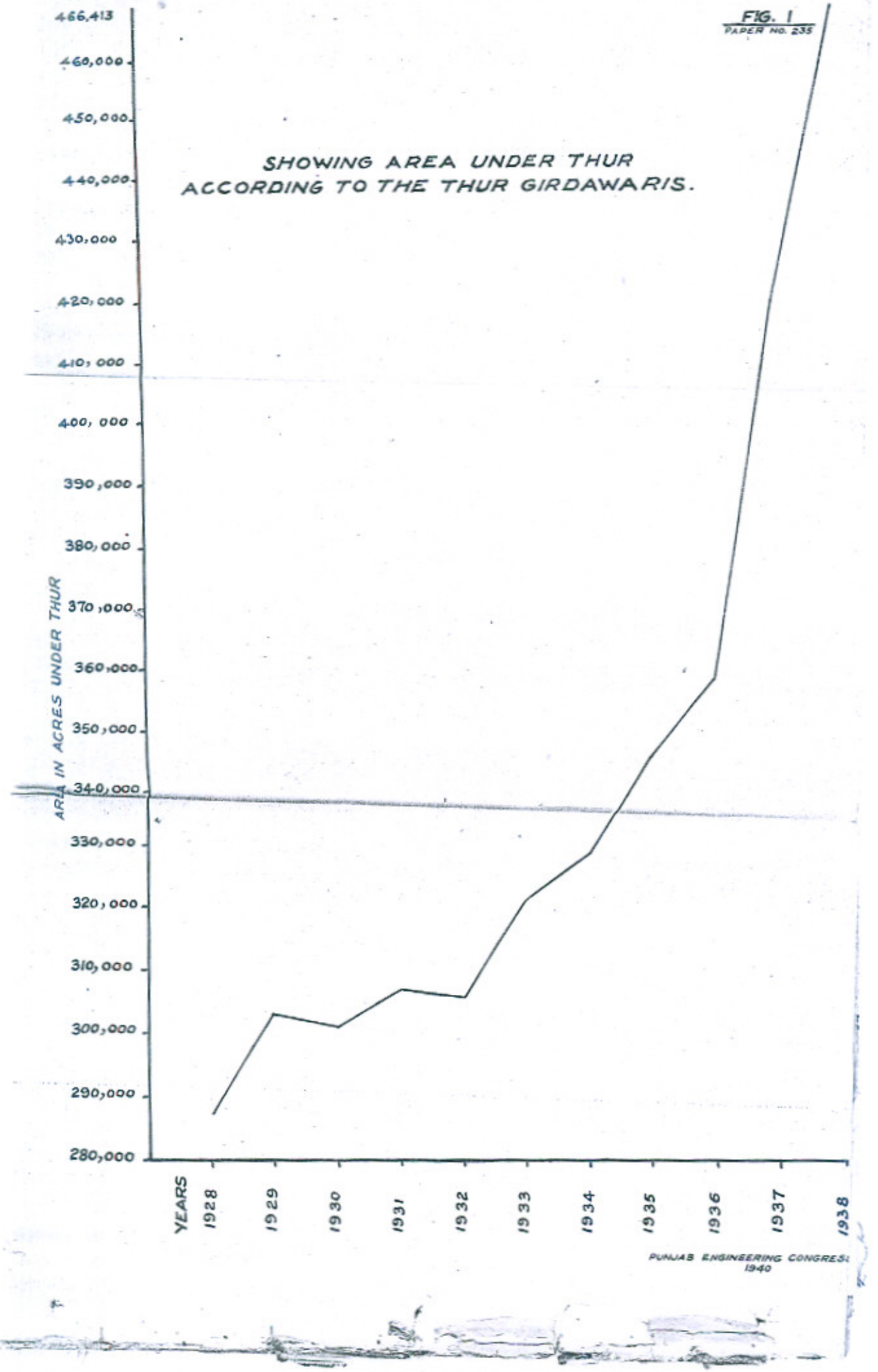
Description of sample.	*pH*	Total solids.
1st 6"	7·89	0·11
2nd 6"	8·00	0·07
2nd ft.	8·12	0·07
3rd ft.	8·22	0·08
4th ft.	8·15	0·09
5th ft.	8·46	0·08
6th ft.	8·38	0·12
7th ft.	8·24	0·08
8th ft.	8·18	0·11
9th ft.	8·40	0·06
10th ft.	8·53	0·06

TABLE No. 14.

Showing results of analysis of soils from the abandoned Chakanwali Reclamation Farm.

Description of samples.	Depth.	Total Soluble Salts December, 1938.	*pH* December, 1938.
A/1 Sub plot 19 Field No. 3 ...	0—7″	0·10	8·20
Do do ..	7″—14′	0·08	8·01
Do do ...	14″—26″	0·06	7·86
Do do ...	26″—36″	0·07	7·69
Do—Sub plot 27 Field No. 1. ...	0—5″	0·29	8·78
Do do ...	5″—15″	0·11	8·49
Do do ...	15″—24″	0·09	7·67
Do do ...	24″—30″	0·04	7·38
G/1 Sub plot 10 Field No. 1 ...	0—7′′	0·05	7·93
Do do ...	7″—16″	0·04	8·18
Do do ...	16″—22″	0·05	8·02
Do do ...	22″—33½″	0·02	8·11
H/1 Sub Plot 19 Field No. 1 ...	0—5″	0·09	7·16
Do do ...	5″—10″	0·11	7·75
Do do ...	10″—21″	0·14	8·02
Do do ...	21″—29″	0·15	8·46
Do do ...	29″—35″	0·15	8·55
Do Field No. 4 ...	0—5″	0·16	8·21
Do do ...	5″—9″	0·18	8·78
Do do ...	9″—15″	0·19	8·73
Do do ...	15″—31″	0·19	8·58
S. Sub plot 1 ...	0—6″	0·10	7·17
Do ...	6″—12″	0·10	7·05
Do ...	1′—2′	0·09	7·39
Q Sub plot 9 Field No. 1 ...	0—4″	0·08	7·71
Do do ...	4″—8″	0·12	7·88
Do do ...	8″—17″	0·09	7·63
Do do ...	17″—25″	0·07	7·18
L. Sub plot 10 Field No. 1 ...	0—4″	0·07	7·30
Do do ...	4″—9″	0·10	7·30
Do do ...	9″—17′	0·11	7·26
Do do ...	17″—21″	0·11	7·10

FIG. 1
PAPER No. 235



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A PART PLAN OF RECHNA DOAB SHOWING THE LINES OF VILLAGES UNDER SPECIAL THUR GIRDAWRI

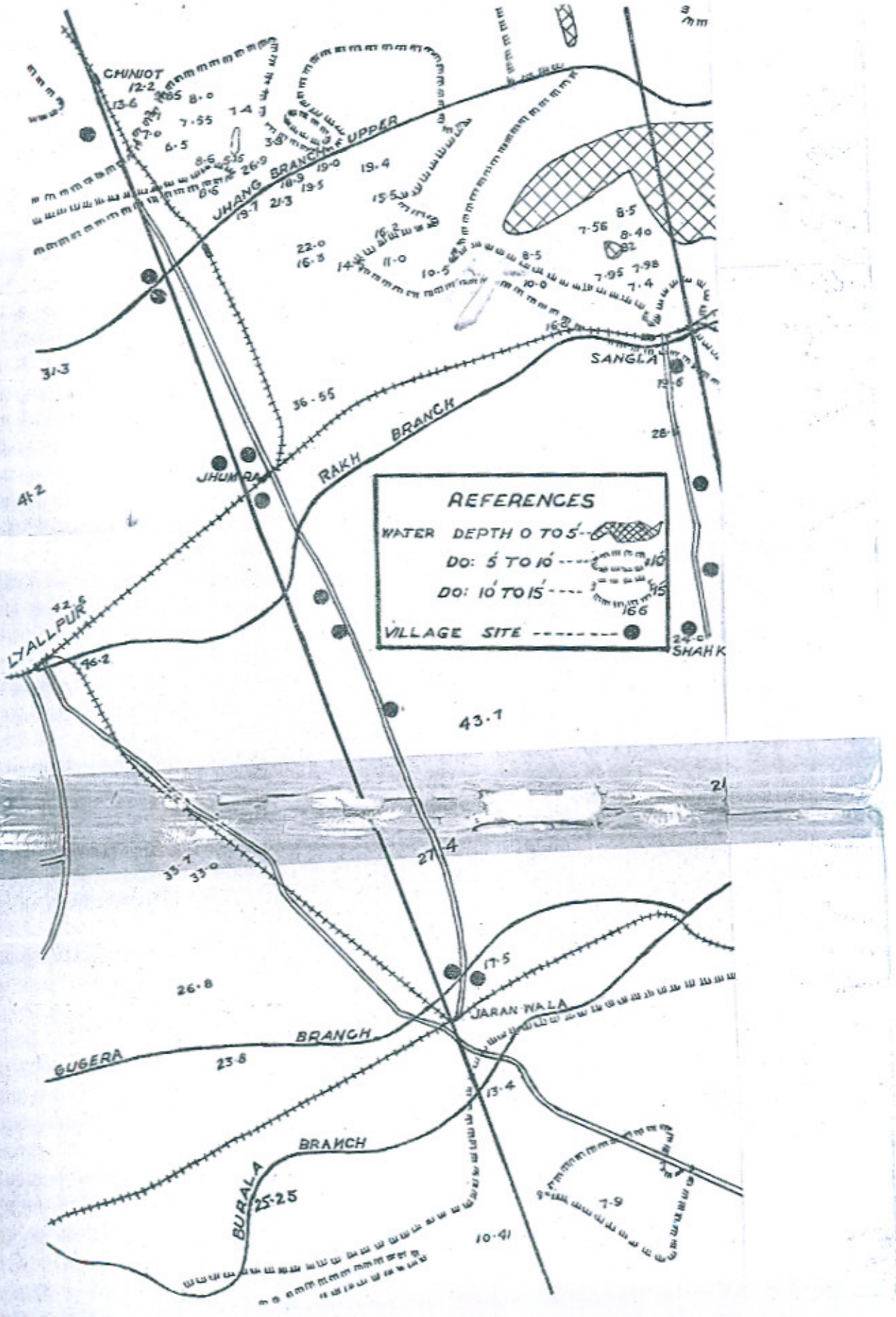


FIG. 3

SHOWING THE ZONE OF ACCUMULATION OF SALT IN A SOIL PROFILE UNDER A COTTON FIELD

CHAK No. 266 R.B.

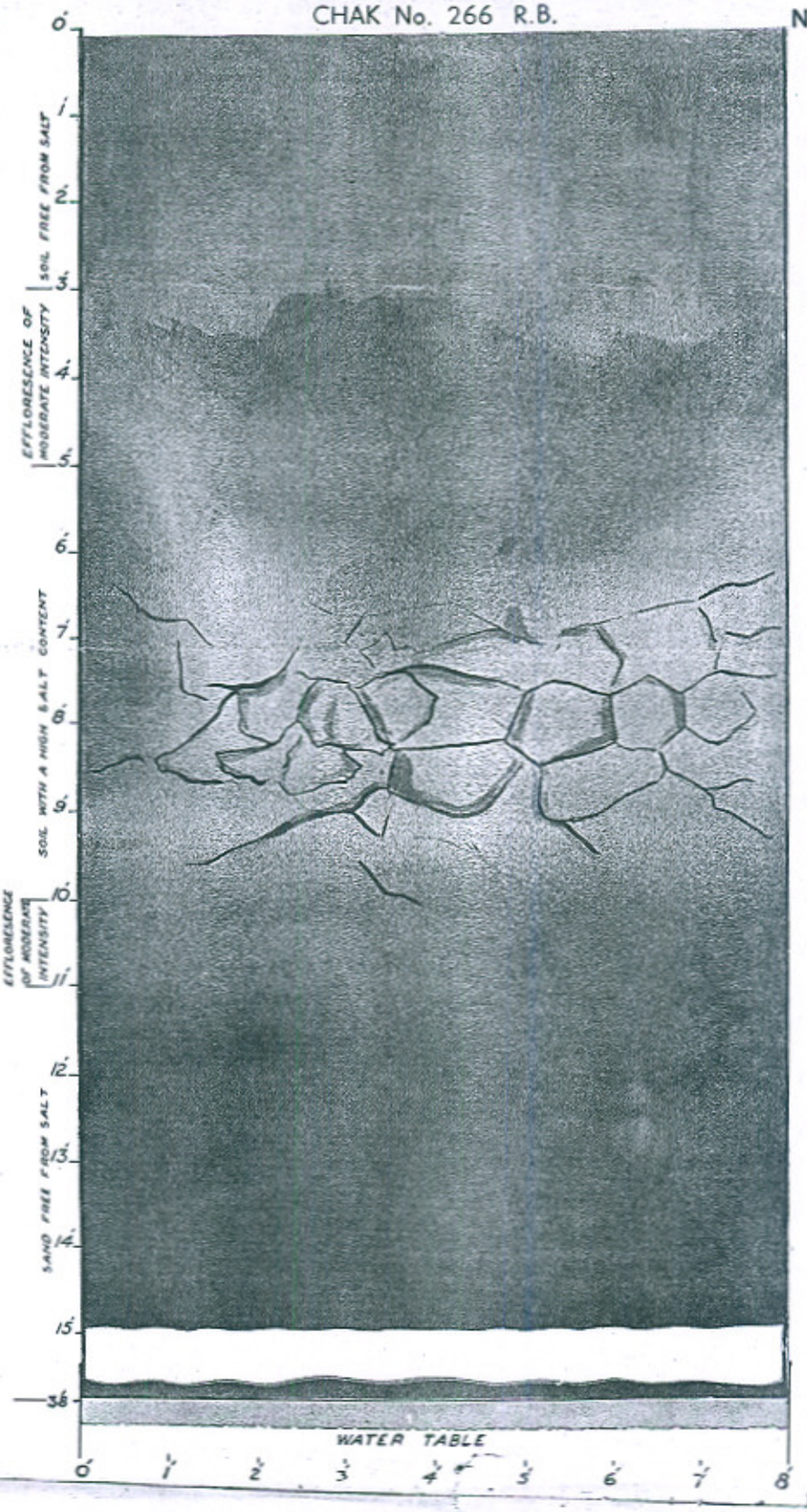


FIG. 4

SHOWING ACCUMULATION OF SALT IN A SOIL PROFILE UNDER A COTTON FIELD

CHAK No. 61 G.B.

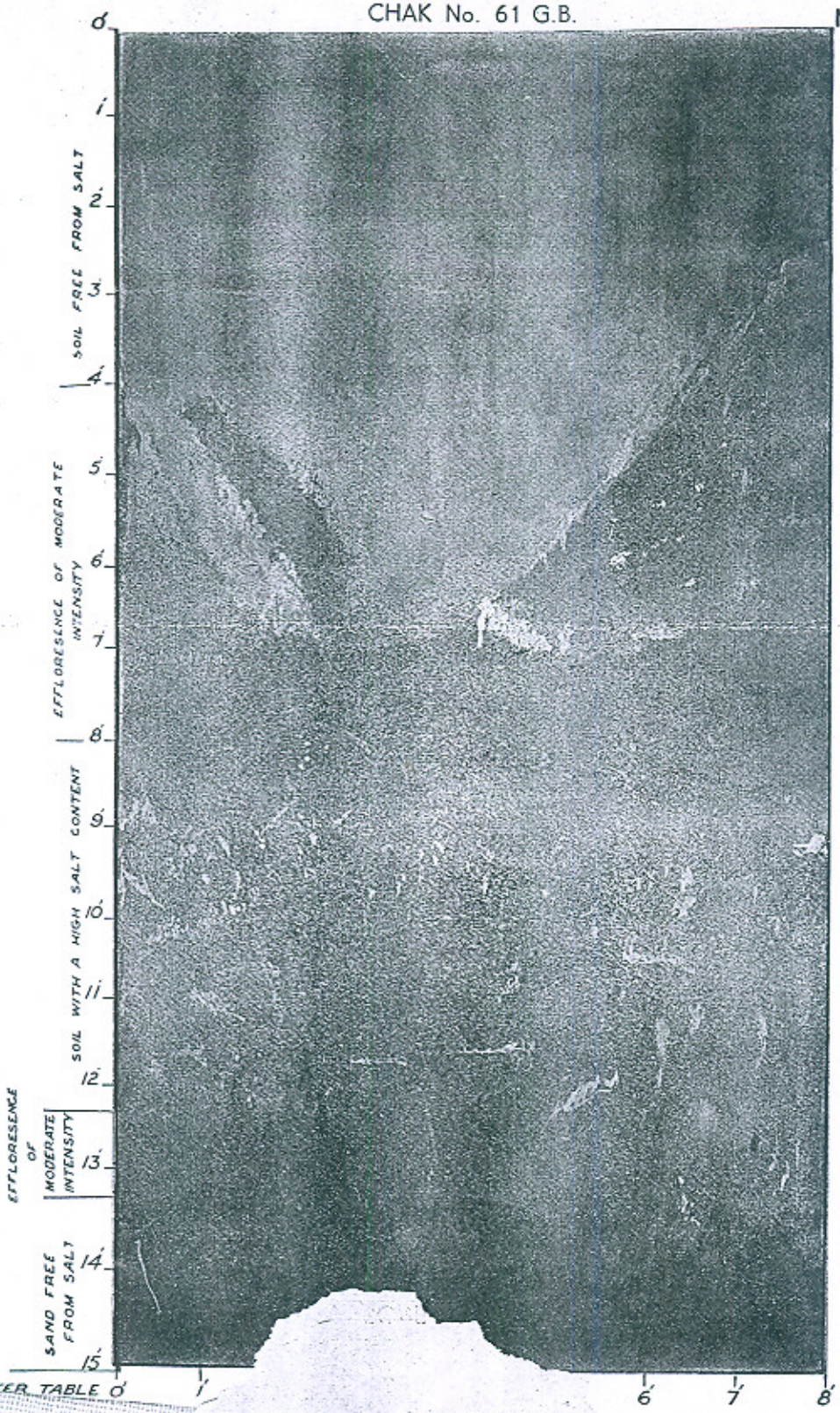


FIG.5

SHOWING THE DISTRIBUTION OF SALT IN SOIL PROFILES

CHAK No 266 R.B.

L.C.C.

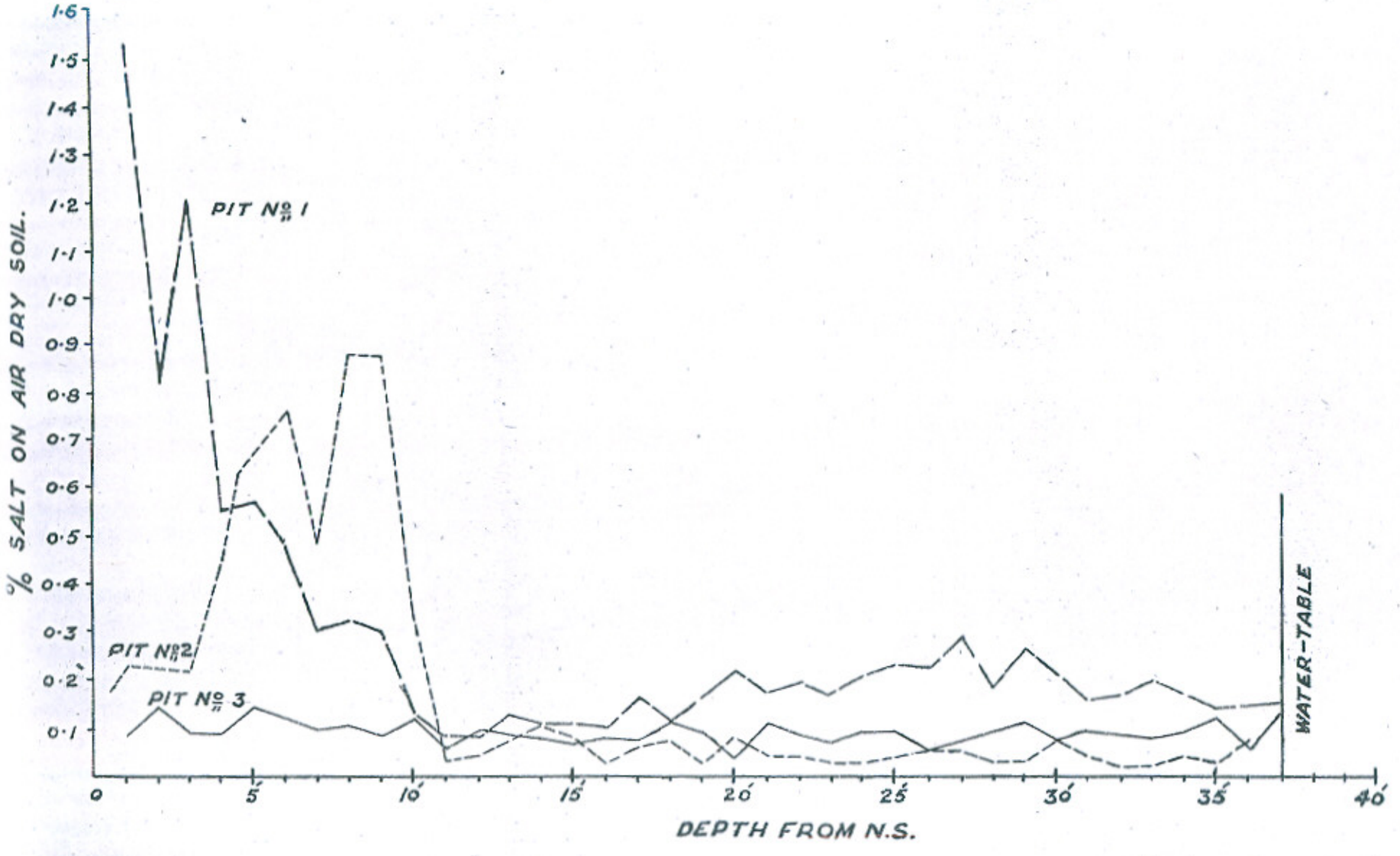
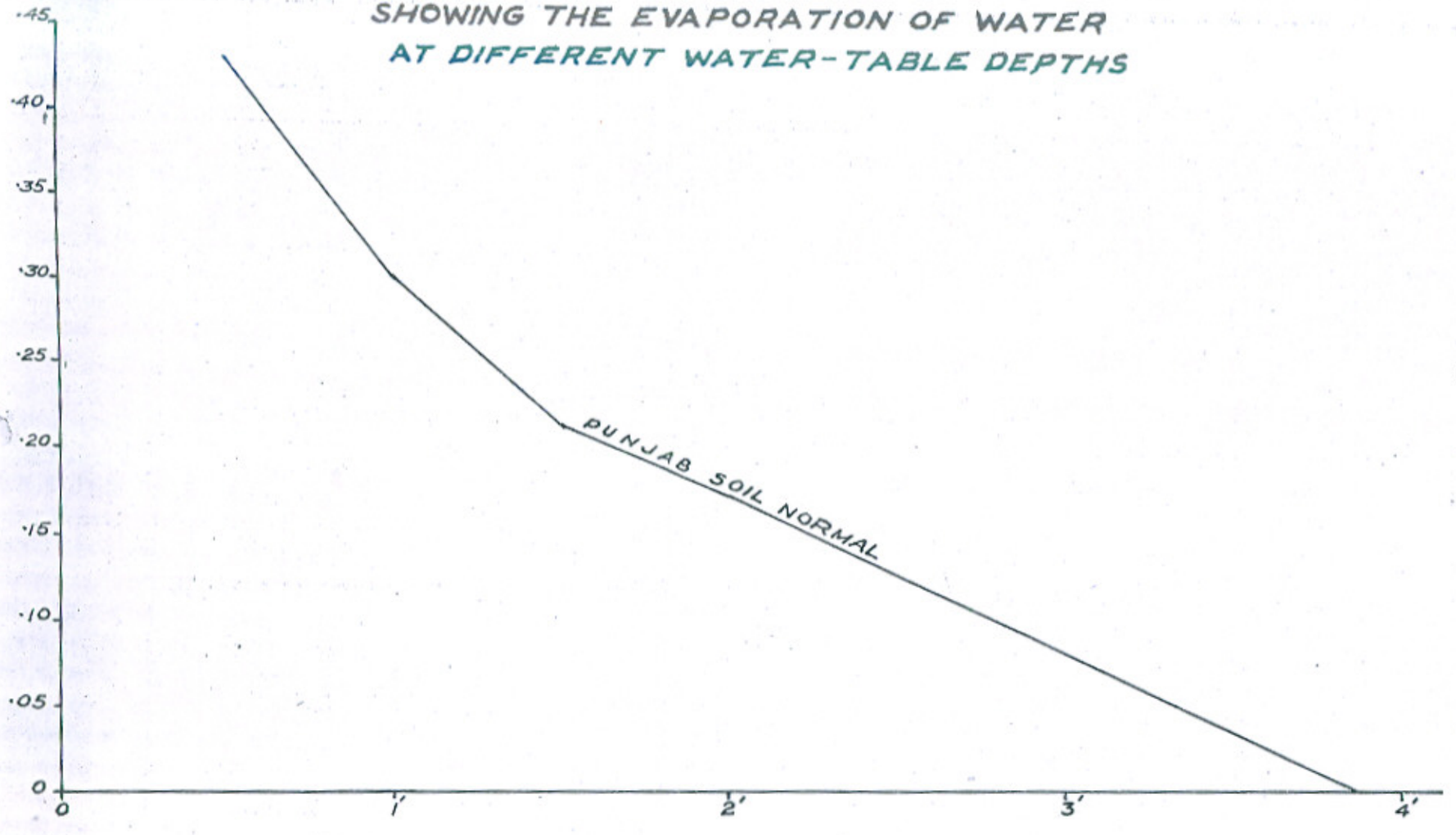


FIG. 6
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SHOWING THE EVAPORATION OF WATER AT DIFFERENT WATER-TABLE DEPTHS



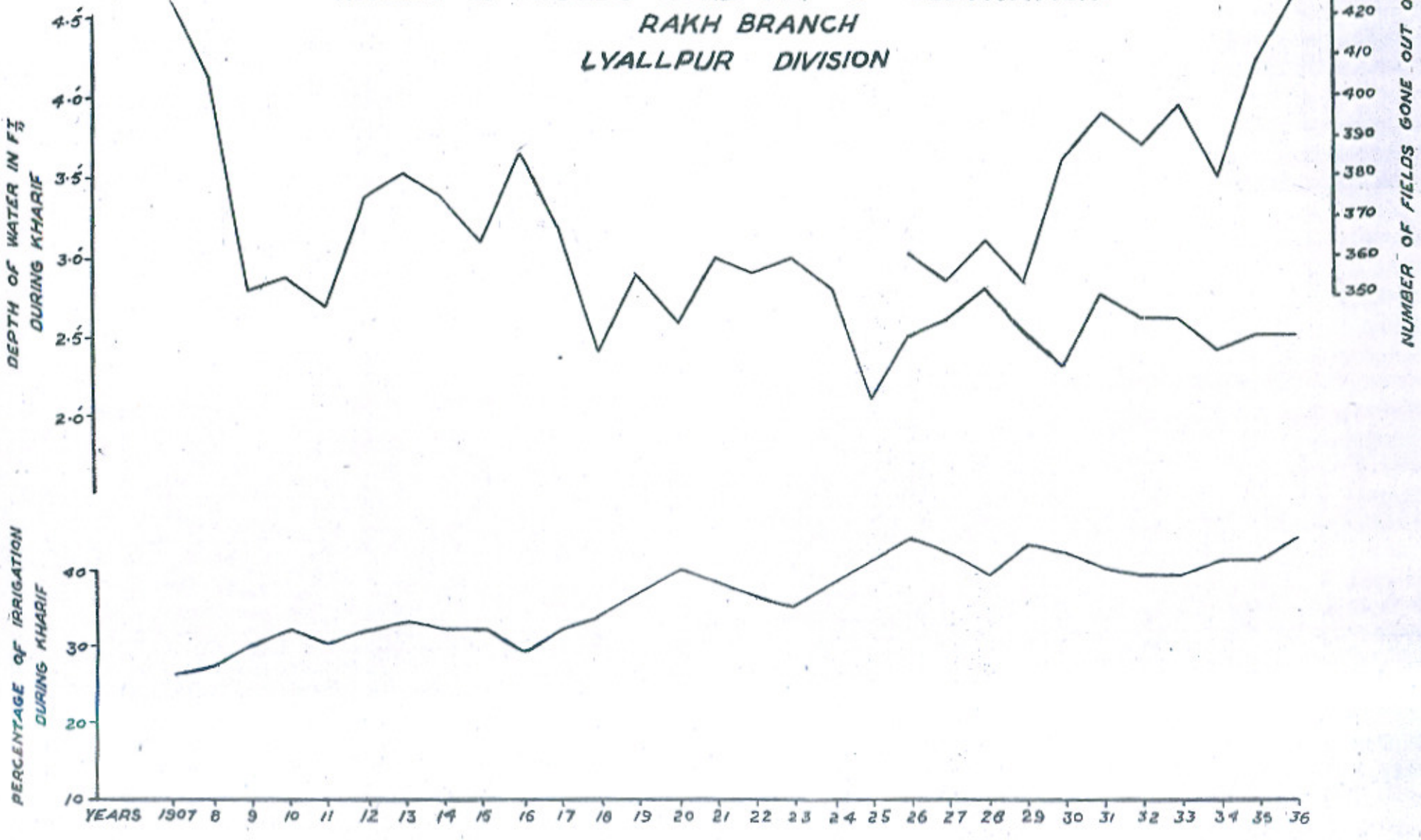
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FIG. 7

CURVES SHOWING THE INTENSITY OF IRRIGATION DURING KHARIF, THE DELTA USED DURING KHARIF AND THE NUMBER OF FIELDS GONE OUT OF CULTIVATION.

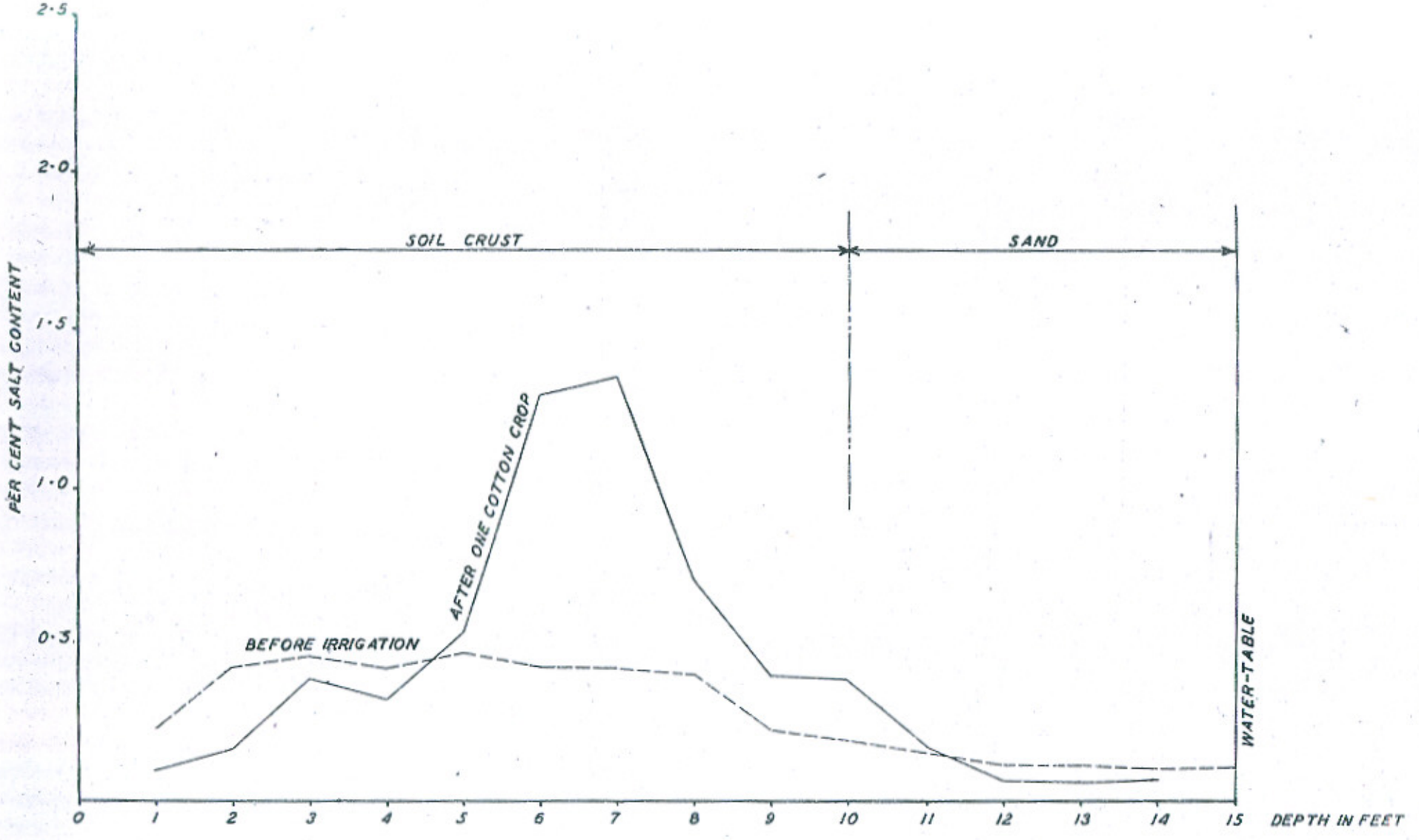
RAKH BRANCH

LYALLPUR DIVISION



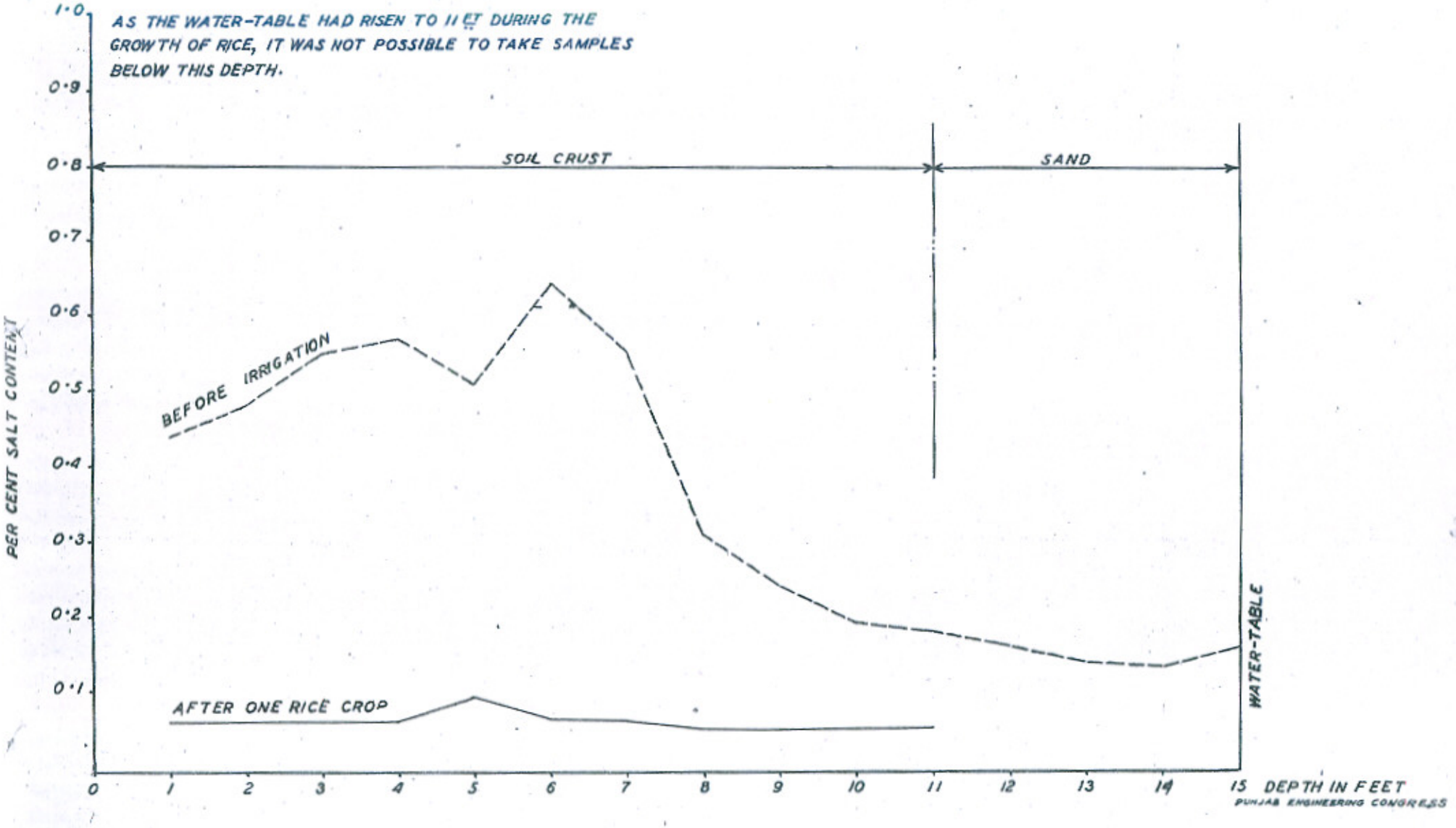
PAPER NO. 235

SHOWING THE DISTRIBUTION OF SALTS BEFORE AND AFTER A COTTON CROP AT JARANWALA



SHOWING THE DISTRIBUTION OF SALTS BEFORE AND AFTER A RICE CROP AT JARANWALA

FIG. 9
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FIG. 10
PAPER NO. 235

PENETRATION OF IRRIGATION IN A BAJRA FIELD IN THE THAL AREA

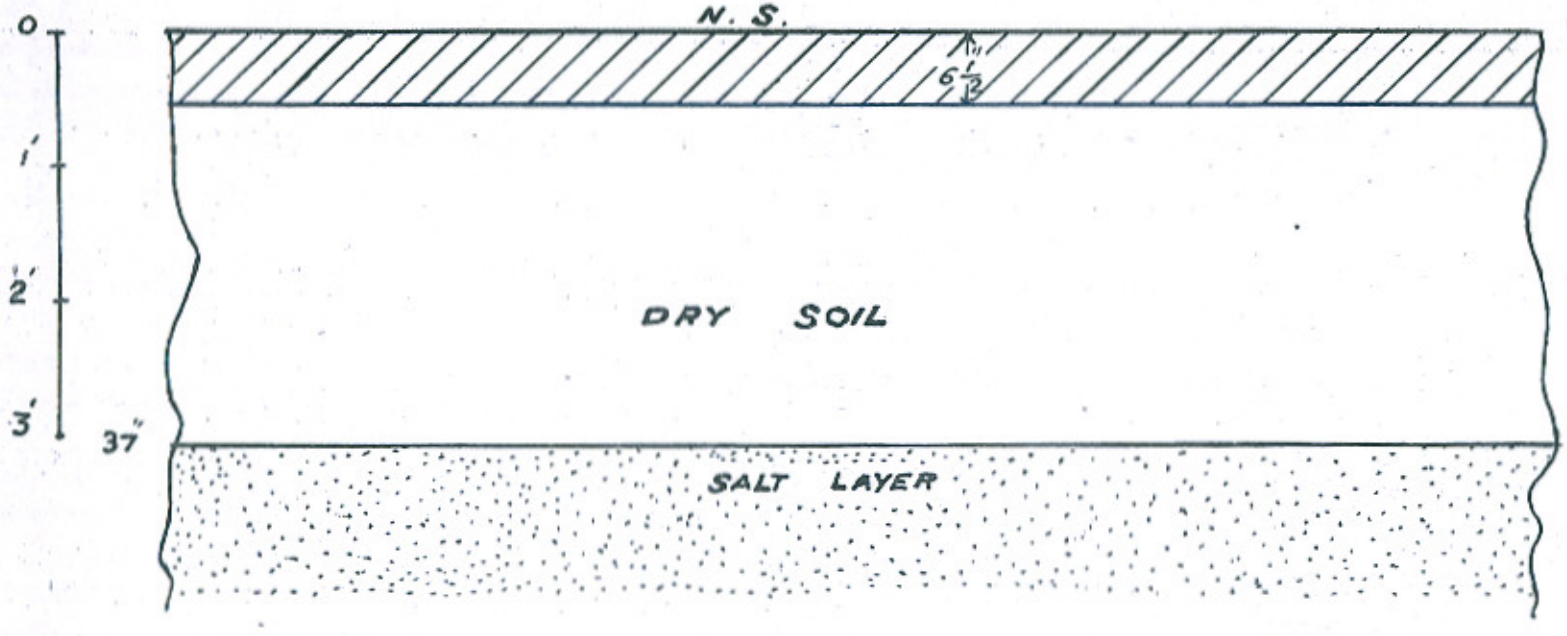
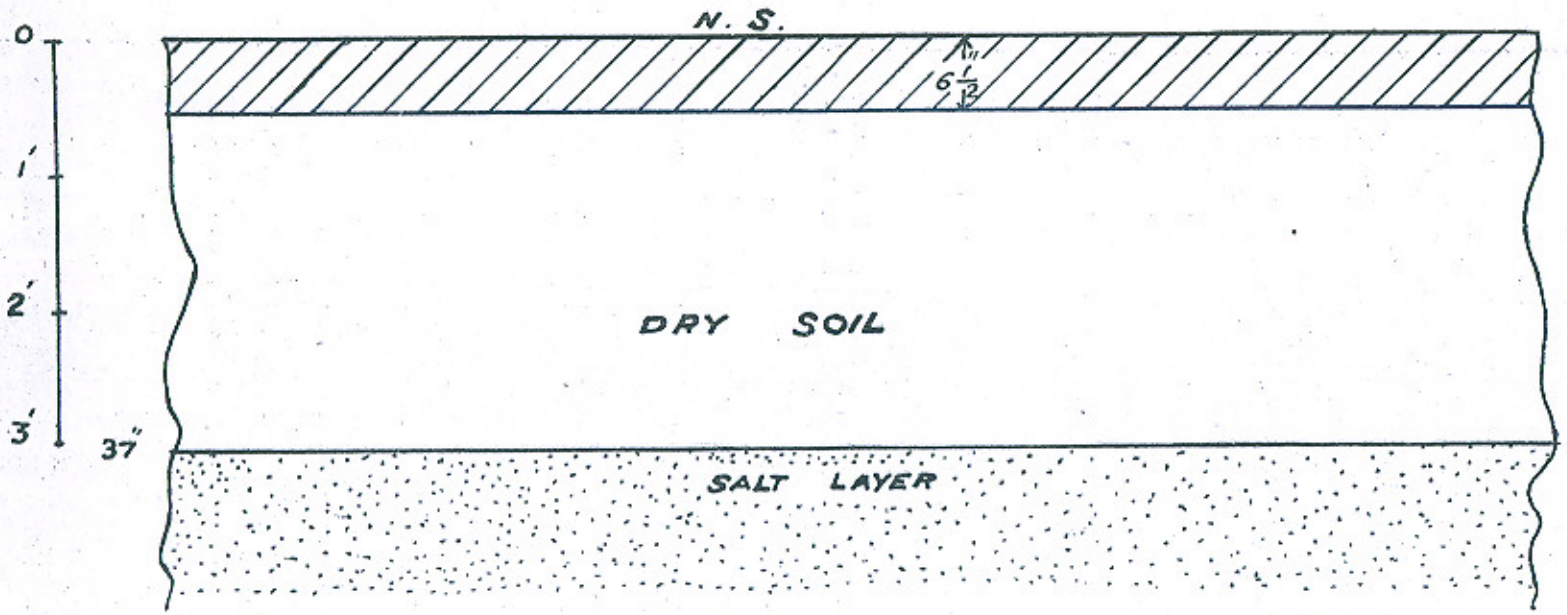


FIG. 10
PAPER NO. 235

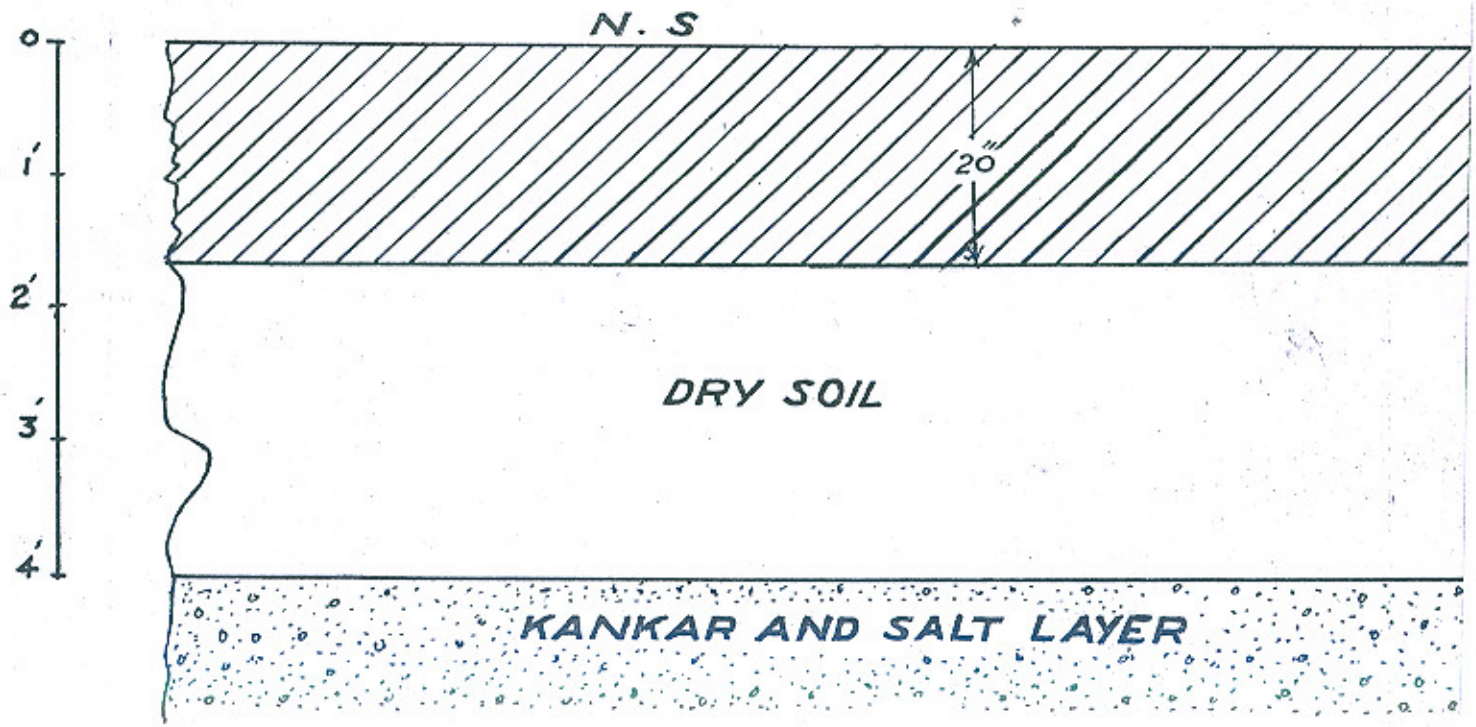
PENETRATION OF IRRIGATION IN A BAJRA FIELD

IN THE THAL AREA



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PENETRATION OF IRRIGATION IN A COTTON FIELD IN THE THAL AREA



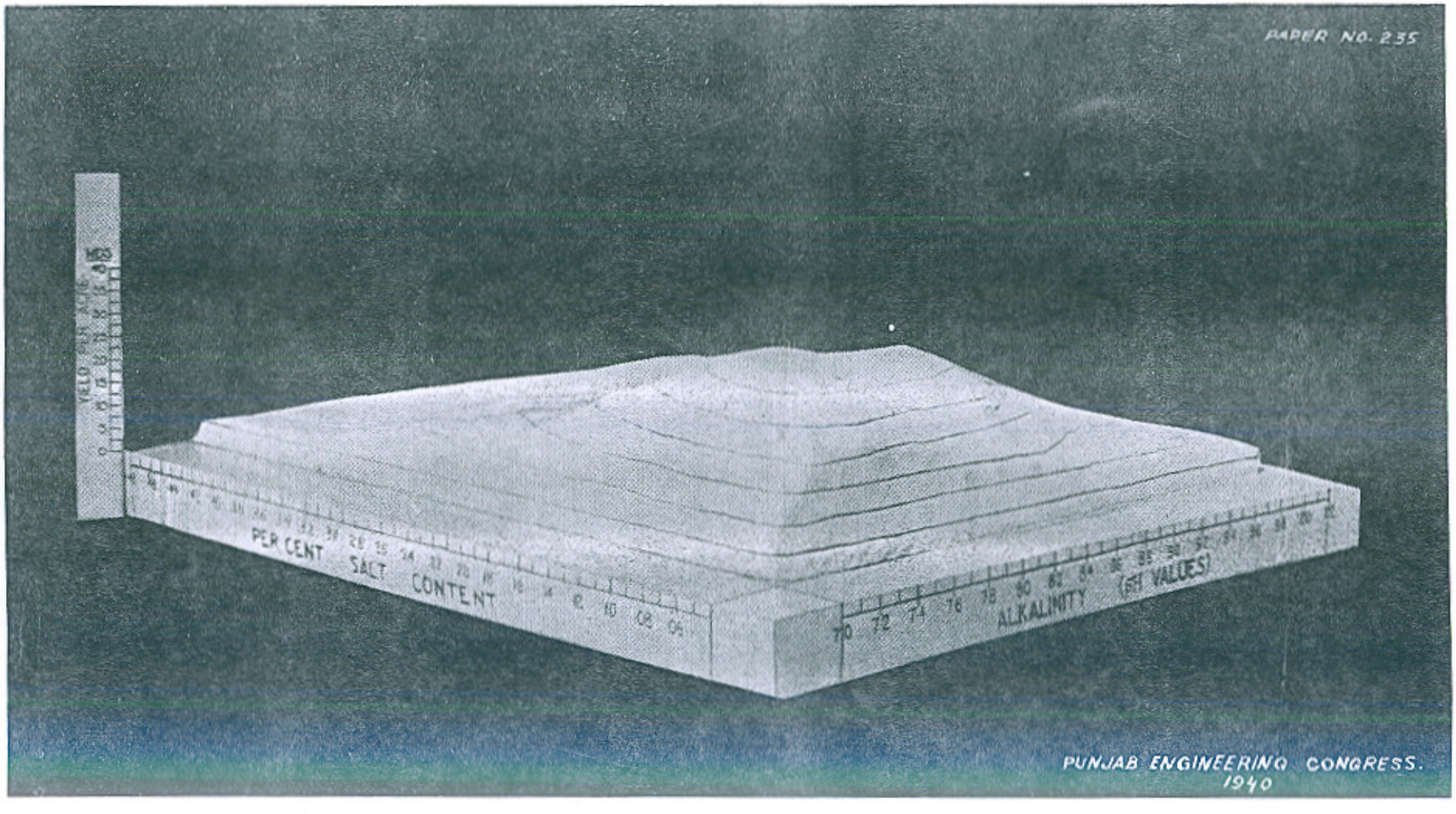

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FIG. 12



FIG. 13

Condition of land before reclamation. The salt efflorescence is easy to distinguish in this photograph.



FIG. 14

Photograph showing the first berseem crop after reclamation. Berseem is the leguminous crop taken after rice.



FIG. 15

Photograph showing cotton and sugarcane in reclaimed land. These are the first crops taken after reclamation and the growth of one berseem crop.