A NOTE ON THE SHERAQI SOILS OF EGYPT. A STUDY IN PARTIAL STERILISATION.

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(With One text-figure.)

In a previous communication[1] attention was called to the possibilities of partial sterilisation under field conditions in the case of the summer fallow of Egyptian agriculture.

This fallow period or "sheraqi" is particularly characteristic of the basin system of agriculture during the interval between the harvest of the winter crop and the Nile flood, but it is also common under perennial conditions of irrigation after the winter crops.

The conditions may be stated simply as extreme dryness with relatively high temperatures. Besides checking the bacteriological activity of the soil, this causes the soil to shrink and to crack to a considerable depth and this cracking probably plays an important part in the maintenance of the tractability of the heavy soils of the Nile valley. In the writer's gardening experience the effect is very similar to that exerted by a severe frost under English conditions of farming.

According to V. M. Mosseri[2] this cracking is probably fundamental in the maintenance of the fertility of the soils of the Nile valley under the classical system of Egyptian farming because it prevents the accumulation of salts and allows of perfect aeration with probably further chemical and physical effects. This author has shown that salts concentrate on the outside of the lumps of soil and are hence easily washed away by the irrigation or flood water. The cracks permit the access of air to relatively great depths of the soil.

It is not intended in this paper to discuss this undoubted important physical effect of the sheraqi period, but to place on record some of the data obtained in 1918 and 1919 relating to the biological aspect of the question.

[1] This *Journal*, 1919, IX. 216.

[2] *Bulletin de l'Institut Egyptien*, 1909, "Le drainage en Egypte." A further communication on this subject by V. M. Mosseri and C. Audebeau is in preparation.

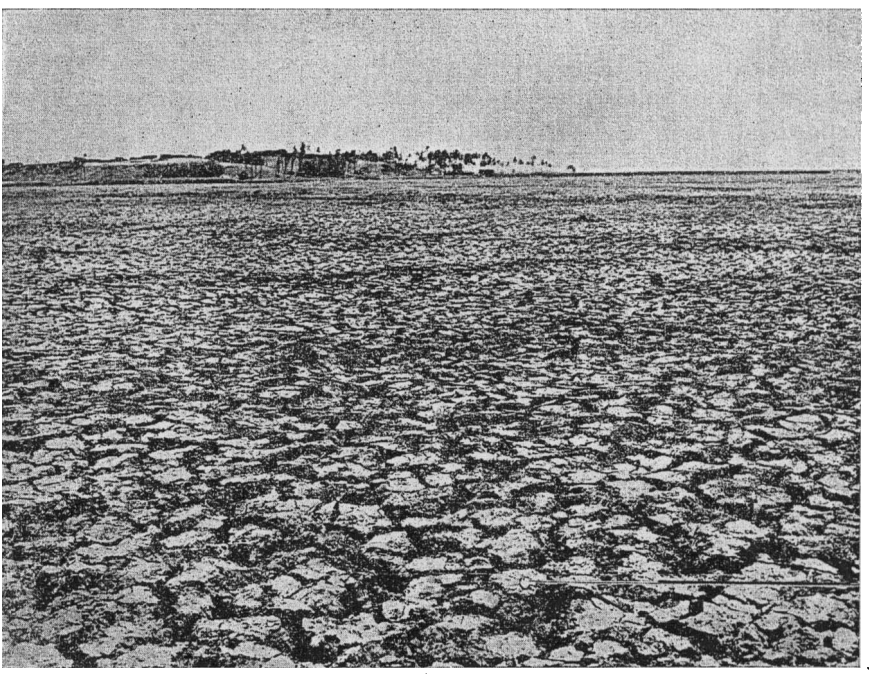
E. J. Russell and H. B. Hutchinson[1] suggest that drought or prolonged heating at 40° C. have very similar effects on the soil as the treatment by heating at higher temperatures or by means of volatile antiseptics.

This partial sterilisation of the soils is followed by an increased bacteriological activity and it was of special interest to obtain some positive evidence of this phenomenon in the case of these Egyptian soils.

FIELD CONDITIONS.

The photograph of the Zenar Basin at Assiut illustrates the characteristic effect of the sheraqi period on these soils.

At the beginning of the summer fallow the moisture content may be fairly high, up to 16 per cent., but this rapidly falls to about 5 per cent.



Zenar Basin, Assiut, August 1918.

The temperature down to 10 cm. approaches 40° C. daily. The following Table I illustrates characteristic temperature conditions for one day in June 1919.

[1] E. J. Russell and H. B. Hutchinson. This *Journal*, 1913, v. 152.

Table I.

Temperature conditions of Sheraqi soil. Bahtim, June 27, 1919.
Degrees Centigrade.

	1 p.m.	3 p.m.	5 p.m.
Surface	55·0	53·5	48·5
5 cm. depth	39·0	38·9	43·0
10 cm. „	37·0	37·0	36·3
20 cm. „	—	33·3	33·3

Bacterial numbers are relatively low, about one million per gramme of dry soil, and no activity has been observed. Nitrates do not accumulate.

The conditions are thus distinctly unfavourable to biological activity and the active period on the renewal of favourable conditions, particularly in relation to the supply of water, ought to show the characteristic abnormal activity. Bacteria ought to multiply more rapidly than in soil that has not been under these conditions and there ought to be an increased accumulation of available nitrogen as ammonia or as nitrate.

It is obviously difficult to obtain strict comparative data on this point, particularly as it is difficult to secure an untreated soil, but the data given below show that this increased activity over soils that have not been sheraqi does take place.

Protozoa are not entirely killed off except possibly under the extreme conditions of the basin lands but they are certainly checked. In the hands of a competent biologist there would seem to be ample material in these Egyptian soils for an examination of E. J. Russell's hypothesis concerning the activity of protozoa in limiting the bacteriological activity of the soil.

EXPERIMENTAL.

The main difficulty in obtaining positive evidence was to obtain a representative sample of soil that had not been under the sheraqi conditions.

In 1919 a piece of rich bersim (clover) soil was selected immediately after the cattle had fed off the last cutting. Samples were taken from three different places and kept at about 20 per cent. moisture in lots of 1 kilo.

After one month a second sample was taken from the same field and again after two months.

Unfortunately the first sample was too rich; probably one of the places from which it was taken had been soaked by the urine of some animal. The whole sample showed an initial nitrate nitrogen content of 60 parts per million of dry soil and was therefore rejected. In spite of its richness its highest number of bacteria was never more than 17 millions per gramme of dry soil during storage at 20 per cent. moisture content for 90 days. Bacterial counts and determinations of nitrate were made at intervals on the stored samples. The temperature of storage was 28–30° C.

Table II.

Numbers of bacteria and amounts of nitrate in sheraqi soils after moistening up to 20 *per cent. water content.* 1918.

	Number of days	Bacteria, millions per gramme of dry soil	Nitrate Nitrogen, parts per million of dry soil	Nitrate produced
S_1 sampled July 1st	0	5·3	24·1	—
Moisture = 7·2 %	5	34·6	38·2	14·1
	15	21·1	51·5	27·4
	30	10·1	54·4	30·3
	58	17·1	84·4	60·3
S_2 sampled August 1st	0	1·6	26·8	—
Moisture = 4·1 %	5	22·5	49·5	22·7
	14	—	61·2	35·4
	31	93·0	68·5	41·7

In the year 1919 a similar piece of land was selected, a small cutting of bersim being taken before sampling began. In this case the first sample, taken on May 27 before sheraqi conditions had set in, was kept in bulk under more or less dormant conditions in the laboratory.

On July 26 the same piece of land was again sampled and the two sets moistened up to 21 per cent. moisture and stored at 30° C. in lots of 1 kilo.

Determinations of nitrate, ammonia and bacteria numbers were then made periodically.

The untreated soil contained on sampling 14 per cent. of moisture which fell to 10 per cent. during storage.

During this period a little nitrate accumulated in excess of that present in the sheraqi sample when sampled two months later.

In both years the sheraqi soils after moistening up show an increased biological activity over the untreated soils, characteristic of partial

sterilisation, the number of bacteria being higher and there being a more rapid accumulation of available nitrogen entirely parallel with the cases investigated by E. J. Russell and his co-workers.

Table III.

Numbers of bacteria and amounts of nitrate and ammonia in sheraqi soils after moistening up to 21 *per cent. water content.* 1919.

	Number of days	Bacteria, millions per gramme of dry soil	Nitrogen, parts per million of dry soil		
			As ammonia	As nitrate	Nitrate produced
Untreated	0	3·4	nil	18·6	—
Sampled May 27th	5	16·4	—	31·7	13·1
Moisture = 14 %	15	15·0	—	32·6	14·0
	32	10·0	—	41·9	23·3
	62	9·1	—	51·2	32·6
	90	13·5	—	55·5	36·9
Sheraqi	0	2·1	10	8·2	—
Sampled July 26th	5	17·5	4	23·7	15·5
Moisture = 5·5 %	15	28·8	—	25·9	17·7
	32	24·1	7	40·0	31·8
	62	13·9	—	51·2	43·0
	90	18·4	—	61·3	53·1

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