ADV.
2/12/1926.

THE "ALKALI" SOIL PROBLEM.

PART II.

[Continuation of an article by Mr. Eric J. West, of the Commonwealth Citrus Research Station, Griffith, N.S.W.]

The Danger of a High Water Table.

A high water table is one of the chief causes of the accumulation of salt in the soil. When the water table is so high that it permits the water to rise to the surface by capillarity the salt in the soil will very quickly become concentrated near the surface where the water evaporates. Besides the indirect injury in causing the accumulation of salts, a high water table is directly injurious, as it is impossible for roots to penetrate a water-logged soil, and if the water table rises in the soil the roots of trees already established will be killed. In irrigation practice the water table should therefore be closely watched and never allowed to remain near the surface.

Pockets of Soil of a Different Texture or Structure.

Pockets of soil of a different texture or structure from the surrounding soil are often the cause of salt spots. Isolated patches, varying in area from a few square yards to a square chain, are found in which the soil is deeper, more permeable to water, and has a greater capillarity (considering both the rate and height of capillary rise) than the surrounding soil, and they therefore absorb much more irrigation water and remain damper at the surface for a greater length of time, which leads to the accumulation of salt. Such spots often owe their origin to rabbit warrens which have been levelled down in grading operations, and are due to the work of the rodents. In places where large trees have been grubbed out of the soil the same condition obtains. The accumulation of organic matter in these cases is probably also a factor in bringing about the physical conditions referred to above. Such salt patches are quite common, and are very annoying, as it is difficult to deal with them. It is practically impossible not to over irrigate them and at the same time to water the rest of the field sufficiently; their situation generally makes tile draining out of the question. It is to be noted that the physical conditions of the soil in these patches are desirable from the point of view of fertility when they refer to the soil as a whole. It is only when small isolated patches of soil of such a nature occur that trouble results. If the top 24 inches of the soil of the whole field is mixed up, as in deep ploughing, to this depth, which practice is adopted on the Murrumbidgee Irrigation Areas at times, the soil is greatly improved.

It is usually noticed that the soil bordering a salt patch carries better herbage than that surrounding. The salt, which contains the mineral plant-food of the soil, is more concentrated here than in the surrounding soil, but not sufficiently to be harmful; in other words, the soil is better fertilised. Besides this, the soil in the locality has a better, though not excessive water supply, owing partly to the presence of deliquescent salts, such as the chlorides of calcium and magnesium, and sometimes partly to the fact that the water table is close to the surface, but has not yet caused a sufficient accumulation of salt to be harmful. Thus salt patches are usually barren in the centre, and surrounded by a ring of great fertility, which, however, gradually becomes sterile as the salt patch grows in extent and the ring of fertility widens.

The Origin of Sodium Carbonate.

Sodium carbonate, or black alkali, is generally the product of reactions in the soil. After the soil is leached continually with sodium chloride (common salt) and then with pure water, sodium carbonate is recovered. At one time it was thought that this was due to the simple reaction between the sodium chloride and the calcium carbonate (limestone) in the soil. According to modern views, however, the reaction is more complicated. When a soil is impregnated with sodium chloride, complex insoluble sodium silicates are formed, together with soluble calcium chloride, which may be leached out. If the soil is now washed with pure water, sodium hydroxide (caustic soda) is formed, which reacts with the carbon dioxide of the soil, giving sodium carbonate, or black alkali. If this is removed from the soil by leaching, fresh sodium carbonate is produced from the store of sodium silicates present, which accounts for the great difficulty experienced in endeavoring to completely remove the black alkali from the soil.

Preventive Measures and Reclamation.

1. Prevention is Better Than Cure.—It is far easier to prevent salt accumulating than to remove it when it once appears. In some cases it is impossible to reclaim salt-impregnated soils. Early in the century the United States Department of Agriculture carried out experiments in reclaiming salt land. Salt lands in three localities were selected for the experiments, the first being at Billings, Montana, where the salt present was mainly sodium sulphate; the second near Salt Lake City, Utah, where, as before mentioned, the salt is mainly sodium chloride; and the third at Kearney Park, Fresno, California, where sodium carbonate was present. In the Utah tract the salt was several inches thick on the surface, and this was therefore a good test. Tile drains [illegible]

[illegible] depth, spacing, and size of the drains being carefully designed by engineers. The soils were flooded several times by irrigation water in an endeavor to wash the salt out of the soil through the drains. In the first two cases the land was completely reclaimed. It was thought at the time that this was also the case with the soil at Kearney Park, and a crop of barley was successfully grown, but after two years the land was as bad as ever, and improvement has never yet been effected.

Kearney Park Ranch, consisting of several thousand acres, planted up to deciduous trees and vines, belongs to the University of California, and is worked by them as a commercial proposition. The water table was originally about 90 feet below the surface; after the continual application of irrigation water, however, it rose to the surface and salt accumulation resulted. Sodium carbonate (black alkali) was formed in the way described above, which accounted for the difficulty of reclamation. The tiles were at first placed 6 feet deep, and as it was thought that an improvement would result if they were placed lower, they were lowered to a depth of 12 feet, but without effective results. Altogether about a thousand acres are affected, and since 1904 much investigation has been carried out in an endeavor to reclaim this plot of land. In fact, more scientific investigation for this purpose has been carried out on this land than on any other in the world, but a solution to the problem has not yet been discovered, although recent work is encouraging.

Fortunately there is very little black alkali on the irrigation settlements in Australia; nevertheless, from the above considerations, care should be taken in preventing the accumulation of salts. In certain cases it may be impossible to reclaim land once it becomes salt impregnated. Not only this, but it is found that in many cases where salt land is reclaimed the fertility of the soil is greatly reduced, due partly to the leaching out of plant food and partly to the poor physical condition of the soil produced.

2. Correcting Poor Irrigation Water.—If the quality of the irrigation water is at fault the remedy is to obtain, if possible, a purer supply. This may be done in some cases by the construction of dams or locks, as on the River Murray.

3. High Water Table.—If a high water table is the cause of the accumulation of salt, this should be remedied by tile draining if necessary.

4. Reducing Surface Evaporation.—By giving light irrigations in deep furrows in order to make the water percolate into the soil without wetting the surface more than necessary and by paying particular attention to cultivation to maintain a good surface mulch, the evaporation from the surface may be reduced and the rise of salt prevented.

5. Washing Salt out of Soil.—In order to remove salt already present in the soil an exactly opposite procedure should be adopted. The land should be flooded by heavy irrigations, wetting the whole of the surface in order to leach the salt out of the soil. In this case it is necessary to make provision for good under-drainage, and the construction of tile drains is almost always necessary. Tile drains will also prevent a high water table, and, if the irrigation water is slightly saline, it will be possible to give fairly heavy irrigations, allowing the excess water to drain away through the tiles, thus preventing the salt accumulating. It is thus seen that tile draining is not only the best preventive, but is the most effective method of removing salt.

6. Use of Gypsum and other Correctives.—If the soil is heavy it may be necessary to apply gypsum in order to facilitate the downward percolation of the water. Gypsum is especially beneficial if sodium carbonate (black alkali) is present, as it tends to convert the latter into sodium sulphate and to replace sodium in the sodium silicates by calcium. However, owing to the mode of the formation of the sodium carbonate, as described above, it is necessary to add far more gypsum than was previously supposed. Sulphur and other substances have also been used to assist in the reclamation of black alkali soils. Heavy dressings of farmyard manure and other organic manures are beneficial in various ways. They help to build up the fertility of the soil and, as explained, the organic matter decreases the toxicity of the salt.

7. Temporary Methods.—It is sometimes possible to remove the salts from the surface to the lower layers of the soil by heavy irrigations or by deep ploughing for sufficiently long periods to germinate or even to grow annual crops. This is important in the cultivation of lucern, which, although being very susceptible to alkali injury in the seedling stage, is very tolerant when mature.

8. Use of Salt-resistant Crop.—If a soil is too saline for one crop it may still be possible to grow one of greater resistance. Beets, which are an important irrigation crop in America, are very tolerant of salt, and are used extensively on salt land, and greater attention should be given to the growth of mangels on salt soils in Australia for the same purpose. Land which is too salt for citrus will often support vines. In Egypt rice is continually grown on very salt soil. In this case the flooding of the land washes down part of the salt from the surface soil, and dilutes the rest to such an extent as to permit the growth of the crop.

Lucern often proves invaluable as a crop for salt lands. When once established it is very tolerant, and it not only improves the soil by the addition of organic matter and by its well-known effect of opening up the soil, but it tends to prevent the accumulation of salt in specific layers of the soil by minimising evaporation from the surface. This is accomplished in two ways. In the first place the dense growth very effectively shades the soil and creates a humid atmosphere near the surface, and secondly, the water is abundantly absorbed by the deeply penetrating roots, to be transpired by the leaves, which checks a continual capillary current to the surface. Melilotus indica and Bokhara clover (Melilotus alba) particularly the latter, are also useful in this respect.

9. Other Preventive Measures.—Removing the salt from the surface by mechanical means, such as scraping, has sometimes been advocated, but is seldom of any practical value. An endeavor is also sometimes made to remove the salt by surface flushing with water. This is quite useless. Only a small part of the salt in the soil is actually on the surface, and of this much dissolves and soaks into the soil, where it cannot be removed by water flowing over it. The only way to remove salt from the soil by water is to make the water soak through the soil and to drain it away by underground drains.

Conclusion.

In conclusion, the distinctions between seepage, a high water table, and salt should be noted. These terms are often used synonymously. Where seepage or a high water table occurs salt usually appears, and again a high water table may result locally from continual seepage from ditches. It is possible, however, to have a high water table without seepage, and salt without either seepage or a high water table. Where a high water table is present it is sometimes difficult to say whether this or the resultant salt is the chief cause of injury to crops growing on the soil, but the remedy is the same in either case.

ADV. 2/12/1926

UNIVERSITY EXTENSION.

Sir David Gordon moved, in the Legislative Council yesterday—"That the grounds at present held by the Mental Hospital at Parkside, when vacated, should, in accordance with promises made by previous Governments from time to time, be reserved for use by the Adelaide University." He said many years ago there was a movement for the removal of the University on account of the congestion of buildings on North-terrace. New buildings had since been erected, and the University was extending towards the River Torrens. The University, however, was steadily growing, and the time would soon come when residential colleges would have to be established in connection with it. The subject was mentioned at the recent celebrations in connection with the jubilee of the University. It was not expected that any resolution carried would be binding, but it was hoped that it would keep the question alive. It was desired that the residential colleges connected with the University should be grouped together. He hoped when the Mental Hospital was being removed from Parkside the position from the point of view of the University's requirements would be considered. The debate was adjourned.

ADV. 2/12/1926

UNIVERSITY EXAMINATIONS.

Referring to the reported lack of graph paper, and the delay caused in handing out papers at a University examination at Mount Gambier, Mr. F. W. Eardley, the registrar of the University of Adelaide, said a report had been received from the authorities at Mount Gambier, stating there had been insufficient graph paper at this examination. The examiners will be informed of the deficiency, and the students will not be penalised on this score. Mr. Eardley said he had not been officially informed of any delay in handing out examination papers. Papers were distributed at all examinations at the hour of commencement, and the loss of time would be negligible.

ADV. 2/12/1926.

THE UNIVERSITY PROCESSION.

From "OLD BOY," North Adelaide:—Some years ago I and many other used to look forward with pleasure to a series of gatherings carried out by University students, who had just completed their year's work. Running over these in one's mind, one great event is found to be missing—the procession. I have seen many such, both here and in other parts of the world, and have been delighted by the spirit underlying the performance as much as the actual display itself. Are the present members content to let this custom drop into oblivion? Is this the first step towards the degeneration of a University into a glorified "cramming" establishment?

Reg. 2/12/1926

UNIVERSITY OF ADELAIDE.

Examination Results.

FACULTY OF SCIENCE.

FOR THE DEGREE OF DOCTOR OF SCIENCE.

Thesis.—Ward, Leonard Keith, B.E.

FOR THE DEGREE OF MASTER OF SCIENCE.

Thesis.—Hossfeld, Paul Samuel, B.Sc.; LeMessurier, Thomas Abraham, B.Sc., M.A.; Samuel, Geoffrey, B.Sc.

FOR THE DEGREE OF MASTER OF ENGINEERING.

Thesis.—Parsons, Rex Whaddon, B.E.

FOR THE HONOURS DEGREE OF BACHELOR OF SCIENCE.

PHYSICS (41).

First Class.—Mitton, Ronald Gladstone, and Wilson, Luther Ernest Crosby (equal).

FOR THE ORDINARY DEGREES OF B.Sc., B.E., AND DIPLOMA IN APPLIED SCIENCE.

Pure Mathematics (30). First Year.

Passed with Credit (in order of merit).—Glastonbury, James Oliver Garnet; Sprigg, Charles Mosse; Baker, Walter Ross, Burns, Mary Leonora, and Finlayson, Frank Harvey (equal); Ballantyne, Elsie Ray; Woods, Nelly Hooper.

Passed (in alphabetical order).—Allen, Leonard Nicholls; Ashton, Mabel Winifred Blown, William Baker; Buring, Rupert Hermann Maurice; Chapman, Stanley Bertram; Clode, Ailsa Marjorie; Edmonds, Stanley Joe; Gazard, John Anthony; Habich, Carl Julius; Heinemann, Mervyn Lambert; Hosking, Lochee Maude; Iliffe, Michael Isaac Glover; Meier, William Erich; Mitchell, Donald Thomas; Pearson, Halley James Crawford; Pitt, Barbara Jean; Richardson, Rosslyn Fenshaw; Semmens, Francis John; Smith, Clarence Herbert; Taylor, Donald William; Thorpe, Claude William; Thyer, Robert Francis; Turner, Edward Robert; Wannan, Ellen Sarah; Webb, Rita Gwendoline; White, William Richard Bolitho.

Pure Mathematics (31). Second Year.

Passed With Credit.—Hughes, Gordon Kingsley.

Passed (in alphabetical order).—Bosworth, Richard Charles Leslie; Cox, Alwyn Birchmore; May, Jack William; Mitchell, Frank Wyndham.

PURE MATHEMATICS (31a).—SECOND YEAR (ENGINEERING STUDENTS).

Passed with Credit.—Blaskett, Kenneth Selway.

Passed (in alphabetical order).—Alexander, William Colin; Bridgland, Reginald James; Cook, Ernest Peter; Finlayson, Frank Harvey; Garrett, Allan Leonard; Mills, Eric Baxter; Plunkett, Norman Ambrose; Taylor, Donald William, Whibley, Cyril George; Woolnough, Geoffrey Lawrence; Yeates, John Norman.

PURE MATHEMATICS (32).—THIRD YEAR.

Part I.—Elementary Analysis.

Passed with Credit.—Symons, Lloyd Alfred Grigg.

Passed (in alphabetical order).—Dawson, Alfred Lisle; Harvie, Sydney Haral; Kriehn, Adolf Oscar, B.A.

Part II.—Elementary Geometry.

Passed with Credit.—None.

Passed.—Dawson, Alfred Lisle.

Part IV.—Spherical Trigonometry and Astronomy.

Passed with Credit.—None.

Passed (in alphabetical order).—Charlesworth, Thomas William; Kriehn, Adolf Oscar, B.A.; Williams, Spencer.

APPLIED MATHEMATICS (33).—FIRST COURSE.

Passed with Credit (in order of merit).—Hosking, Michael; Cook, Ernest Peter; Richards, Cecil Albert, B.A., Alexander, William Colin, Blaskett, Kenneth Selway, and Bosworth, Richard Charles Leslie (equal).

Passed (in alphabetical order).—Bates, William George James; Bridgland, Reginald James Leslie; Gladye, Ernest James; Hughes, Gordon Kingsley; Lang, Philip Roy, B.A.; Leask, John Hunter; Lock, William Ewart; Maloney, Martin James; Martin, Alfred Irwin; May, Jack William; Mickan, Erwin Johannes; Mills, Eric Baxter; Morgan, William Matheson; Sawley, Francis Lee; Smith, Ronald Norman; Walkley, Allan; Witt, Erik; Yeates, John Norman.

APPLIED MATHEMATICS (34).—SECOND COURSE.

Passed with Credit (in order of merit).—Symons, Lloyd Alfred Grigg; McPherson, Alexander Owen; Mitchell, Frank Wyndham.

Passed.—None.

PHYSICS (37).—FIRST YEAR.

Passed with Credit (in order of merit).—Ide, Frank Boyle, and Mitchell, Donald Thomas (equal); Finlayson, Frank Harvey; Blasket, Kenneth Selway, Owens, Arthur John, and Sprigg, Charles Mosse (equal); Gazard, John Anthony, Hughes, Gordon Kingsley, and Semmens, Francis John (equal).

Passed (in alphabetical order).—Baker, Walter Ross; Bateman, Wilfrid; Blown, William Baker; Brauer, Edwin Harold; Buring, Rupert Hermann Maurice; Chamberlain, George Whitfield; Chapman, Stanley Bertram; Cropley, Frederick Waterton; Dane, Allan Lepine Pearce; Dawkins, Lindsay Cramp; Day, Kathleen Emilie; Duell, Allen John; Duncan, Raymond Adamson; Edmonds, Stanley Joe; Gibbs, James Alfred; Glastonbury, James Oliver Garnet; Green, Richard Maslen; Habich, Carl Julius; Hamilton, James Frederick; Harris, Ray Lawrence; Heinemann, Mervyn Lambert; Hill, Victor Arthur, Hudson, Lindsay Stuart; Hussey, Francis Leitch; Iliffe, Michael Isaac Glover; Kinnaird, Alexander Ross; Lawrence, Alfred Oscar; McDougall, Edwin George; Maclean, Godfrey Hubert; Meyer, Heinrich Carl; Mitchell, Albert Leonard; Paterson, Alfred Harold; Peek, Dudley Keith Leslie; Pohlmann, William Frederick Claude; Ridley, Kenneth Lincoln; Saddler, Bruce Allder; Sawley, Francis Lee; Schulz, Ernst Adolf; Smith, Clarence Herbert; Taylor, Donald William; Thorpe, Claude William; Thyer, Robert Francis; Turner, Edward Robert; Ure, Constance Douglas; Venville, Charles Rupert Gordon; Verco, Wilfred Douglas; Verrall, Raymond Wilfred; Ward, Leonard Rosslyn; White, William Richard Bolitho; Wilkinson, Frank Stanley; Williams, George Eeson Keith; Woodman, Stanley Kenneth.

PHYSICS (38).—SECOND YEAR B.Sc. COURSE.

Passed with Credit (in order of merit).—Bosworth, Richard Charles Leslie; Hosking, Michael; Goldsworthy, John Garfield; Mitchell, Frank Wyndham; Witt, Erik.

Passed (in alphabetical order).—Cook, Ernest Peter; Garrett, Allan Leonard; Hunwick, Arthur Philip; Maloney, Vernon Thomas Steven; Mara, Margarita Anna Flora.

PHYSICS (38a).—SECOND YEAR, B.E. COURSE.

Passed with Credit (in order of merit).—Honner, Wilfred Weston; Glayde, Ernest James.

Passed (in alphabetical order).—Galbraith, Cyril; Maloney, Martin James; Martin, Alfred Irwin; Mills, Eric Baxter; Morgan, William Matheson; Threl, Percy Elliott.

PHYSICS (40).—THIRD YEAR, B.E. COURSE.

Passed with Credit.—McPherson, Alexander Owen.