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REMARKS ON THE HAWKESBURY-NEPEAN ALLUVIAL DEPOSITS AND IRRIGATION.

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THE area which forms the subject of these remarks is the nearest extensive alluvial deposit to our metropolitan market, to which, since the foundation of the colony, it has furnished immense quantities of agricultural produce. It is distant about thirty-six miles due west from Sydney. The district is most interesting geologically, as well as being renowned for the wonderful fertility of the "flats" or bottoms. The gently undulating clay shale country so characteristic of the central portions of the metropolitan county, extends westwards until terminated abruptly by the rocky towering ledges of the Blue Mountains, close under which the Hawkesbury Nepean River flows in a northerly direction, traversing the western margin of the shale formation which it has in many places deeply eroded, and covered large areas with the alluvium washed down from the uplands by the flood waters. The sudden transition from the clay shales to the rugged sandstone has been caused by an immense fault along a line having a general bearing north and south. The downthrow is on the eastern side, the vertical displacement being many hundred feet. To this fault is largely due the development of the existing physical conformation of the valley and its environs. Mountain torrents discharge their turbulent floods into the river on its left bank, whilst the streams joining on the right have an inferior fall, and drain long, gently rising, valleys which stretch away amongst the low hills, and have a general course somewhat parallel with the main valley. The most important western tributary is the Grose River, which drains a profound and extensive gorge within the mountains. South Creek

is the chief eastern tributary, and it drains an extensive area of gently sloping country. The native name for South Creek is Wianamatta, and from the fact that the drainage basin of the Wianamatta Creek lies wholly within the clay shale area—the late Rev. W. B. Clarke, F.G.S., named this formation, which is in horizontal layers, the Wianamatta beds.

The Hawkesbury-Nepean valley commences about three miles south of Penrith, at which point the Nepean River issues through a precipitous rocky gorge on to Emu Plains. As the River flows northerly it is joined near Richmond by the Grose. From this point on the river is known as the Hawkesbury. The fertile alluvial flats now become very extensive, and extend far back from the river banks, first on one side and then on the other, until near Pitt Town the hills begin to close in upon the river, thence fertile benches of alluvium alternate with rocky headlands, the latter becoming more numerous, and at last the river is again enclosed between towering sandstone heights.

The main valley, which contains the continuous stretch of alluvium, is about twenty-two miles in length, and the river water for the whole of this distance is always fresh. The tide rises and falls at Windsor, washing on one side alluvial banks and on the other the hard shaly outcroping layers of the Wianamatta beds. In times of severe flood the silt-laden waters are poured down into the valley from the back country, and, quickly rising, spread over the flats, upon which they deposit part of their load. When these flats were covered with a dense growth of vegetation—scrub and high trees, etc.—the movement of the flood waters over the surface must have been checked, and the deposit of the finer patches of silt facilitated. The obstruction offered to the passage of minor floods across the flats must also have produced a stronger current in the main channel. Now the flats are cleared, floods may be expected to deposit coarser silt on them, and also deposit silt in the river channel itself. This is actually taking place, and the Hawkesbury which was once navigable for boats as high up as Richmond Bridge is now only navigable for similar craft to Windsor Bridge. The disturbance of the soil on the upland

slopes of the watershed, by settlement of population thereon, tends to increase both the rapidity of the off-flow of storm water, and the amount of silt carried down.

On examining the valley and its environs, it will soon be seen that there are indications of two distinct alluvial deposits, of different ages, and having different surface levels. The lower of these is the most recent, and comprises the rich alluvial flats or bottoms along the river banks. The soil is a dark-coloured loam of very fine texture, and of unsurpassed fertility when a proper amount of moisture is available. These flats are all under cultivation, and produce, in favourable seasons, splendid crops of lucerne and maize. The surface of this deposit is from twenty to twenty-five feet above summer level of the river. Bounding these lower flats, more or less, along the whole length of the valley, are benches of a reddish and yellowish coloured soil. The summits of these benches, except where reduced by erosion, are uniform, and form long stretches of exceedingly level land, which extend back from the river until lost amidst the country, and have an average elevation of from fifty to sixty feet above the river. This deposit is much older than that composing the low level flats, and appears to have at one time been continuous over the whole valley. According to the Government Geologist, it belongs to the Pleistocene age. It consists largely of a ferruginous sand with a small admixture of clay; but it varies very much, in some places iron preponderates, in others clay, and in others sand. Large areas of it have attained a fair degree of consolidation. It also contains extensive deposits of pebbles of all sizes, from that of a pea up to 18″ x 12″. The pebbles are chiefly quartzites, altered sandstones and claystones, with reef quartz pebbles. One of these, assayed recently, showed traces of silver. These pebbles are altogether different to those which are removed from the bed of the Nepean at Penrith, and broken up for road metal. Bordering the whole of the alluvial deposits on the eastern side, and partly on the west, are the sloping sides of the shale hills of the Wianamatta beds. The weathering of the shale, and its transportation on to the alluvial, obscures the junction line.

The Pleistocene or upper alluvial beds are fairly fertile, but require a higher degree of cultivation than the recent alluvials. For this reason very little has been put under crops; large areas have been cleared, but the greater portion is still uncleared. Several thousand acres have been reserved for commons for the local towns. The clay shales are also fairly fertile if well cultivated.

The relative positions of these three formations may be graphically described thus: The Wianamatta beds are the oldest, and were hollowed by subsidence and erosion. In the depression the Pleistocene beds were deposited and consolidated. Subsequently these beds were extensively scooped out, and in the hollows the recent alluvium has been deposited. The area of the watershed which drains into the Nepean at the head of the valley is over 4,000 square miles.

The long and severe period of drought which has but recently been terminated by the welcome rains has had the effect of concentrating and directing attention more forcibly than ever to the necessity for the conservation of water and its application for irrigation purposes. The many years during which local meteorological observations have been recorded have, so far, not indicated a system or style of any practical use to agriculturists. The rainfall is most erratic in its occurrence. During 1887, at Sydney, 60·16 inches of rain fell, and last year the record was 23·01. Under such conditions serious losses are inevitable. The average rainfall at Windsor, which may fairly be taken to represent the whole valley, is 32·63; this is the result of twenty-five years' observation. Out of these twenty-five years two were slightly under 20″, viz., 19·96″ and 19·21″, and for ten of these years the record was over 20″ and under 30″ per annum. For the remaining thirteen years the record was over 30in. On the whole, therefore, the rainfall may be considered very favourable, the soil on the flats being so very fertile the good seasons more than make up for the bad ones. The bad seasons are due to excess of rain with floods or to droughts. The former must be endured, the latter can be remedied by making use of the river water so near at hand.

The farmers, however, have been so accustomed to balance the seasons, and from experience finding that their returns are ample, it will be difficult to get them to go in for innovations. There is also a danger to be apprehended from irrigation, unless systematic drainage is likewise carried out. If, for instance, after a copious watering a wet season should follow, the result would not be at all to the satisfaction of the farmer, hence the need for drainage which, moreover, would be necessary to prevent injury to a neighbours' crops. A system of sub-soil drains might be arranged to act as drains to remove the surplus water during wet seasons, and for sub-soil irrigation during dry seasons. It is on the upper alluvium and on the slopes of the surrounding hills that irrigation may be expected to make headway. The value of the land is low, but it is of a class that would be wonderfully benefited by the application of river water. River water almost always contains the elements of fertility, and properly applied to land it gradually enriches the soil, notwithstanding that crops are taken off. The Nepean water has been estimated to contain ten grains of solid matter per gallon.

It is estimated that for general agricultural purposes a rainfall of not less than 30 inches per annum is required. The rainfall on the valley may generally be relied upon to amount to 20 inches each year. Water for irrigation purposes would only be required to supplement this, and to make certain of watering at the critical period of growth; with this assured, the crops would be secure. It is probable that fruit growing will be found to pay best on the upper alluvium and the shales. Fruit trees and vines do not require very much water, particularly if the soil be properly worked. Altogether the volume of water required for the irrigation of the whole valley would not be so great as some anticipate, but in the absence of reliable surveys of the area it is impossible to form an opinion of the probable amount. Proposals for the irrigation of the valley have often been mooted, and they nearly all have included the construction of a dam across the river-bed within the gorge south of Penrith. This would have to be high enough to back the water up to a level sufficient to command as much of the valley as possible, and save pumping. The district under

present conditions is prosperous, but with the advent of irrigation on a proper scale, and under efficient management, it would go ahead with leaps and bounds. Success will only be achieved by united action, and no doubt there will be great difficulties to surmount and prejudices removed, before a comprehensive scheme is carried out. The success of the present movement is greatly to be desired, and it would be a pity to see it die out. The work is one of national importance.