NOTES

GROUND SURFACES ON FLOOD PLAINS

W. A. Pullar*

The occurrence of analogous soil profiles on widely separated flood plains at Gisborne, Whakatane, and Hawke's Bay suggests that the soil could be used to nominate bodies of alluvium by identifying their ground surfaces†. In this note only flood plains and associated low benches are considered—not the contiguous high-level terraces, for the recognition of which another method has been proposed (Pullar, 1965b). Ground surface is a useful device for finding one's way about the landscape.

Ground surfaces recognised in order of decreasing age and from a higher to a lower level are as follows: **Taupo Pumice, Waihirere, Matawhero,** and **Modern**.

TAUPO PUMICE

Taupo Pumice, which was erupted c. 1820 years ago and showered over the Taupo, Rotorua, Bay of Plenty and Gisborne districts (Vucetich and Pullar, 1964), is found in the topsoil and identified by its creamy coloured, highly vesicular lapilli. It occurs in the Hexton, Kaiti, and Tamarau localities at Gisborne, and on the uppermost bench at Red Bridge in Tukituki valley, but is not present at the surface in Rangitaiki Plains or Galatea Basin where the air-fall bed is often buried too deeply for easy observation. At Gisborne, a local name, **Te Hapara,** was used for this ground surface (Pullar, 1965a), but the widespread fall of Taupo Pumice suggests that the same name as for the ash could well be employed. The distribution of this ground surface in Hawke's Bay and the Waikato has not yet been established.

WAIHIRERE

Waihirere is derived from Waihirere soils on the Gisborne Plains where they occur on the highest parts of the flood plains and have been largely flood-free for a long time. They were formed after the Kaharoa eruption of c. 930 years ago. The soil

* 114 James Street, Whakatane.

† **Ground surface** is a term proposed by Butler (1959): ". . . for specific surfaces of significance to the pedologist . . . it is the layer and surface of deposited and residual materials exposed at one time and on which soil profile organisation has developed or is developing . . ." In this note only deposited materials (alluvium and volcanic ash) are considered.

is marked by A/B horizons of black topsoil on a pale yellow subsoil with a sharp boundary between the two, and on drying out, a weak, gross prismatic structure shows up in the subsoil. As Kaharoa Ash lies 30in. below the surface on Gisborne Plains, it is assumed that gradual sedimentation continued until c.1450 A.D. (see Grant, 1965), when rivers commenced to degrade and so leave Waihirere soils high and dry. Analogues of this profile are common on flood plains in the Bay of Plenty, Gisborne, and Hawke's Bay districts, so that the Waihirere ground surface can be regarded as a valuable benchmark in the landscape and worth investigating as a possible universal event for the North Island.

MATAWHERO

Matawhero is also derived from Gisborne Plains where widespread accumulation has buried Waihirere soils and allowed the surface soil to express weak A/C horizons of brown on olive brown. Accumulation commenced suddenly and the event was catastrophic, for nowhere is the accumulation assimilated with Waihirere soils, as would happen with slow, periodic sedimentation when the topsoil gradually moves upwards with the accumulation. A date for this event could not be determined at Gisborne and is borrowed from Grant (1963:158, 166), who reported catastrophic destruction of the forest on Huiarau Range c. 1650 A.D. This assumption is reasonable as the range is within 20 to 30 miles of Gisborne.

In the Tukituki valley (Grant, 1965), Matawhero deposits are new bodies of alluvium and not merely an accumulation on Waihirere soils as on Gisborne Plains. In the Whakatane River meander trough, no Matawhero deposits have been recognised and are most likely buried too deeply for easy observation. On eastern Rangitaiki Plains, the ground surface is largely Waihirere, most surface alluvium having been deposited shortly after the Kaharoa eruption; Matawhero alluvium, if any, would have to be searched for in the natural levees of Rangitaiki River. Numerous flood layers, however, indicate that this river has been continually overflowing its banks, so a search might prove difficult.

MODERN

The name **Modern** is adopted to label the effects of erosion and sedimentation since about the start of European settlement. A commencing date may vary from region to region depending on the onset time of accelerated erosion. On Gisborne Plains, the name **Waipaoa** was selected and a commencing date of 1932 assumed for the reason that a hiatus in flooding between 1918 and 1932 encouraged a weak humification of the surface of previous deposits and so presented a marker bed from which to measure subsequent accumulation. On the Rangitaki Plains, the date of the Tarawera eruption (1886) is accepted because of the ease of measuring accumulation from a seam of black Tarawera Ash (Pullar, 1963). In the Tukituki valley, however, Grant (1965) has assumed c.1840 as a commencing date for Modern erosion and sedimentation.

INTERPRETATION

The Waihirere ground surface is the most common and widespread and suggests that flood plains are not much older than 500 years. This ground surface marks an interval during which other natural events might be elucidated; for example, the amplitude of old loops in the Waipaoa meander trough indicates meander sweeping on a larger scale than today—suggestive of more frequent bank-full discharge by Waipaoa River. According to Dury (1960:237), it would seem that little more annual rainfall is required to increase the frequency of bank-full discharge. Thus, meander sweeping during Waihirere times suggests rainfall a little higher than to-day, but with no erosion and with rivers reworking their alluvium.

Few traces of Maori occupation have been discovered on the Waihirere ground surface; most by far have been recorded on the surrounding hills. The recognition of this ground surface could be of some help to Green (1963:99), who postulated a proto (pa or village) Maori phase c.1450–1650 A.D. Waihirere soils were most likely used for Maori agriculture (Taylor, 1958:76-77).

The Matawhero event may be restricted to the east coast of the North Island. While Grant (1965) has been successful in drawing implications subsequent to the event, the history of rivers in the Gisborne district, particularly in the upper and middle sections, may be masked by the effects of serious accelerated erosion during Modern times.

Of importance is the rate of accumulation and distribution of Modern deposits. In the Waipaoa River meander trough on Gisborne Plains, accumulation from 1932 to 1950 (18 years) ranges from 6–36in. In the Whakatane River meander trough near Whakatane, the rate is slower but still appreciable at 12in. to more than 36in. from 1886 to 1962 (75 years). On Gisborne Plains, the Waihirere ground surface in the Lavenham locality began to receive increasing amounts of Modern alluvium from 1932 onwards; and in the Ormond, Waerenga-a-Hika, and Awapuni localities, thin accumulations continued during the 1948 and 1950 floods. At Waimana and in the Rewatu locality near Whakatane, the Waihirere ground surface received one to three inches of fresh alluvium during the 1964 flood, and the same surface in the "City South" suburb of Whakatane was covered with flood waters in the 1965 flood.

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INSTALLATION AND FROST PROTECTION OF LAMBRECHT RAIN GAUGES

A. Chandler*

INTRODUCTION

The Lambrecht monthly chart recording rain gauge is now widely used in New Zealand. With a time scale of 1cm/hour and a vertical magnification of eight times, charts are very clear and easily interpreted. However, it has been found that both the gauge housing and the general weather resistance are inadequate for many New Zealand localities. Three Lambrechts have been installed in South Canterbury, one in each of the Rocky Gully and Orari regional catchments and a third at Fairlie. The collecting can has been retained in all cases.

INSTALLATION

Holding down bolts and stay brackets are cast in a 4–6in. lightly reinforced slab, with overall dimensions about 4ft x 5ft. Stay brackets are made from 3in. x $\frac{1}{8}$in. flat mild steel and have a $1\frac{1}{4}$in. horizontal slot near the top, enabling easy levelling of the instrument. The stays are Dexion angles, with ends crimped together (Fig. 1).

* Engineer-Hydrologist, South Canterbury Catchment Board, Timaru.

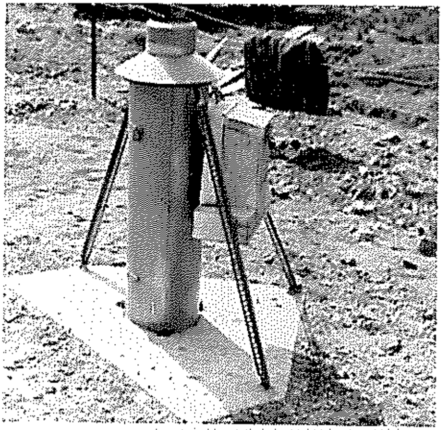

Fig. 1—SLAB BASE, dexion stays and kerosene burner housing.

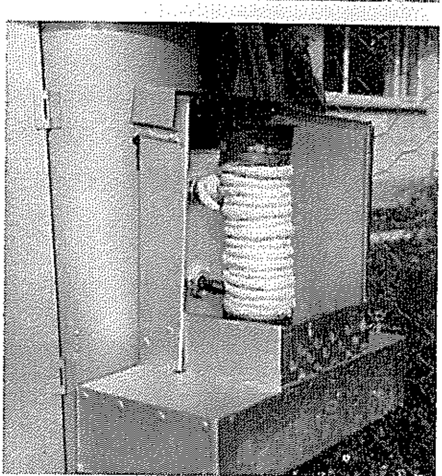

Fig. 2—KEROSENE BURNER with 2-gallon fuel tank, lagged reservoir and shielded air vents.

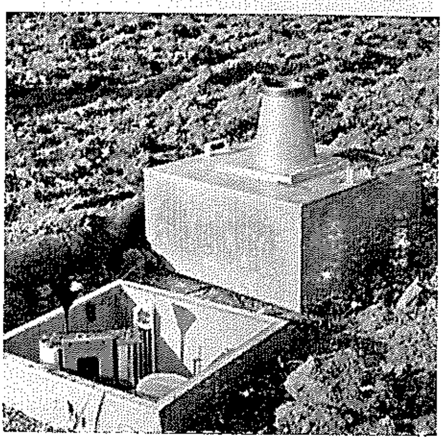

Fig. 3—GROUND HEAT INSTALLATION. Note gauze-covered top of ground heat tube.

This form of installation is rigid, permanent and quite tidy in appearance. The job can be completed in one day if rapid hardening cement is used.

FROST PROTECTION

The Rocky Gully Lambrecht was installed at a height of 2,700ft in January 1963, with a ground heat drum (Speight, 1962) below it. In addition, glass wool insulation was wrapped around the outer casing at the beginning of winter. Probably due to poor circulation of the ground heat, the inside temperature was never noticeably above that outside. However, the gauge successfully withstood temperatures of 24°F, but eventually the float burst when the temperature dropped to 22°F.

Conclusions reached were that:

(a) This type of gauge is extremely difficult to insulate effectively due to its large exposed surface.

(b) If the gauge is installed in a region where consistently low temperatures are experienced, some form of artificial heating is required, unless better circulation of ground heat can be attained.

Kerosene Heating

As the Rocky Gully site is remote from electric power supply, experiments with kerosene burners were started, having in mind the following factors:

(a) Only the float chamber requires heating.

(b) A burner inside the gauge is impracticable because of smoke, condensation and lack of space.

(c) The burner should perform effectively for up to a month without attention.

The burner shown (Fig. 2) contains a $\frac{3}{8}$in. wick, fed from a 2-gallon tank, the depth of which should not exceed 4in. (approximate limit of capillary action). The reservoir consists of concentric $1\frac{1}{2}$in. and $2\frac{1}{2}$in. copper tubes, the rings being sealed top and bottom except for a filler hole at the top. The flame is below and concentric with the reservoir, the hot gases passing up the inner tube. A $\frac{3}{8}$in. copper tube is coiled three times around the float chamber and connected to the top and bottom of the reservoir. The reservoir is filled with Shell Light Separator Oil, and expansion and contraction due to heating and cooling, supplies the circulating force.

During trials, the float chamber temperature was maintained at 20-35°F above air temperature and when the float chamber was insulated, this was raised to 35–45°F. Unfortunately, it is not possible to measure minimum float chamber temperatures in the field without more refined equipment.

Careful insulation improves the efficiency of the system: the gauge case being lined on the inside with paper-backed glass wool, the float chamber lagged with the same material, the reservoir lagged with asbestic rope, and the burner container lined with 1in. polystyrene sheeting. In addition, the float chamber is insulated from the base plate by a cork gasket. To date, this method of frost protection has proved satisfactory, with the burner operating unattended for a month or longer.

Fuel consumption is of the order of one gallon per month, so that the 2-gallon tank gives an ample reserve. If additional heat is required, a larger wick should be used rather than using a higher flame, which will cause soot to form.

Electric Heating

The Lambrecht installed at Lochaber in the Orari catchment is at the homestead and it was decided to use electric heating in this case. The interior of the gauge was lined as in the previous case and fitted with a light socket. An underground lead was run from a nearby shed containing the house switchboard with another light socket at the switchboard. The sockets contain 60w. bulbs, connected in series—the actual wattage then being 15. The bulb at the switchboard gives a continuous check to the farmer that the system is switched on and also that both bulbs are functioning.

To date, 15 w. has proved sufficient to warm the gauge, and it is not recommended that higher wattages be used, unless prior testing is carried out, due to the excessively high temperatures that will be achieved on warm days. (It is assumed the power will be switched on continuously for the winter.) During the 1964 winter, minimum recorded inside and outside temperatures were 26°F and 20°F respectively.

The alternative is a higher wattage heater operated by a thermostat, and this is possibly a better solution. The heater could be extended to melt snow and ice in the receiving orifice in addition to warming the float chamber. However, additional expense would be involved and a separate meter would be required at the switchboard.

Utilizing Ground Heat

In this case, a new gauge housing was constructed which is essentially a plywood box 19in. square by 32in. deep (Fig. 3). This was lined on the outside with 1in. polystyrene having a protective covering of 26-gauge galvanised steel. The lid was similarly constructed. Because of its ready availability, a 5in. diameter brass orifice rim was used and, in this case, a half-inch float rise very closely represents 10 points of rain.

Ground heat is extracted by means of a 24in. x 10in. x 6in. light steel box buried at a depth of 5ft. Two 4in. diameter tubes connect this to the rain gauge container, one with its lower end at the top of the ground heat box and upper end near the top of the rain gauge housing, and the other with its lower end near the bottom of the ground heat box and upper end at the bottom of the housing. These differential levels should considerably assist air circulation.

The normal Lambrecht base plate is mounted on a plywood shelf with space beneath for the siphon tube and collecting can.

This rain gauge was temporarily installed at Fairlie and during the 1964 winter was tested by many severe frosts, the lowest recorded outside temperature (18in. above ground level) being 11°F. The minimum recorded temperature within the rain gauge was 32°F, thus giving a useful safety margin (see statement above that a Lambrecht had withstood temperatures of 24°F). With a more refined design and construction, the efficiency could probably be improved and still be at a fairly reasonable cost.

This method of frost protection should be sufficient for average New Zealand conditions, but would probably not be adequate for mountainous areas.

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LETTERS TO THE EDITOR

OPTIMUM SOIL MOISTURE LEVEL

D. S. Rickard*

The use of the phrase "optimum soil moisture level" in the December 1964 editorial might imply to the unwary that a soil can be induced to remain at some predetermined soil moisture. The only moisture level that a well-drained soil can be maintained at is field capacity; neither a practicable nor desirable proposition. Any addition of water to a soil will normally raise a particular depth completely to field capacity and all an irrigator can do is to attempt to control the degree of dryness the soil reaches between irrigations.

* Winchmore Irrigation Research Station, Ashburton.