EROSIONAL EFFECTS OF RECENT AND PAST CLOUDBURSTS IN THE GODLEY VALLEY, LAKE TEKAPO

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A Recent Cloudburst

Each year a cloudburst somewhere in New Zealand makes the headlines. This report describes the ecological effects of a recent cloudburst in the South Island high country and gives evidence of similar cloudbursts in the past.

On 26 December 1957 a cloudburst occurred in the headwaters of the Tasman and Godley Rivers, with the Hermitage recording an all-time maximum of 19 inches of rain in a day. This rain was from a northwest air flow and a change to the southwest early on the 27th probably resulted in little additional rain (Meteorological Office — pers. comm.).

On the 31 December, the silt and high water marks in the smaller side valleys draining into the main Godley River were examined. In the Godley Valley the heaviest rainfall was evidently confined to a 5–6 mile wide zone centred on the mid Godley Valley, and the rainfall had decreased slightly towards the head of the valley, and decreased greatly down the valley towards Lake Tekapo. The few rain gauge stations in the area showed this decrease down both the Tasman and Godley Valleys (Table 1).

In one of the smaller side valleys (catchments ca. 6 sq. mile area) the stream is usually about 20–30 ft. across by 1–2 ft. deep, but on this occasion there were water and silt marks 4 ft. above the normal level on both sides of a 50–60 yd. wide gorge. There was spectacular aggradation of the stream beds in each of the smaller catchments within the zone of maximum rainfall. The amount of aggradation, estimated from known land marks, in the previously mentioned catchment, was of the order of 10–15 ft. deep by 60–100 yd. wide and extended upstream 1–2 miles from near the mouth of the valley, i.e. approximately a million cubic yards of material. In a similar sized neighbouring catchment the dimensions were 15 ft. × 100 yd. × 1½ miles. The surface of the deposition was even. The material itself was mostly fine shingle washed from the sides of screes bordering the stream, and from hill slopes. The "mobile layer" of scree (Fisher 1952) was removed from many of the upper scree slopes exposing the bare "compact" layer. Small gutters on the slopes, normally shallow and dry, were converted into deep impassable gullies. There were some new landslides and slumps throughout the mid and upper Godley Valley, but seem-

Table 1. *Rainfall on 26-27 December, 1957. (Information furnished by the Meteorological Office.)*

Station	*Miles from mid Godley Valley*		*Rainfall (in.)*	*Approx. frequency of such daily rainfall*
Godley Valley				
Lilybank Stn.	6	SE	2.33	once per year
Godley Peaks Stn.	14	S	1.07	3–5 times per year
L. Tekapo Hydro	25	S	0.68	6–8 " " "
Tasman Valley				greatest on record
Hermitage	18	WSW	19.34	(1925 on)
Braemar Stn.	23	SW	2.73	once every 2–3 years
L. Pukaki Hydro	43	SSW	0.68	6–8 times per year

ingly few considering the intensity of the deluge.

In the following months and years, the streams rapidly cut down through the aggraded material, transporting it out of the side valley and depositing it on the fan (delta) abutting the main Godley River. The streams have frequently changed their courses because of the amount of material being transported and are covering the vegetation on the fan with a layer of gravel. On the slopes, the rain-steepened gullies have been the origin of increased headward and sideward erosion into scree slopes and vegetation.

PAST CLOUDBURSTS

Three lines of evidence suggest that cloudbursts of similar or greater magnitude have occurred in the past. Firstly, at the head of the Cass River, which also drains into Lake Tekapo, there is one small catchment area notable for its large outwash fan with only a small entrenched stream. This fan is about 1½ miles long, 1 mile wide and several hundred feet deep. Except for the rocky stream bed, it appears to be composed predominantly of fine gravel. The upper surface of the fan is very even. The vegetation is uniform over the whole area with a crustose lichen (*Placopsis* sp.) covering the rock, and scattered small shrubs and herbs of *Helichrysum depressum, Pimelea prostrata* and *Epilobium melanocaulon*. This uniformity of vegetation at an early seral stage indicates that the whole area became available for colonization at the same time. The fine gravel and even upper surface is similar to that aggraded by streams in the recent cloudburst. The cloudburst presumably responsible probably occurred in the late 1800's. Haast (1879) made a geological and botanical exploration of the headwaters of the Cass River in 1862 and did not mention this fan. From this I infer that it probably did not exist at that time because it is now a striking geological and botanical feature.

The second line of evidence comes from an instance where the main Godley River cuts deeply into a fan from a side valley and has exposed three fossil soil profiles. These are brown silty loam soils 1–2 ft. thick and separated from each other by 5–6 ft. of gravel. The upper profile is overlaid by 10–20 ft. of gravel and capped by the present soil. This sequence indicates periods of stability during which a soil could develop, followed by periods of gravel deposition similar to that happening to the upper soil layer at present.

The third and most tenuous line of evidence is the age structure of the matagouri (*Discaria toumatou*) which covers many of the fans. Ring counts on one well-covered fan showed that while there was much variation in external diameter, most of the bushes were in the 30–50 year old range, though a few were in the 100–120 year range (assuming that number of rings = age in years). The 30–50 year old bushes may represent recolonization on gravel resulting from a cloudburst, and the few 100–120 year old bushes may be survivors of the previous vegetation.

CONCLUSION

The cloudburst of 27 December 1957 shows that in South Island high country they can produce great changes in localized areas in a short time. The few years that have already passed show that their long term effects may be just as great in initiating or accelerating an erosion cycle. This recent cloudburst also presented features which enable one to interpret other observations as resulting from cloudbursts of the past. Thus, occasional and exceptional rainfall should be recognised as a factor in attempting to understand the ecology of the South Island high country.

REFERENCES

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