MOUNTAIN LAGOON AND THE KURRAJONG FAULT.

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The area we discuss in this paper is the region to the north of Kurrajong Heights, between Mountain Lagoon and Wheeny Creek, a belt of country in the County of Cook some three and a half miles long by about one mile broad.

The only approach to this area is by way of Bilpin, a settlement eight miles from Kurrajong Heights on the Bell road. From Bilpin a track leads through to Mountain Lagoon, following the top of the ridge which is the main divide between Wheeny and Tootie Creeks. By this, the only practicable route, the Lagoon is fifteen miles from Kurrajong Heights, although in a direct line it is only five or six miles. (See Fig. 1.)

The only previous literature we have come across that deals in any way with this district is Professor David’s ‘‘An Important Geological Fault at Kurrajong, N.S. Wales,’’ read before the Royal Society of New South Wales on December 3rd, 1902. Of this we have made use in so far as it applies to this region.

We also acknowledge the use of Willan’s map of the Sydney District. This we found useful and suggestive, but unreliable both as regards contours and creeks, especially in the immediate neighbourhood of the Lagoon.
Unfortunately we have been able so far only to make a contour map of the northern part of our area. This we hope is more in accord with the facts than any hitherto published.

Fig. 1. Plan of the Kurrajong-Fault Area

Where the creeks in the area did not already have names, and most of them had not, we have named them ourselves for convenience of reference. The Lands Department has now adopted these names.

The Monocline and the Kurrajong Fault.—Extending in a north-south direction from Glenbrook to Kurrajong there lies the great monocline fold. At Kurrajong this folding has caused an uplift of over 850 feet, although it is only
half that amount at Glenbrook. To the west of the monocline at Glenbrook is a slight downwarp or fold of about 100 feet. Behind Kurrajong there is a well defined fault, with a throw of 450 feet. The fault here and the fold at Glenbrook probably belong to the same movement although their connection has not yet been definitely established. They were probably caused by readjustment after the monoclinal fold, according to Professor David. (See Fig. 1.)

The Colo, the Grose, and the smaller Wheeny Creek were all alike confronted with the fault and were all able to cut their way through it and continue very largely in their old courses, though they were probably all diverted slightly to the south. (See Fig. 2.) Apparently the faulting took place so slowly that these streams were able to cut a channel right through the upthrust side while the action was going on, for in our cursory examination of Wheeny Creek we could find no evidence of lacustrine deposits indicating a temporary dam, and where the smaller stream was able to continue its flow uninterruptedly, it is unlikely that the larger streams were even dammed up for a time, unless they have changed in volume, which is also unlikely.

It is clear, however, that Mountain Lagoon was caused by the damming up of a small stream, which, before the faulting, flowed straight across into the Colo. This course is occupied now probably by Taylor Creek. For a time, no
doubt this old stream was able to keep pace with the faulting for a wind gap has been cut in the fault behind the Lagoon. This wind gap at its lowest point 400 yards from the Lagoon shore is now only eleven feet above the surface of the Lagoon, but this is owing to deepening by headward erosion of Taylor Creek. It is improbable that the original wind gap came down as low as this (See Fig. 3.)

The Lagoon Topography.—Mountain Lagoon may be roughly compared with an overturned saucer. The lagoon itself occupies the shallow depression within the rim of the bottom of the saucer. (See Fig. 4.) Its watershed con-
sists of only the narrow rim itself, outside which are streams which besiege it on all sides. Each of these has a very steep grade.

The lagoon is fed by no stream of appreciable size. The longest is a mere soak some 600 yards long, flowing in from the west. We use the term "soak", here and elsewhere, for a short creek-bed normally dry but which carries water after rain.

In the north one proceeds over a narrow strip of country some 150 yards wide to the top of a divide only 50 feet above the Lagoon. On the far side of this divide are the headwaters of Cora Creek, draining into Tootie Creek and hence into the Colo.

On the south the rim of the bottom of the overturned saucer is even lower. Here the divide is between the Lagoon watershed and Lagoon Creek. Normally the latter does not drain the lagoon, but a few years ago a ditch was cut through the divide to connect the two in order to empty

Fig. 4. Block Diagram of Area
the Lagoon for cultivation purposes. However, nothing was done in that direction and the drain has now become almost filled with silt. Apparently the flow of water from the Lagoon was not sufficient to keep a clear channel, but in course of time the headward erosion of Lagoon Creek must eat back along the ditch and so open the outlet again—this time permanently. As matters are now Lagoon Creek, flowing southward, commences its course some 60 yards to the south of the Lagoon.

The longest slope to the depression is on the west, and down this slope is the soak before mentioned. On this side the divide is over half a mile from the Lagoon. This divide separates the soak waters from those of Stewart's Creek, a tributary of Lagoon Creek.

On the east the saucer analogy is weakest. Here there is a most interesting example of capture. About 150 yards from the Lagoon, running north-south, is the great fault scarp. This scarp is breached by a wind gap right opposite the Lagoon. The divide between it and the headwaters of Taylor Creek lies in the wind gap—400 yards from the Lagoon shore and only 11 feet above it.

Taylor Creek has just captured Russell Creek, which but yesterday, geologically speaking, flowed into the Lagoon. Taylor Creek has eaten back the divide and by doing so has captured Russell Creek, which now, making an angle of about 40°, turns and flows in the opposite direction.

How precarious the position of the Lagoon is can readily be seen. As soon as one of the besieging streams reaches it all traces will be removed in a very short time.

*Topography of Surroundings in Detail.*—Lagoon Creek for some 500 yards of its course occupies merely a little V-shaped silty trench, five feet deep. This quickly deepens after that and in quite a short distance the creek occupies the bottom of a juvenile gorge some hundreds of feet deep.
Lagoon Creek follows the edge of the fault scarp closely, no doubt because that is a line of weakness, making erosion easier. (See Fig. 5, Section A.)

Just before the junction with Wheeny Creek it takes a turn into the downthrust side of the fault, leaving the scarp. There is here a well-marked shelf on the eastern side of the valley. This shelf is level with the top of the gorge on the western side. Section B (in Fig. 5) shows this shelf.
The reason for this is that the creek is probably following up another line of weakness—a cross fault. The result is that it joins Wheeny Creek with a boat-hook bend.

Dorothy Creek is the only appreciable tributary of Lagoon Creek on the left-hand side. The rest are mere soaks. The reason of this lies in the smallness of the watershed, being confined wholly to the scarp face. Dorothy Creek is the biggest, probably because it has cut its way into the basalt rock of Basalt Hill (see below) and that is easier to erode than the sandstone.

On the right-hand side there are three creeks. Of these the most northerly is Stewart’s. The source of this creek is due west of the Lagoon about half to three-quarters of a mile. At its source the level of the creek is much the same as that of the Lagoon, but in its length of only 1500 yards it has a fall of 400 feet.

The two other creeks joining the main creek on this side are Grahame and Flat Rock. Of the three, the last is the longest and has the greatest volume. Both of these creeks flow from the main ridge running from Bilpin to the Lagoon, the main divide between Tootie and Wheeny Creeks. Both Grahame and Flat Rock Creeks are typical juvenile streams with steep grades, falls and gorges.

Wheeny Creek has cut a magnificent gap through the upthrust side of the fault. Just before it reaches the fault it flows through a canyon with walls 500-700 feet high, but where it cuts through the upthrust these are increased by an extra 500 feet. The sections C and D in Fig. 5 give some idea of the difference.

Cora Creek, to the north of the Lagoon, flows into Tootie Creek. It descends even more rapidly than Lagoon Creek, and soon becomes intrenched in a great gorge.
Taylor Creek, on the east, drains straight through to the Colo. As explained above, it probably represents the beheaded stream which formed Mountain Lagoon, when unable to keep pace with the faulting. It, too, flows through a gorge and descends at a steep grade.

When we stand on the divide in the wind gap and look down Taylor Creek we notice that the valley is very wide for such a small stream, even allowing for the captured Russell Creek which flows towards us obliquely and then turns into the main creek. The floor of the valley is here 200 feet wide, but ahead, that is to say downstream, we can see that it narrows. Section (E) is at the wind gap, and section (F) 500 yards below. (See Fig. 5.)

This is very obviously abnormal, and how are we to account for it? Our first theory was that the wide valley represented ordinary erosion by Taylor Creek in the shatter belt caused by the fault. This was strengthened by our noticing that where the valley is wide there is no stratification of the sandstone visible, only huge loosely-sorted boulders forming gigantic talus slopes. Erosion would be, of course, more rapid in a shatter belt.

However, although we do not reject this theory, a second has suggested itself, that the wide valley represents the wind gap cut by the old stream, deepened, as we have said, by the headward erosion of Taylor Creek. The narrow valley below would then represent the normal juvenile valley of Taylor Creek. This does not altogether explain why the outcropping strata are covered in the wide valley while they remain visible in the narrow, so perhaps there is a little of the truth in both theories.

Summary.—The topography of the downthrust side of the fault is a dissected peneplain with a slope towards the east to the great fault scarp. Although the Lagoon occu-
pies a small local depression, it is actually higher than most of the downthrust side of the fault, being one of the few remaining parts of the peneplain as yet undissected.

**Geology.**

The main geological feature of the area is the Hawkesbury sandstones, the middle series of the local Trias system. In places these are covered by Wianamatta shale beds, but nowhere did we find Narrabeen shales exposed. At Mountain Lagoon there is an outlier of Wianamatta shales. (See Fig. 4.) This is just what we would expect to find at the core of the old peneplain. The shales cease abruptly at the fault scarp on the east. On the north and west we find the shales for a short distance but as the country becomes more dissected they have been worn away. In the south the shales cease abruptly at a small local upwarping of some fifteen feet. This warp is a distinct feature at right angles to the main fault and it is where it crosses them that both Stewart's and Lagoon Creeks enter into their gorges.

On the side of the fault scarp south of the Lagoon there is an exposure of basalt. (See Fig. 4.) We were not able to discover if this was post-faulting or not. However, we noted—

1. that no basalt is exposed at all on the downthrow side;
2. the basalt does not reach the level of the downthrow side;
3. it is not found even as talus in Lagoon Creek;
4. it reaches to within 50 feet of the present top of the fault scarp;
5. it has been weathered into a rich chocolate soil, and there are few exposures of the actual rock.

The boundaries of the basalt and Wianamatta shale are indicated approximately on the block diagram submitted. (Fig. 4.)
Settlement and Economic Effects of the Fault.

At present there are five farms in the district, but only two are being worked. Citrus fruits are grown chiefly. The orchards are located on the Wianamatta shale in the Lagoon area and on the main divide at the Lagoon end. There does not seem much prospect of any greater density in the population, for the best areas have already been taken up, and there only remains a small portion of Wianamatta shale soil. We understand Basalt Hill has been selected, but it is as yet uncleared. The total number of farms in the whole area can never exceed a dozen, so that the construction of a good road is unwarranted unless a tourist route be made, following the present track from Bilpin to Upper Colo. This would make Mountain Lagoon, a place of great geographic and also of scenic interest, much easier of access, but since it is not a place of economic interest it hardly seems likely that such a road will be constructed at present.

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