

**“No stone unturned: the Bulolo Gold Dredging story”
Talk to the Sydney Mining Club, Thursday 2 June 2011, Tattersalls, Sydney**

1. Sydney Harbour Bridge

For most of you this will seem a strange slide to begin a talk about gold dredging in New Guinea.

But in fact it has two specific links to the next photo....

2. Dredge No.1

...which is of a dredge at Bulolo – inland from Lae in New Guinea.

The links relate to the timing of the photos as well as the people who constructed each of them.

The Sydney Harbour Bridge was opened on 19th March 1932, while this photo was taken at Bulolo the next day – and the day before the dredge was launched – 21st March 1932.

It was during the Depression – and with no work available in Australia, many of the riveters and boiler-makers who had worked on the Bridge went to Bulolo in 1931, where they were employed constructing this dredge. Some stayed on to build more dredges and to work on them as dredge hands in the years that followed.

In March next year, we’ll celebrate the 80th anniversary of the opening of the SHB. But there’ll be no celebrations in PNG.

3. Dredge No.5 today

This is all that remains of the largest of the dredges built in Bulolo before the War. Nothing remains of dredge No. 1, which was cannibalised for parts in the 1950s before being sold for scrap.

4. Title

Why should we be interested in what happened in Bulolo so long ago? I suggest there are several reasons:

1. It was the first successful large scale gold mining operation in Papua New Guinea, whose rugged, highly folded terrain we now know to be exceptionally auriferous.

Between 1932 and 1965, less the war years and their immediate aftermath, Bulolo Gold Dredging produced 2.3 million ounces of gold and more than a million ounces of silver.

2. Secondly, Bulolo Gold Dredging demonstrated how an innovative approach could successfully overcome the challenges posed by New Guinea's difficult terrain.
3. Finally, the company's approach to risk and financial management was exceptional and one that can be held out as a model for mining companies, even today.

My talk today will explore each of these themes. I'm going to concentrate on the pre-war period, as many of the circumstances I'll discuss changed after 1945.

But first you may be interested in a little background.

5. Map 1

Today, people are well aware of PNG's gold mining potential, but as late as the 1920s nothing was known about its mineral resources.

Not that a lack of knowledge discouraged wishful thinking. In 1528 the captain of a Spanish ship sailing eastward from the Moluccas encountered the western end of New Guinea – and believing it to be rich in gold, named it *Isla del Oro*.

In 1606 Captain Don Diego de Prado, who sailed with Torres along the southern coast of New Guinea, went a step further, venturing that:

There is no doubt that these lands contain many mines of rich metals, as they are at the same altitude and parallel of that part of Peru which has the best mines of gold.

However, discoveries prior to World War 1 were relatively small. There were none in German New Guinea, while small mining operations scattered around Papua produced around 360,000 ounces, of which Woodlark Island accounted for more than 40%.

Nor did things improve after the War. The former German colonial territory of New Guinea remained a backwater, as did Papua. Each had a tiny non-indigenous population, with copra production the only significant economic activity.

In New Guinea, this changed in 1926 with the discovery of gold at Edie Creek.

6. Map 3

It might be useful to show you the area I'm now talking about. Mention

- Lae – little more than a camp used by the occasional patrol
- Salamaua – the only place on the coast where there was a safe anchorage
- Watut River of which the Bulolo was a tributary

- Wau – a township that developed after 1927 and became the hub of the goldfields.
- Villages between the Bulolo River and the coast

7. Map 4

Shows the area in close up. Mention

- Wau
- Edie Creek at the back of Mt Kaindi
- Lower Bulolo River flats
- Hidden Valley

In January 1926 a prospector, Bill Royal, struggled up Mt Kaindi and discovered gold in unimaginable quantities at upper Edie Creek. He exclaimed incredulously to his partner, Dick Glasson, *"It looks like gold but it can't be. There's too bloody much of it."*

His reaction was understandable. Each dish he washed contained up to 20 ounces of gold. Although it had a high silver content, it was an extraordinarily rich find.

Shortly afterwards, using simple sluice boxes, Glasson and another member of the syndicate, Joe Sloane, recovered 7,600 ounces of gold in six weeks. At the prevailing gold price, this was worth \$1.1 million in today's terms.

It took a while for word to get out, but once it did, there was a rush of men from Australia to Salamaua.

Photo 8. Kunda bridge

Edie Creek is 32 miles inland from Salamaua and getting there involved a 6 to 8 day trek over mountainous jungle-covered country, using precarious bridges to cross many raging mountain streams.

It was claimed that – on the way in to the Bulolo River – one climbed 30,000 feet for a net gain of 3,000, and from the Bulolo to Edie Creek was another 4,000 foot climb – straight up.

9. Levien

Cecil Levien was a former District Officer who – by 1925 – had come to believe that the alluvial flats comprising the Bulolo Valley downstream from Edie Creek had considerable gold-bearing potential and were amenable to dredging.

10. Map 4

Given the problems of getting heavy mining equipment to the site, Levien speculated that aviation might be used to transport it – this at a time when no plane had ever flown in New Guinea.

No Australian investors were interested in his ideas, but publicity surrounding the Edie Creek discovery a year later gave him fresh hope.

By the middle of 1926, Levien had persuaded some investors to form a new company, Guinea Gold – and he'd pegged and applied for leases over a wide area of the lower Bulolo Valley.

By year's end, he'd persuaded the Guinea Gold Board to acquire a small biplane – the first plane to fly in New Guinea....

11. The DH 37

..... and early in 1927 built an aerodrome with a 1 in 12 gradient at Wau on the lower slopes of Mt. Kaindi.

However, Guinea Gold was poorly capitalised and progress was limited. In 1928 it was on the verge of collapse when a small Canadian mining company, Placer Development, took an option over the Bulolo valley leases.

12. Map: Bulolo Valley – southern and northern leases

These covered more than 2,500 acres along 11½ miles of the Bulolo River. The property comprised two sections – the upper or southern leases and the lower or northern leases, separated by a gorge.

It was decided to test only the southern leases initially. Using hand drills – there being no other source of power – it soon became evident that Levien was right – the alluvial gravels were indeed rich in gold. A miner with long experience who reviewed the results observed,

I regard this Bulolo area as the world's most important placer deposit since Klondyke. There is nothing in Australia like it.

The southern leases tested covered 1100 acres over 4½ miles of the Bulolo River and surrounding flats, and it was estimated that they contained 39 million cubic yards of gold-bearing gravel, with an average depth of 22 feet.

The mining engineer's report concluded that two dredges, each with 8½ cubic foot buckets, would handle 3 million cubic yards per year – at a cost that was less than one third the value of estimated gold production.

But getting dredges to the valley was easier said than done. Between it and the coast were miles of impenetrable jungle. There was no road on which dredging machinery could be brought in to the valley and the Administration was unwilling to build one. Nor was there power to operate dredges.

The challenges were endless. There was simply no infrastructure of any kind – no airstrip, no local roads, no townships and no labour force.

While an airfield could be constructed, the few planes then in New Guinea were small. The largest could only carry 2,000 lbs in freight and so were in no position to fly in the equipment needed to build a dredge and a power house.

In October 1929, as Placer's directors were considering their options, Wall Street collapsed. Aviation had never previously been used to support a large mining operation in a remote location and it was hard to see investors being attracted to this option at such a difficult time.

However, rather than pass up such a potentially rich mining opportunity, Placer's directors pressed ahead, deciding that the dredges could be sectionalised and flown in to the Bulolo Valley where they would be assembled.

13. Junkers G31 'Paul'

The planes they chose – and on whose effectiveness the whole operation depended – were two Junkers G31 aircraft. Each of these could carry nearly three tons of freight and at the time were amongst the largest planes in the world.

An operating company – Bulolo Gold Dredging – was established, and after raising the funds needed – no mean feat given the state of world financial markets – the 11th March 1932 was set as the date for the first dredge to begin operating.

This was only 21 months away, and was an audacious target.

Co-ordinating the supply of machinery, equipment and people from all over the world in an era of poor communications was a massive logistical exercise. The dredge hull and superstructure were made in Balmain, in Sydney, dredge machinery came from San Francisco, turbines from Sweden, alternators from England, electric motors from Switzerland and, of course, the G31 planes from Germany – with American engines.

As there was no port, everything would have to be landed at Lae using lighters, before being flown in on planes the company didn't yet have to an airstrip that didn't yet exist.

In the Bulolo Valley, jungle would have to be cleared, roads built and power lines erected while a dredge and a hydro-electric power station were constructed by a labour force that hadn't yet been recruited.

14. Bulolo Valley

Mention: aerodrome and 1st dredge under construction

Each dredge hull was assembled in a large rectangular pit. Once the hull had been constructed, the pit was filled with water to a depth of about 10 feet. The superstructure was then completed and dredging machinery installed.

Jack O'Neill – who later worked on the hull of another dredge – vividly described the experience:

It was a huge rectangular frying pan – a hot frying pan. All around it on the edge of the pit were stacked the steel plates, cut, numbered and already drilled for the rivets – pieces of a 'Meccano Set'. My first step was onto that frying pan, which – situated only a few degrees below the equator – was at a good cooking temperature.

Soon there were red-hot rivets flying through the air from the forges up above to the riveters' off-siders, who caught them in steel funnels and poked them through the holes. The sweat dripped off our noses and sizzled to nothing on the hot steel. We were building a huge, rectangular, ugly, flat bottomed boat – and as day followed day the frying pan became a series of ovens as the sides and bulkheads went up – we were the roast.

Constructing the hydro-electric power station was no easier. It was decided to locate it where the river left the gorge at the southern end of the Bulolo flats **[point]**, with a head race drawing water from 1½ miles upstream to drive the turbines.

This involved driving a tunnel by hand through the side of a mountain that was more than 1600 feet long and 8 feet by 8 feet in cross-section, constructing more than 3,000 feet of cedar fluming, and digging an open ditch 2,900 feet in length.

15. Flume

16. Power house

The target may have been ambitious, but it was achieved. Or almost.

The first of what was eventually to be eight dredges was launched ten days later than the planned date, on 21st March 1932.

17. Dredge No.1

The dredge was 106 feet long, 50 feet wide and had a 9 foot draught. It weighed over 1,000 tons and was equipped with 63 - 10 cubic foot manganese steel buckets, each weighing 1½ tons, which dug to a depth of 29 feet.

18. Dredge buckets

19. Full dredge buckets

23 buckets passed a given point every minute, 24 hours a day, 363 days a year.

20. Dredge at night

The dredged gravel was discharged into a hopper and then passed through a perforated revolving screen 40 feet long, where it was washed under high

pressure. The fine material passed through the screen and dropped down to gold saving tables where the gold was trapped by riffles and amalgamated with mercury. The larger tailings were dumped well astern of the dredge via a conveyor belt on the stacker.

Dredges stopped only once every ten days for a few hours to collect the gold and undertake repairs and maintenance.

21. No.1 at southern end of the valley

Construction of the second dredge began immediately after the first had been launched, and it began operating in October 1932.

Meanwhile, testing of the northern Bulolo leases had revealed the presence of gold in commercial quantities at depths of up to 65 feet. The leases were estimated to contain 50 million cubic yards of gravel. While the gold content was not as high as in the southern leases, dredging costs were estimated to be only a little more than one third the value of the gold produced.

In December 1931 – even before the first dredge was launched – BGD decided to construct two more to work the northern leases, about 7 miles down river from Bulolo. An aerodrome was constructed and the new township of Bulwa established near the junction of the Bulolo and Watut rivers.

Dredges 3 and 4 were larger than the first two and could dig to between 50 and 60 feet. They were launched in November 1933 and August 1934.

22. Dredge No.4

23. Bulwa from the air 1935-36

Mention:

- Two dredges
- Bulwa township
- Aerodrome

Back on the southern leases, further testing with powerful electric drills during 1935 confirmed suspicions that the initial testing with hand drills had hit a false bottom at around 22 feet, and that gold-bearing gravel extended to a much greater depth.

It was estimated that the leases contained a further 170 million cubic yards. The gold price had risen from \$US 20.67 to \$US35 an ounce in January 1934, so these increased reserves were potentially very profitable.

BGD therefore decided to build two new deep-digging dredges that would be amongst the world's largest, designed to dig to a depth of 125 feet.

Weighing 2,500 tons, they were more than twice the size of the first dredge and were capable of digging 250,000 cubic yards a month. Each had a digging ladder with 118 eleven cubic foot buckets that passed a given point at the rate of 24 a minute.

The first of these dredges began operating in December 1937 and the second in June 1939.

24. Dredge No.5: the first of the two large dredges

It was a mark of the company's propensity to leave no stone unturned in its quest for gold that, while planning to build a couple of the largest dredges in the world, it was also focused on an alluvial deposit that would require one of the smallest.

In 1935, BGD took up an option over leases near Wau containing a shallow alluvial deposit of 6.3 million cubic yards. In 1937 a 1,000 ton dredge with 77 six cubic foot buckets was constructed, and it began operating in March 1938.

Thus by the late 1930s, BGD had extended its operations to Bulwa and even further downstream, was dredging at greater depth across the southern Bulolo leases, and had a dredge working upstream near Wau.

The final piece of its plan was now to dredge the lower reaches of the Watut River above its junction with the Bulolo. To do this it constructed an eighth dredge, which began operating in November 1939.

So what were the keys to Bulolo Gold Dredging's success?

Undoubtedly, its innovative use of aviation was top of the list. BGD initially acquired two Junkers G31s, and contracted Guinea Airways to fly them.

Everything required to build and maintain eight dredges, three hydro-electric plants and two townships was flown in from Lae to Bulolo and Bulwa on these two planes. They were called *Peter* and *Paul* after the children's nursery rhyme, as they made five – and often more – round trips a day.

A couple of pictures of the G31s at work.

25. Loading *Paul* at Lae

26. Unloading *Peter* at Bulwa

Their performance attracted mining experts and aviation enthusiasts from all over the world. As one writer noted,

The breakthrough was not just a matter of shattering world freight records, although every one of them was demolished time and time again; it involved

learning how to do things with aeroplanes that had never been attempted before, of achieving high standards of efficiency and safety under great difficulties.

Between March 1931 and January 1942 the two G31s, supplemented on occasion by a third, flew 14,000 trips over 1.4 million miles, carrying nearly 40,000 tons of freight and around 7,000 passengers.

The activities of *Peter* and *Paul* were matched by an extraordinary volume of air traffic between Salamaua and Wau to meet the needs of a steadily growing goldfields population.

27. Air Freight – International comparison

In consequence, throughout the 1930s New Guinea was the largest airfreight carrying country in the world, flying more than half as much freight as all planes in the United States, Canada, Germany, France and the UK combined. In no year did any other country's planes carry more freight than in New Guinea.

That Bulolo Gold Dredging succeeded so spectacularly was due to the quality of its directors and managers and, in particular, their risk and financial management skills.

Four of its five directors were experienced mining engineers and, although three were located in Canada and the US, they were directly involved in different aspects of BGD's operations whenever necessary.

Given the difficulty of communicating between Bulolo and Vancouver – where Placer's and BGD's main office were located – general oversight of the Bulolo operations was left in the hands of my grandfather, Les Waterhouse, in Sydney. Day to day operations at Bulolo were handled by an experienced general manager.

It was a very flexible line of command, involving considerable delegation of responsibility and mutual trust.

BGD's success was critically dependent on three things:

28. Factors critical to BGD's success

- the uninterrupted flow of materials and electric power
- the ability to fix promptly anything that went wrong, and
- the quality of its labour force.

The primary focus of directors and management was on managing the risks associated with these.

While the likelihood of losing a plane was considered low, the disruption would be so great if one were to occur that BGD implemented a three pronged strategy to minimise the risk:

- It carried considerable quantities of spare under-carriages, parts, wheels and tyres;
- Full engine overhauls were substituted for the light servicing required every 200 hours; and
- It acquired a third G31 in 1933, which was kept on standby in case of emergency.

BGD's foresight was vindicated in May 1934, when *Paul* crashed at Lae, after petrol drums shifted on take off, affecting the plane's balance. It was 18 months before it resumed flying, during which time the third G31 shared the load with *Peter*.

Wherever possible, dredge and power station parts and machinery were standardised so that the loss of a critical part wouldn't interfere with operations.

- Thus, when No. 1 dredge was being constructed, all parts for No. 2 were already at Lae and could have been substituted for any that were lost.
- Similarly, it was decided to make the second of the deep digging dredges a duplicate of No. 5 rather than build an even larger one – although this meant passing up the opportunity to dig at even greater depths.

After the first power station was damaged by flood debris, a second and then a third power station were built to guarantee a reliable supply of electricity to the dredges.

Lost dredging time was lost money. To minimise stoppages, BGD maintained the most advanced machinery shop in New Guinea, with an oxygen-making plant and boiler making, welding and electrical annexes able to carry out all engineering repairs and maintenance.

Critical to BGD's success was its ability to build and retain an experienced workforce. In March 1932, there were about 125 Europeans and 380 New Guinean labourers at Bulolo. Numbers grew steadily as more dredges were constructed, reaching a peak of 330 and 1,525 respectively in 1939-40. About one third of Europeans had their families with them.

BGD provided excellent living conditions for white employees and their families. Refrigeration plants and locally grown vegetables meant fresh rather than tinned food.

29. Bulolo township

Unmarried employees were accommodated three to a house – each with their own bedroom – and they ate in the company mess. Married men lived in two bedroom houses.

By the early 1940s the range of recreational facilities provided by BGD would have done justice to a fair size town in Australia. A picture theatre showed films twice a week, and Bulolo and Bulwa between them could boast four recreation halls with billiard tables, table tennis, a lending library and reading room – four tennis courts with lighting for night tennis, three swimming pools fed by natural springs, a six rink bowling green, nine and six hole golf courses, a 600 yard rifle range and a cricket pitch.

Nor did BGD neglect its indentured labourers. Most came from villages in the Sepik district and were recruited for two or three years. BGD realised at the outset that it would need many labourers, and would be more successful in attracting them if they returned to their villages happy that they'd been treated well.

30. Housing for labourers

BGD rejected the large, impersonal barracks typical of plantation compounds and – in an attempt to retain elements of the familiar village atmosphere – built many small huts, each accommodating two to four workers. These were located within compounds, which had electricity, running water and showers and a septic tank sewerage system.

Nearby were gardens containing sweet potato, taro, corn, paw paws and bananas. Rather than a communal mess, rations were issued individually, so that labourers were free to cook and eat in small groups and at times of their own choosing.

They also had access to the best equipped hospital in the Territory. As a result, their mortality rate was considerably less than elsewhere on the goldfields.

The attention BGD directors paid to financial management was equally precise. Running a highly profitable operation, they may have been forgiven for a relaxed attitude towards costs.

But from their initial decision to purchase two G31s rather than construct a road, they took every opportunity to accelerate revenue streams while containing costs – so long as this was consistent with their approach to risk management.

Planning in 1931 had assumed working costs of 15 cents per cubic yard dredged. In practice, BGD kept this to between 8 and 9 cents throughout the 1930s. While this was partly due to spreading fixed costs over an increasing number of dredges, BGD also contained costs by concentrating on doing what it did best – mining.

Wherever possible, it outsourced other activities that it considered could be done better and/or more cheaply by others. Thus it used private recruiters to recruit labourers, Guinea Airways to fly its G31s and the postal service to deliver its gold safely to Australia.

31. Stamps

An era unique in Australian – and indeed in world history – ended abruptly at 12.30 pm on 21st January 1942, when five Japanese zeros attacked Bulolo, destroying all three of the Junkers G31s on Bulolo aerodrome.

32. Peter on Bulolo aerodrome

33. Pat on Bulolo aerodrome

Bulolo Gold Dredging's performance during the 1930s is unique in Australian mining history. Initially a two dredge operation, it expanded progressively until the eighth and final dredge began operating late in 1939. By the time operations ceased following the Japanese attack, these dredges had handled 119 million cubic yards of alluvial gravel, producing 1.3 million ounces of gold and nearly 600,000 ounces of silver.

BGD started with known reserves of 40 million cubic yards of gold-bearing gravel. By opening up new ground – both vertically and horizontally – its reserves increased to 150 million cubic yards at the outbreak of war – that's additional to the 119 million I just mentioned.

BGD and the many smaller pre-war operators did little more than scratch the surface in their search for gold. With modern mining technology, companies are of course now exploring at far greater depth, resulting in mines such as that at Hidden Valley and prospective gold mining operations at Wafi-Golpu and Woodlark Island.

But it was Bulolo Gold Dredging which was the first to confront the difficult challenges of mining in PNG to mount a successful large scale gold mining operation there.

BGD's innovative approach to the challenges it faced and its astute approach to risk and financial management may be of another time, but they remain a sign post to the future of gold mining in PNG today.

Thank you