

'GONE BUT NOT FORGOTTEN'

Caves of the Cobden Quarry, West Coast, South Island, New Zealand

Mary Trayes

ACKMA, NZSS, GSNZ

Email: maryt.runanga@xtra.co.nz

Abstract

Investigation of a former quarry in the Cobden Limestone, West Coast, South Island, New Zealand has revealed the existence of previously unknown cave and karst development. The Cobden Limestone (the type name comes from the quarry area) generally has a lower calcium carbonate content (70 - 80%) than other karst and cave forming Oligocene limestones of the region. Other known caves in the Cobden Limestone are generally muddy, and small to moderate in size only, but research about the 130 year period of the quarry's working life indicates that cave development there may have been more extensive than usually found within this formation. Since 1881 when quarrying began, five caves of varying size have 'come to light' due to blasting. It is postulated that the five chambers uncovered may have been part of one larger cave. A study of the drainage in the area also points to this. A large 'sink' was identified north-east of the quarry in 2013 and for many years a creek drained from the lower face. Formations retrieved from the last cave uncovered about 1999 allow a glimpse of what might have been and one stalagmite collected is in the process of being dated. Many fossils have been collected from the quarry and it is a listed geo-preservation site for Oligocene Echinoids. Large parts of a fossil Ziphioid Whale skeleton were also found in 1887.

Introduction

This paper is part of wider research being undertaken about the Cobden Quarry. Other aspects under study are its land tenure, the rock as a resource, the effects of having such a large quarry within close proximity to a town, sociological effects (a steady employer but also a dangerous place to work), how we remember such places for posterity and what other non-quarrying activities have taken place there.

The author first became interested in the Cobden Quarry when, as part of her employment with the West Coast Regional Council (WCRC), she was involved with the quarry's 2005 closure and site rehabilitation. Since retirement research about the quarry has become a major interest including talking to people who worked there, or their descendants, learning about past quarry techniques and plant and

chasing up where all the rock went to. From 1881 to 1930 a dozen men lost their lives (eight in the Cobden Quarry alone) and many more were injured, in the effort to win sufficient rock to form two large breakwaters for training the river and stabilising the bar at the Port of Greymouth.

Setting

Modern day Greymouth straddles both banks of the Grey River just downstream of the Grey River Gorge with the suburb of Cobden, and the quarry, on the north side. The Grey River has a large catchment, with the river flowing 120kms south-westwards from its source near the Lewis Pass to enter the sea over a sandbar at Greymouth. Rainfall in the region is high – 2500mm per year at Greymouth alone – so the river is prone to flooding. Flow rates in the river regularly reach 3,000m³/sec and during big floods can exceed 5,000m³/sec. The prevailing weather, from the west off the Tasman Sea, often causes big swells on the bar and when these are combined with strong flow rates in the river, shipping movements in and out of the Port of Greymouth can be quite hazardous. Many ships and fishing boats have been lost over the years.

Either side of the Greymouth Gorge is a line of tectonically uplifted limestone hills with the Rapahoe Range (also called the "Twelve Apostles") to the north and the Peter Ridge to the south. The river has successfully cut down through the limestone to form a deep gorge, the bottom of which is 40- 50m below water level. Much of this depth is filled with gravel eroded from glacial terraces further upstream then brought downriver by successive floods.

After a clear night in autumn and winter, a cold katabatic wind, the 'Grey Barber', drains down the Grey Valley through the gorge making mornings in Greymouth and parts of Cobden unpleasantly cold and windy. Between the wet climate, the Grey Barber and its south-facing aspect, the Cobden Quarry just downstream of the gorge, was a far from idyllic workplace for much of the year.

The town of Greymouth developed from 1864, firstly as a port of entry for goldminers, then later when the gold began to run out, as a main centre for shipping coal and later timber. The first quarrying was done

on the south (Greymouth) side of the gorge in the early 1870's to make room for both a road and railway. In order to do this at least two caves, one a Maori burial cave, were quarried away.

In the same period there was a disastrous flood (1872) when many buildings by the river were washed out to sea. The government quickly funded the building of the town's first floodwall – the 1874 wall – while the fledgling town council sought engineering advice about 'training the river.' Rock for the first floodwall came from the Southside (Greymouth) Quarry but when engineering advice suggested that breakwaters be built on both sides of the river, the Cobden Quarry was opened on the north side around 1875. The Cobden Quarry then became the main supplier of rock for both breakwaters, continuing to operate, with only a few years downtime, right through until 2005.

When the breakwaters were finally finished at the end of World War II, the Greymouth Harbour Board decided to close the quarry (1948) but it was opened again in 1957 when rock was needed to carry out emergency flood protection work at nearby Coal Creek. In 1959 the Westland Catchment Board then took over control of the quarry, followed by its successor, the West Coast Regional Council in 1989. After two disastrous floods in 1988, a large amount of rock was again taken from the Cobden Quarry to fast track a flood protection scheme already begun on the Cobden side of the river. In November 1990 the Greymouth Floodwall was officially opened and to date has not been topped by any flood. All up, around two million tonnes of limestone rock were taken from the Cobden Quarry between 1875 and 2005, most of which has been used for the Grey River breakwaters and associated flood protection works.



Figure 1: This 1950's White's Aviation photograph shows the north and south breakwaters, and a half tide wall along the Grey River. The Greymouth Gorge is in the back-ground with the obvious 'hole in the hill' on the left (north side) being the Cobden Quarry. Photo: History House Museum, Greymouth

Geology

The Cobden Limestone was named by geologist-surveyor Alexander McKay in 1877 when he was collecting fossils from limestone exposed at the Greymouth Gorge and at Point Elizabeth (other end of the Rapahoe Range). The first mapping of the limestone was carried out in the early 1900's by PG

Morgan, of the New Zealand Geological Survey (NZGS), at the same time as he was mapping the nearby Greymouth Coalfield. A cave in the Cobden Limestone out at Point Elizabeth was noted on the 1911 map produced from this work.

In 1974 geologist Simon Nathan, began fieldwork to update the geology of the Greymouth area. This

included mapping of the rock strata and collecting many fossil samples. He then compiled a report with all previous and new fossils finds (1974) and completed a new edition of the Greymouth geology map with handbook (1978). In the latter Nathan describes the Cobden Limestone as a “fine-grained creamy-white to light brown-grey muddy micritic limestone, locally containing interbedded bands of calcareous mudstone. With rare exceptions analysed samples from throughout the formation contain less than 80% CaCO₃, most being in the range 70-75% CaCO₃.”

During fieldwork Nathan closely examined the well exposed sequence of limestone at the Greymouth Gorge and proposed that the formation be subdivided into three members, the underlying Ngarimu Limestone, the mid-layer Tarapuhi Limestone and the overlying Puketahi Mudstone. Fossil dating of foraminifera and calcareous nannoplankton was also carried out to ascertain just when the various limestone layers were laid down. Results showed that all three members were laid down in deep water offshore between the mid to late Oligocene and the early Miocene, i.e. between 34-22 M years before now.

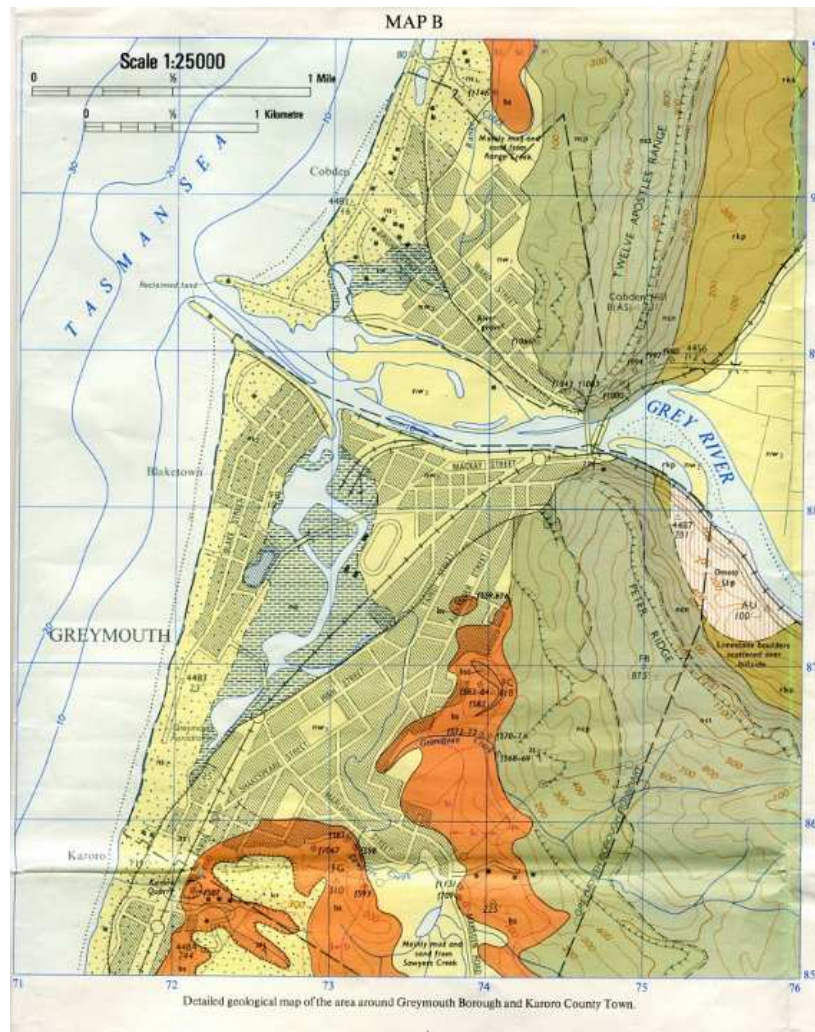


Figure 2: The 1:63,360 Greymouth Geological Map (Simon Nathan, DSIR, 1978) has side maps at larger scale. Here Map B shows the Cobden Limestone in olive green ('ncp' or 'nct'). Listed fossil sites by the quarry on the north side of the road bridge are f1043, f1003 and f1000.

Many macrofossils have been found in the Cobden Quarry over the years, both by trained scientists and casual fossil seekers. Echinoids and molluscs are relatively common on freshly exposed surfaces in both the mudstone and harder limestone layers, and corals and brachiopods can be found at times. Collections made at the quarry by geologists over the

years are listed on New Zealand's fossil data base (FRED) at Geological & Nuclear Science, Lower Hutt and the site is ranked as regionally important for Oligocene Echinoids in the Geoscience Society of New Zealand's Geopreservation Inventory.

In April 1887 a number of large bones – six vertebrae with ribs attached – were found in a block of rock about 2ft by 4ft which had been uncovered by blasting. They were recognised as being those of a saurian or reptile and featured in local newspaper articles at the time. The block containing the remains was retrieved from the quarry and given to the School of Mines in Greymouth. Drawings of the bones were then made and sent to geologist Professor F. W. Hutton, NZGS, who identified the part skeleton as that of a Ziphioid or Beaked Whale of Oligocene age. Unfortunately no further trace of these bones, or the drawings, has been found to date in any of the larger South Island museums.

As far as cave and karst development goes in the Cobden Limestone, the muddiness of the upper Puketahi Mudstone layer appears to preclude good cave formation but there are some modest sized caves, some with formations, known from the better quality Tarapuhi Limestone. These include Te Ana Puta Cave at Point Elizabeth, Cobden or Tainui's Cave (by the Greymouth Gorge only 250m from the Cobden Quarry), Cleopatra's Bath and Welshman's Cave at Limestone Road, Whiskey and Stillwater Caves at Cape Terrace, an unnamed cave quarried away on the south side in the 1870's (known from newspaper reports) and those recorded below from the Cobden Quarry.

To date no caves are known from the Ngarimu Member, the lowest strata in the Cobden Limestone Formation, but there may be some below river level at the Greymouth Gorge, a major karst feature in its own right. Engineers building the second road bridge in 1974 -75, sank sixteen test bores through the river gravel up to 10m into the limestone and found that not only was the bottom very uneven, but there were holes under the surface of the limestone as well. Those building the new rail bridge in 2006, just upstream from the road bridge, struck similar problems. Other karst features away from the Greymouth Gorge area include many tomos and grikes, plus two small gorges and a stream capture at Cape Terrace.

Cobden Quarry Caves

Five caves are known to have been exposed due to blasting in the Cobden Quarry. The exposures occurred in the years 1889, 1904, 1933, 1986 and 1999. Dates and documentation for the first four were found in various archives but for the last all the information has come from those who were there at the time, and the formations they collected. All the information for the 1889, 1904 and 1986 finds is set out below but for space purposes only a selection has

been made for the 1933 and 1999 finds. No photographs have been found of any of the caves to date and as per the table at the end of this section summarising all the information, details about cave size and location are fairly scant.

1889 Cave

26th July 1889, The Grey River Argus (GRA):
UNTITLED [part article only]

.....“Mr J. Ring, who never misses an opportunity of bringing his camera to bear whenever a good picture is obtainable, yesterday took some pictures of a cave in the Cobden quarry laid bare by the last big blast. The cave is at the top of the quarry, is about 9ft high and 6ft wide, and widens out the farther in one goes, There are numerous stalactites, which produce quite a pretty effect but as the visitors amuse themselves by breaking these off the cavern will soon possess no more interest than any ordinary hole in the rock.”

1904 Cave

28th October, 1904, GRA: UNTITLED [part article only]

“A blast was fired at the Cobden Quarry yesterday afternoon which was far from being satisfactory. For the past few days work has been in progress in the direction of having a big blast. The arrangements were well thought out and 2,800 pounds of powder placed in the drives. The fuse was lit and a large crowd waited with expectation for the result. There was a roar, the hill trembled, and all was over, not a ton coming down. On inspection it was found the shot had spent its force in a cave. The result is to be regretted, but no blame can be attributed, to “anyone.” The existence of caves in limestone hills are frequently met with. The only fear now is that the face may be dangerous to work.”

31st October, 1904, GRA: UNTITLED [part article only]

.....“After the unsuccessful blast at the Cobden quarry last week, the overseer on inspection stated that the shot had spent its force on a cave. On Saturday morning this theory was borne out as the workmen came on a large cave fully 30 feet long, near the lower chamber.”

2nd November, 1904, GRA: HARBOUR BOARD ENGINEER'S REPORT [part article only]

.....“On October 27th, a blast was fired in the Quarry without results. On examination it was found that the lower chamber containing 1100lbs of powder had blown into a cave at the back. The upper

chamber containing 1800lbs did not explode owing to some defect in the fuse.”

1933 Cave

5th December, 1933: ENGINEER’S MONTHLY REPORT TO GREYMOUTH HARBOUR BOARD [extract]

“COBDEN QUARRY Blasting operations on the toe disclosed the presence of a cave 80 feet long by 28 feet wide and of a maximum height of 35 feet. The cave is located close to the rear face of the quarry and the roof follows the dip of the strata, rising from a few feet at one end to a height of 35 feet at the other. The rear end of the cave is blocked by debris which has fallen from the roof and sides, and the floor is covered with clay to a depth of approximately six feet. It is probable that the cave is of greater extent than is apparent at present and as its presence will very materially affect the design of the next tunnel shot it is essential that accurate information is available regarding its precise location and extent.”

7th August 1934: ENGINEER’S MONTHLY REPORT TO GREYMOUTH HARBOUR BOARD [extract]

“Cobden Quarry:the condition of the quarry at present is such that the carrying out of another large tunnel shot is not be recommended. It has not been possible, on account of the dangerous character of the roof, to explore thoroughly the cave which was discovered some months ago and the absence of accurate information as to the extent and location of the cave renders the design of a large blast too speculative to be contemplated on account of the expenditure involved. While a large tunnel shot is undoubtedly the quickest and most economical method of obtaining stone at Cobden quarry, it is considered that the slower and more expensive method of extracting stone by a system of benching is preferable to embarking on a project which would be difficult in its execution and highly problematical in its results.”.....

1986 Cave

1st May 1986: MEMO, MINES INSPECTORATE CORRESPONDENCE, NATIONAL ARCHIVES, CHRISTCHURCH

This handwritten memo to Alan Best, Quarry Inspector says, “Pat Morgan has been drilling for the next shot – has struck a cavern low down in the middle (of the face) – drilled all round it. Plans will be drawn up after drilling is completed. The cavern in the middle of the road will make results uncertain but we should go over the placings and loading of the holes with Pat before he fires.”

[Pat Morgan was Quarry Manager from 1973 – 1993, firstly for the Westland Catchment Board, then the West Coast Regional Council]

28th May 1986: VIDEO FOOTAGE AT WEST COAST REGIONAL COUNCIL [now on DVD]

The blast, for which preparation was being made as above, was carried out on May 28th 1986. The final preparations and the blast were videoed by Westland Catchment Board Engineer, Wayne Moen from a position across the Grey River. Most of the footage is in the ‘long view’ but the camera zooms in just before the blast, enough to allow a glimpse of the cave low down mid-face.

1999 Cave

Information about this cave has come together in bits and pieces, to eventually form a coherent story. The author retired at the end of 2012 and began her quarry research in early 2013, but even before this there were hints about possible caves in the quarry. In 2007 she found part of a stalactite about 30cms long by 12cms in diameter during a planting session on the lower terraces and three people, including a WCRC employee, told her at different times that they'd found small pieces of formation up in the north-east corner of the quarry.

However it wasn't until she talked to Ken Dalzell in 2013 that real confirmation came about. Ken, a member of the West Coast Gem and Mineral Club, told her that there were some stalagmites from the Cobden Quarry in the Club's display out at Shantytown. The formations had been donated to the Club by Graeme Warriner, former WCRC Quarry Manager, before he moved to the North Island after his retirement in March 2001. The author

then began corresponding with Graeme and it was soon clarified that sometime in the late 1990's a routine small blast in the top right hand corner of the quarry had uncovered a small but well decorated cave. The actual date has been hard to pin down as quarry records for the period have not yet been found at WCRC, but it's been narrowed down to post 1995 and before Graeme's retirement. 1999 is thought to be the year but if further information comes to light this may need to be amended.

When the cave was uncovered those present soon realised that the blast had de-stabilised the cave roof, making it unsafe. So after retrieving some accessible formations, another blast was made which dropped a large rock down over the entrance of the cave, effectively sealing it. When the author and a friend went looking for the cave in February 2014, they found it still sealed although it was possible to look down a number of holes into the cave with the aid of a torch. There were also small mossy stalactites around the former entrance and pieces of broken formation lying about.



Figure 3: The author at the former entrance to the cave uncovered by blasting in 1999. Despite the entrance now being covered by a large rock, vestiges of the cave were still visible on this visit in February 2014. Photo: Bruce Annabell

In mid-2014 Graeme Warriner and the Gem & Mineral Club agreed that the smaller stalagmite (30cms high and 9.8 kg in weight) could be sent to Melbourne University for dating and in return she donated the stalactite she'd found to the Shantytown display. In November the stalagmite was sent over to Professor Russell Drysdale at the Geography

Department, Melbourne University and in May 2015 it was cut, and part polished ready for dating by mass spectrometry. The results of this are still pending as of July 2015 but Professor Drysdale said in mid-May that the polished surface *"looked interesting and showed plenty of visible changes that look suspiciously like millennial-scale climate events of the last glacial period."*



Figure 4: Stalagmites at the West Coast Gem & Mineral Club which were taken from the cave uncovered by blasting in 1999. The smaller one on the left has been sent to Melbourne University for dating. Photo: Mary Traves, 2013

In 2013 local cavers did some exploration behind the quarry rim and down toward Kells Hotel. They didn't find any caves but there were other karst features such as the large grike behind Kells Hotel (immediately adjacent to the quarry) and at least three other grikes parallel to, and back about 30 - 50m from the quarry rim, one of which goes down at least 10m.

There is also the large doline – drainage area northeast of the quarry. However given what is known about the former quarry caves, the karst development by the quarry and the Cobden Limestone generally, it is very probable there are other caves to the north along the Rapahoe Range.

Caves Information Summary

Discovered	Documentation	Description	Location	Other notes
1889, 27 th June	26 th July Grey River Argus (GRA),	9ft high x 6ft wide with numerous stalactites	“top of the quarry” i.e. unclear exactly where	Greymouth photographer, James Ring took photographs but none have been found. 600lbs of blasting powder was used to dislodge 20,000 tons rock at the time.
1904, 27 th Oct.	1904, 28 th Oct. GRA 31 st Oct. GRA 2 nd Nov. GRA	30ft long cave	near lower (blasting) chamber, i.e. unclear exactly where	Drives were put into upper and lower chambers at the ends of two tunnels which were then packed with blasting powder. Only the lower one went off, expending all its force into a cave with no rock coming down at all.
1933, Unstated date in November	1933, 5 th Dec. Monthly Engineer’s report to Greymouth Harbour Board 1934, 1 st Aug. Monthly Engineer’s report to Greymouth Harbour Board	80ft long x 28ft wide x 35ft high at top end. Filled with clay & debris to 6ft depth. Not possible to explore re extent because cave roof too dangerous	Mid way along the main face and just below the top of the toe of rock brought down by a major blast on Feb. 25 th 1932. The full extent of this cave remained unknown because blasting made it too unsafe to explore.	The 1932 tunnel blast took 5 months preparation. Three tunnels were driven into the face with 14,600 lbs of powder laid. The blast brought down 105,000 tons of rock, only about ½ of which was useable for the training walls, the rest being shattered to rubble. When the cave was exposed in 1933 the floor was filled to a depth of 6 feet with clay and rubble. Its presence made future tunnel blasting unsafe and from then the method of benching with smaller blasts was used. The presence of the cave was a problem for safe quarry management right through until WWII.
1986, Unstated date at end April	1986, 1 st May Memo in Mines Inspectorate Correspondence, National Archives, Christchurch	Size not given, estimated moderate to small	Low down in middle of the (north) face. <i>NOTE: A video was made of the blast which followed on 28th May. The cave can be seen briefly mid-face before the blast drops rock down over it again.</i>	When the cavern was uncovered during preparatory drilling for the next blast, it added to concerns the quarry inspector already had regarding instability of the lower end of the main quarry face ex blasting in 1984. This cave may have been the remnant of the one exposed in 1933. The latter went well back into the face so it makes sense that some of the cavity may have still been present.
1999, exact date unknown	Documented by the author in 2014 after talking to current & former WCRC staff who were present when the cave was found	Small, well decorated cave about 5m wide x 3 high at the entrance. Depth unknown.	Upper right/east face, site visit made and position photographed but not GPS’d (bush a problem).	After this cave was uncovered by a small blast there were immediate concerns about public safety so after those present took a few formations each a large rock was dropped back down over the entrance. Vestiges of cave can still be seen today. A survey of the quarry boundaries later revealed that the cave was beyond the legal boundary and either on Fox Street road reserve or on Department of Conservation managed land.

Discussion

The five instances of caves being found in the quarry show two probable areas of cave development, one low down in the north or main face (1933, 1986) and another at the top right of the quarry at right angles to this, i.e. facing west (1904, 1999 and possibly the 1889 cave). These two areas could well have been connected via the dissolution effects of rainwater

submerging through joint lines and grikes, and the doline above the north-east corner of the quarry, then running down the bedding planes (which are on a 30 degree slope in the quarry). On its journey down through the hill the water would have dissolved out chambers of varying sizes before resurging from the bottom of the hill as a spring.

This theory is based on information found in various reports and newspapers (particularly those about drainage problems in the quarry), looking at old photographs and from knowledge about karst processes. Reports made by various Greymouth Harbour Board Engineers over the years have been a particularly good source of information about the day to day working of a large limestone quarry and the difficulties of working around a large cave in the middle of the main face. Despite this information the theory that all the caves may have been part of one larger system is impossible to prove because the caves are long gone with only the 1999 cave's location known. One can only say that it is possible that all the caves have been part of one larger system.

It would appear that in the early years of the quarry's operation there was very little understanding about karst processes or how caves are formed, rather just an acceptance of the fact that caves might be found if limestone was quarried. Newspaper reporting in this era tended to be philosophical - the 'that's what you get' attitude - rather than knowledgeable. After 1925 when the quarry was really busy again getting rock to again lengthen the breakwaters, successive Harbour Board Engineers tended to dwell on the practicalities of blasting – how big a blast, how much rock – rather than thinking through all the problems which might ensue, including breaking into a cave. Did they even know there had been historical problems with blasting due to caves behind the quarry wall?

For many years the preferred method of blasting was driving one or more large tunnels into the rock then packing chambers at the end of the tunnels with large amounts of blasting powder. Some of these tunnels were quite long, for instance the one driven over a five month period in 1928 was 81ft long with a cross drive of 46ft at the end, and the combined length of the three tunnels excavated for the big blast in February 1932, was nearly 400ft. But as was found on more than one occasion, the chambers at the ends of these tunnels were prone to filling with water which ran down the bedding planes after heavy rain. This occurred during final preparations for the 1932 blast but reports of the time indicate that the engineer's main concern was how to keep the powder dry. There was no contemplation given to where the water might be going (into a cave) and what effects that might have on the blast. There seemed to be no memory that in 1904 all the energy of a major tunnel blast went into a cave with no rock coming down at all.

It's quite likely that this lack of understanding about karst processes also led to two men being killed on

11th March 1902. A couple of days after a routine blast, a complete section of the quarry face, 30ft high and almost vertical, collapsed along the line of the face, burying both men. In the following report to members of the Harbour Board, John Thomson, Harbour Board Engineer at the time, gives an explanation as to how this might have happened. However he doesn't seem to have taken into account how water might have built up in a 'space' behind the face with the weight of the water causing it to fall outwards after being de-stabilised by blasting.

GRA, 22nd March 1902: ENGINEER'S REPORT (to the Harbour Board)

"I have the honor to report as follows. I regret to state that an accident took place in the Cobden quarry on Tuesday, 11th inst., causing the death of two men Messrs Evan Williams, and John Simmons. At the time of the accident the men were getting stone on the south side, where work had been in progress since December. The height of the face was about 30 feet and nearly vertical. Any danger would naturally be expected from slips coming down the lower and inclined bed on which the stone rested, but in the present instance about 2.30 the whole face fell over at right angles to its length, burying William and Simmons, who were filling trays for the crane. There was no indication of any unusual danger, and Mr Walton was watching the work for about half an hour before coming over to report progress to me at 11 o'clock that morning. A few days previously several men with bars examined the top, and on the day of the accident after a shot had been fired it was examined again.

The verdict at the inquest was that John Simmons and Evans Williams met their death by accident, no blames being attached to anyone. Judging by the appearance of the stones after they fell, I think that the outer and vertical wall was pushed over by pressure from behind, caused by soft wet clay working its way between the stones at the back, some of which probably had beds sloping outwards. This would give the required pressure and would account for no indication being seen in the face till it came down in one mass."

The presence of the wet clay, the main breakdown product of the thin mudstone bands in the limestone, may have exacerbated the rockfall rather than being the main cause. Photographs taken along the face in 1985 and again in the 1990's (see Figure 5) show a tendency for the quarry face to bulge out along the bands of mudstone. Perhaps this also occurred in 1902 before the face gave way.



Figure 5: View along the quarry face looking east taken in the 1990's at the time of drilling for a small blast. Note the mudstone band at the point of the slight bulge in the quarry face. Photo: Graham Warriner

Despite these problems, quarry safety improved greatly during the busy years of the 1930's, even after the large cave was found in 1933. The Harbour Board took their Engineer's advice and from then on tunnel blasting was abandoned in favour of the slower benching method. Between benching and the use of more modern quarry plant, plus regular visits from the Quarry Inspectors, the Cobden Quarry became a far safer workplace from the early 1930's. In fact there were no major accidents or injuries to workers from then on.

The potential for major rockfall was always there however and as late as 1986 a Quarry Inspector was expressing concerns about the stability of the western (lower) end of the main face after blasting in November 1984 left an arch of overhanging rock (see Figure 6). Not long after a cave was found to the right (east) of this and all care had to be taken when a blast was planned near it.



Figure 6: Preparatory drilling being carried out in the mid-quarry area in 1986. The drilling rig is near the face on the upper bench with a compressed air line running up to it from the compressor truck. Note the unstable area with overhang and arch, the result of blasting in November 1984. Photo: WCRC Collection

References to water actually coming out of the quarry face are few, but it's clear from both newspaper and Harbour Board Engineer's reports that there was quarry run-off both from surficial and underground sources. The natural drainage of the quarry is toward the corner of the present day Kells Hotel carpark and then south-westwards to the Grey River. As a consequence the quarry floor was apt to become a swamp. To alleviate this various drainage systems were put in place over the years in an attempt to direct water through culverts under the road and away to the river. From examination of rainfall and flood event records it would appear that heavy localised downpours usually culminated in the culverts under the road being unable to cope causing flooding across Bright Street by Kells Hotel car-park.

In February 1916 a landowner living near the quarry complained to the Grey County Council about the excess water coming from the quarry and the County Engineer then "recommended that representations be made to the Harbour Board with a view to inducing them to make provision for the escape of water complained of through the quarry to the river." This was actioned by the Harbour Board but the drainage system put in place was no match for the coming early winter deluge.

3rd May, 1916, GRA: Extract from ENGINEER'S REPORT, GREYMOUTH HARBOUR BOARD ANNUAL MEETING

"Cobden Quarry:— On April 14th an extraordinary heavy rainfall caused an unusually large overflow of water from the quarry face, which the new 18in pipe was quite unable to carry away, the surplus water running over the road, in all directions. In addition to the old box drains which cross the road I would recommend that a new 3ft by 1ft box about 50 feet long be put in. The cleaning out of quarry drains and water tables will be completed this week."

7th December 1953, Greymouth Evening Star (GES)

"STREET 'TORRENT' IN COBDEN"

"Portions of Cobden which never previously been flooded suffered this morning, as the result of a torrent which swept down from the hills in the area of Bright Street between the two hotels. The flow of water across the road at the old Harbour Board quarry was no greater than usual in time of exceptionally heavy rain, but a few hundred yards to the west a miniature river emerged from the hills. It is thought likely that the blocking of a big cave in the quarry some years ago produced the change.

The new 'river' reached the street through three properties on the north side, including the Cobden Hotel, and, although it did not enter the buildings, it caused damage to the sections and gardens. The water raced down Bright Street, cascading over the kerb like a miniature rapid. It was several feet deep at the side of the bitumen and covered even the crown of the road. It was high on the wheels of motor-vehicles and the street effectively closed to pedestrians. There was one report of a cyclist being swept off her machine by the force of the current."

9th May, 1958, GES: GREY RIVER IN HIGH FLOOD AFTER STORM

The paper had much on this event including a note that this was the "eighth flood since early summer" and that the "rainfall for the 24 hours to 9am Friday morning May 9th was 3.59" at Karoro and 4.78" at the Greymouth tiphead". Continuing on with reports from round the town, the paper then said, "In Cobden a great volume of water poured from the quarry across the road and there was flooding in lower Ward Street.".....

In 2005, when the West Coast Regional Council announced they were going to close the quarry and landscape the site, they invited the local community group 'Forever Cobden' to have some input. Long-time Bright Street resident Bill Murphy attended a number of meetings on behalf of the group. At an early one he asked if the Regional Council intended uncovering the creek which used to come out of the quarry face so the original drainage could be restored and thereby prevent flooding of the type which had occurred in 1953. The request was turned down after it was found that the Grey District Council had, at

great expense, put in an alternative system of drains behind the properties on the east side of Bright Street to alleviate potential flooding of the area after heavy rain.

In the early 2000's proof came that there was 'more cave' behind the quarry wall when several exploratory drill holes made into the western or lower end of the main quarry face went back into 'space' after only a couple of metres. It had been decided to explore rock reserves in this area because quarrying had actually gone outside the quarry boundary at the other, eastern end of the face (where the 1999 cave was found). However the lower or western end is also the one closest to Kells Hotel and some of the houses in Bright Street, and knowing that any blasting could be compromised by the presence of caves, with possible damage to the properties, it was decided to scale quarry operations down. After some minor blasting in the mid-face area in 2002 and then utilising what rock remained on the quarry floor, the Regional Council decided at their January 2005 meeting that they would close the quarry and rehabilitate the site.

In May 2013 the author and two friends checked out the exploratory drill holes made just a few years before. They shone high powered torches into a number of those within reach, but found their lights just disappeared into darkness after about 3m, noting also that a couple of holes near the ground had built up minor calcite deposits. The best confirmation that there was a space behind the wall actually came from two holes well up out of reach. This showed that water flowed out from time to time, water which could only have come from a cave.



Figure 7: Karen Rohloff points to the water stain below one of the exploratory holes drilled into the western end of the quarry face around 2000. The water stain is an indicator that there is space – a cave- behind this end of the quarry wall. Photo: Mary Traves, 2013

Conclusion

In terms of the 2015 ACKMA conference theme, “Caring for the Country,” one would probably say that in the example of the Cobden Quarry the country or rather the town of Greymouth (including Cobden), hasn’t come off that well. The downsides of 130 odd years of quarrying have not only been the loss of the caves, but the deaths of eight men with many others injured, property damage and public disruption from blasting and ending up with a ‘big hole in the hill’ right opposite the town. As an armourstone, the Cobden Limestone was of fair to poor quality only and the breakwaters were only finished when concrete was used to make the heavier blocks needed to withstand the constant heavy seas at the tipheads.

On the plus side the rock was handy to where it was needed and relatively cheap, and the quarry was a steady source of employment, especially during the Depression years of the 1930’s. Quarry safety

improved markedly in the 1930’s with better quarry management and the introduction of Quarry Inspectors. There were no deaths over the last 75 years of the quarry’s life. And as far as the caves and fossils go, there is plenty more Cobden Limestone along both the Rapahoe Range and Peter Ridge so there are very probably plenty more caves and certainly more fossils.

Greymouth wouldn’t be the port town it is today if the breakwaters and wharves had not been established. The port was busy for many years with colliers and coastal traders coming and going and remains a haven today for Greymouth’s fishing fleet. The town probably wouldn’t be where it is today either, right by the river, had flood protection works not been carried out over the years. It’s probable that most Greymouth people today would say that having the use of their port over the years, plus the peace of mind which adequate flood protection has brought

them, amply justifies all of the downsides engendered by 130 years of Cobden Quarry use.

Unfortunately the memories of people today about such issues are usually short with the losses of the

past being easily forgotten. If nothing else this paper is an attempt to bridge part of this gap.

‘The caves might be gone but they are not forgotten’



Figure 8: A late afternoon view of the former quarry in 2014. The lower terraces were planted as part of the rehabilitation work but the upper terraces have revegetated naturally. The photograph was taken from the Greymouth Floodwall and looks across the half tide training wall with the new Cobden Bridge at right and the red roof of Kells Hotel at left. Photo: Mary Trays

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