Trevithick Society

2013 AGM

Programme Notes

Compiled by

Pete Joseph and Graham Thorne

AGM 2013 Programme, St Agnes-Perranporth

1. **Friday May 10th afternoon**
   1. Perranporth Airfield and Wave Hub Monitoring Station
   2. British and Colonial Explosives Works
   3. Cligga Head Mine and Wheal Prudence

2. **Friday May 10th evening**
   Clive Benney's talk at the Miners' and Mechanics' Institute

3. **Saturday May 11th morning**
   1. Trevellas Coombe and Blue Hills Mine
   2. Blue Hills Tin Stream

3. **Saturday May 11th afternoon**
   3. Trevaunance Cove

4. **Saturday May 11th afternoon and evening**
   Rose in Vale Country House Hotel:
   4.30 for 5.00 AGM
   7.00 for 7.30 Annual Dinner

5. **Sunday May 12th morning**
   1. Wheal Kitty

6. **Sunday May 12th afternoon**
   2. St Agnes Museum
   or
   3. Wheal Coates

Acknowledgments

Thanks to Tony Clarke for supplying information, Rick Stewart for photos and Roger Mason for proof reading.

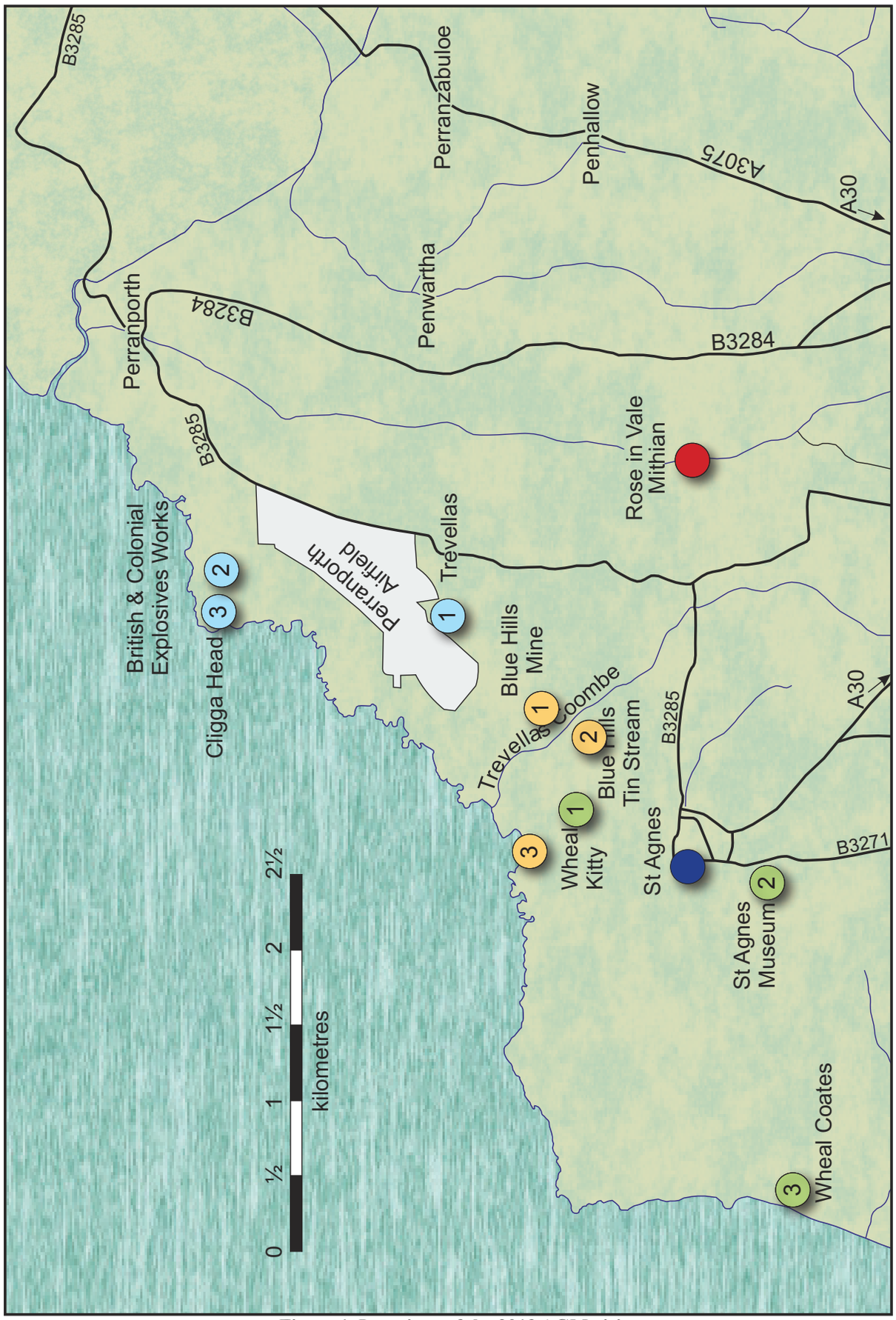

Figure 1. Locations of the 2013 AGM visits.

Perranporth (Trevellas) Airfield 1941 - 1945.

With the fall of France in May 1940, the German armies occupied the French Channel coast and rapidly started to convert existing airfields for their own use and to build new bases. Those in Brittany were lined up strategically to attack bases in the South West of England. Targets included the Devonport Naval Base, Plymouth and Falmouth as well as the air bases and army camps in the SW area. One of the main targets in Cornwall was St Eval which was one of the main Coastal Command airfields and well placed to cover the German naval threats in the South West Approaches. While the Battle of Britain was still in progress, a Squadron of Spitfires was rapidly sent to St Eval which became a Fighter Command Sector HQ. Fighter patrols defended ports, shipping and other targets round the Cornish coast and as far as Plymouth and South Devon. With the U-boat war being stepped up and the base also being used for photo-reconnaissance and even bomber units, it was desirable to find another airfield for the Fighter Sector HQ. Portreath was chosen as the main fighter base and would be supported by Perranporth flying day-fighters and Predannack with night-fighters.

Work was started on the airfield at Perranporth in 1940. The site had been chosen as it was reasonably flat, would not involve a lot of demolition of buildings and the work could be carried out without too much delay. Some 165 acres of the site had housed the widely separated sections of the former British and Colonial Explosives and later WWI munitions factory. However it was necessary to move spoil from the mining activities of Cligga Mine and other workings, such as Wheal Prudence. There was always the possibility of old mine shafts opening up but these were desperate times. Agricultural holdings were taken over and incorporated in the airfield. Developments required the acquisition of Cross Coombe Farm and later the nearby Cross Coombe Sunday School and Chapel. The existing buildings on

Figure 2. The remarkable Fairey Swordfish; this appears to be a MkII as it has hard points for underwing ordnance. The Swordfish is best known for its attack on the Italian fleet at Taranto and damaging the *Bismarck* prior to her sinking. What is less well known is that Swordfish flying from Malta, attacking Axis shipping at night when they were almost invulnerable to FLAK and fighters, sank more shipping than all of the Royal Navy's battleships combined.

the Perranporth side, previously used by an explosives factory were taken over as the Motor Transport Section and a watch-office - the forerunner of the control tower - and the Squadron flight offices were put up. The main station buildings, such as SHQ, cookhouse and billets were accommodated on the southern side of the airfield. In the early days, officers were housed in the Droskyn Castle Hotel which had been requisitioned, sharing accommodation with civilians. However as numbers increased the RAF were to take over the Hotel completely. Many airmen were billeted locally or rented their own accommodation.

Trevellas was opened on 28th April 1941, just over a month later than Portreath. At first facilities were almost non-existent with just one runway and a marquee for the airmen. The gusty winds and sweeping rain on this exposed 320 foot site had to be taken into consideration. The intention was to operate one squadron of Spitfires mainly for the defence of coastal towns, for protection of shipping and escort duties. The first squadron to arrive was No. 66 which flew in from Exeter as soon as the airfield opened. The Spitfires were the LR IIA version and were fitted with long range tanks desirable for operations in this remote coastal area. Building progressed with the erection of the long, low Tees Side Type 'S' hangar for general maintenance and servicing while the typical small rounded blister hangars served for the day-to-day maintenance on the airfield. Before long the triangular pattern of runways with inter-connecting taxi-ways was completed and other new buildings were erected. Still noticeable are the double blast pens which protected the aircraft from enemy attack as well as from the weather. For airfield defence a Bofors gun was in place supplemented by Lewis guns at strategic sites. There is no evidence that the Luftwaffe made any attacks on the airfield itself but bombs fell in the area. The neighbouring bases of St Eval and Portreath certainly were targets of the enemy bombers. Falmouth and Plymouth were attacked regularly at the time when RAF Perranporth was opened. The aircraft's guns were tested on the range on the seaward side of the airfield and floating targets (yellow buoys) as well as the Bawden Rocks were useful for this purpose. Also air-to-air firing practice was accomplished by shooting at drogues towed by the Henley aircraft which often used the base. The AA Gunners at St Agnes Beacon and Penhale also used this facility for target practice. The noise of the AA gunfire and black puffs of smoke were a regular daily occurrence. The nearby Cameron Camp was set up as part of our coastal defences and became important for the training of AA gunners throughout the war. The St Agnes Head local beauty and picnic area shows very little evidence of this former army base. Penhale Camp further up the coast near Holywell is still used in the summer by the TA. It suffered a damaging raid on July 7th 1940 when 15 soldiers were killed and a similar number injured. It might well have been a different story if Trevellas had been operating then!

Figure 3. MkIX Spitfire, unknown location. This version was essentially a MkV with a more powerful engine. The marking below the exhaust shows that this was flown by a Polish pilot.

As the pattern of the War changed by about 1942, there were often two squadrons on the base. The activity now also involved offensive fighter-sweeps over France and the long-range Spitfires were useful in escorting bombers from airfields further afield in attacks on French

ports such as Brest and on attacks on enemy shipping. Activity continued to increase and improvements were deemed necessary and were put into effect in 1943, when three squadrons were often in residence. There were small extensions to the runways and a new operations room and control tower were built. Other improvements involved lowering the disused buildings in the Cligga Mine complex and piling up spoil heaps at the overshoot ends of main landing runs. In mid-September 1943, No.183 Squadron flew in with their Typhoon fighter-bombers but the short runways caused difficulty for the heavily laden aircraft and after about a month, these operations were transferred to Predannack (Lizard). This was not the first time that fighter-bombers had been seen on Trevellas as in February 1942, 'Hurribombers' of 402 Squadron had been flown in from Warmwell in Dorset to attack 5 German destroyers off Roscoff. The raid was a considerable success with one sunk and another damaged. They had been returning from escorting the Scharnhorst, Gneisenau and Prinz Eugen up the Channel in the infamous "Channel Dash".

Activity continued to increase as Spitfire Squadrons took turns - some 18 in all - over the period from 1941 till the run-up to D-Day in 1944. Nationalities included Czechs and Poles as well as British and Commonwealth Squadrons. By the end of 1943, the Free French of 340 and 341 Squadrons were in residence and were joined in the New Year by 329 Squadron to form 145 Wing. They were now flying the improved Mk IX Spitfire on offensive sweeps over Brittany and attacking shipping and communications. In April 1944, all the Spitfires left and control of Trevellas changed to 19 Group Coastal Command - the same Group at St Eval - committed to anti-shipping activities to supplement the anti-U-boat war of its neighbour up the coast.

Figure 4. The airfield from above. The control tower is on the left-hand side. Former explosives factory buildings are to the right. Cligga Mine can just be seen directly above it.

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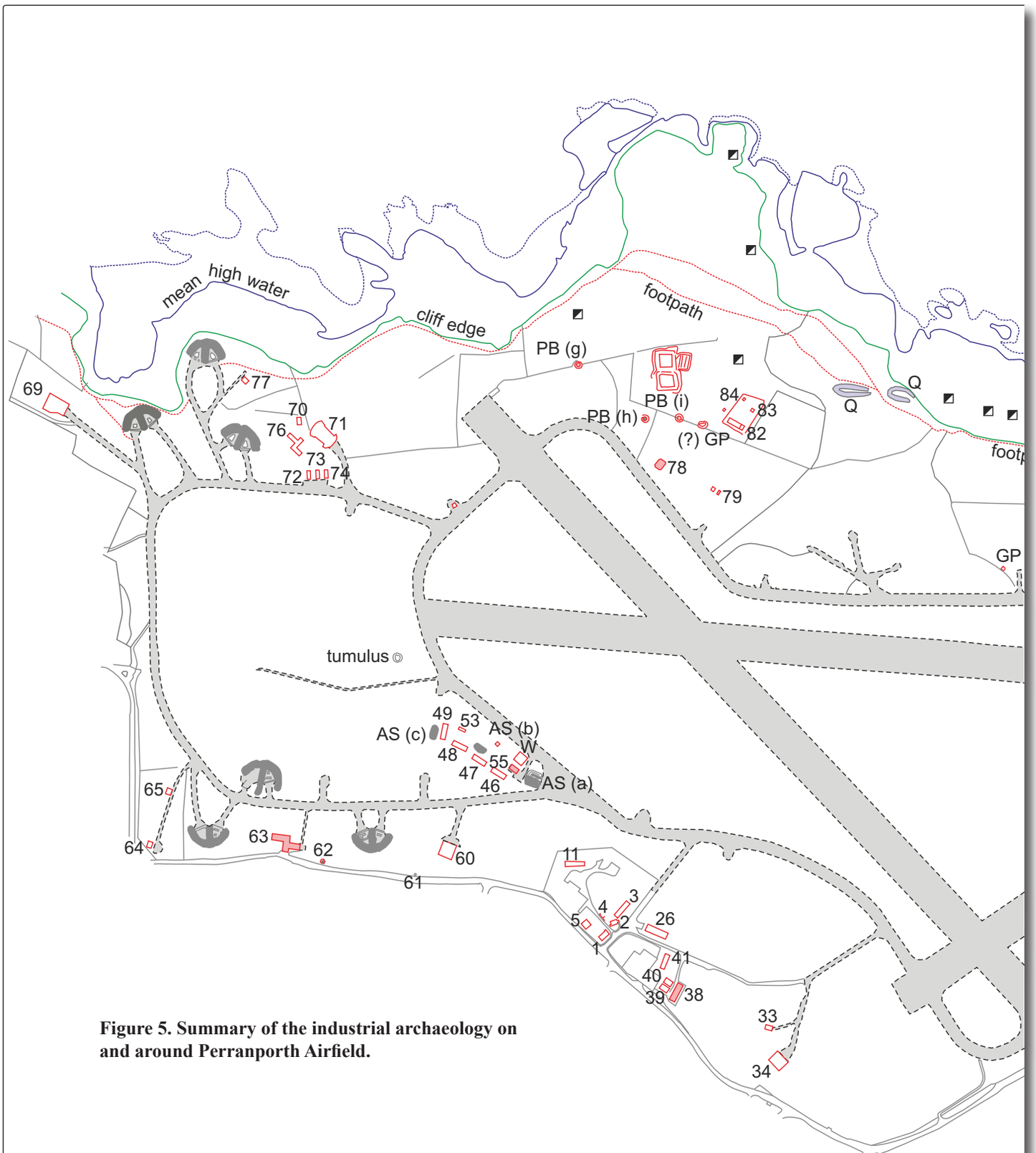

Figure 5. Summary of the industrial archaeology on and around Perranporth Airfield.

Friday May 10th afternoon

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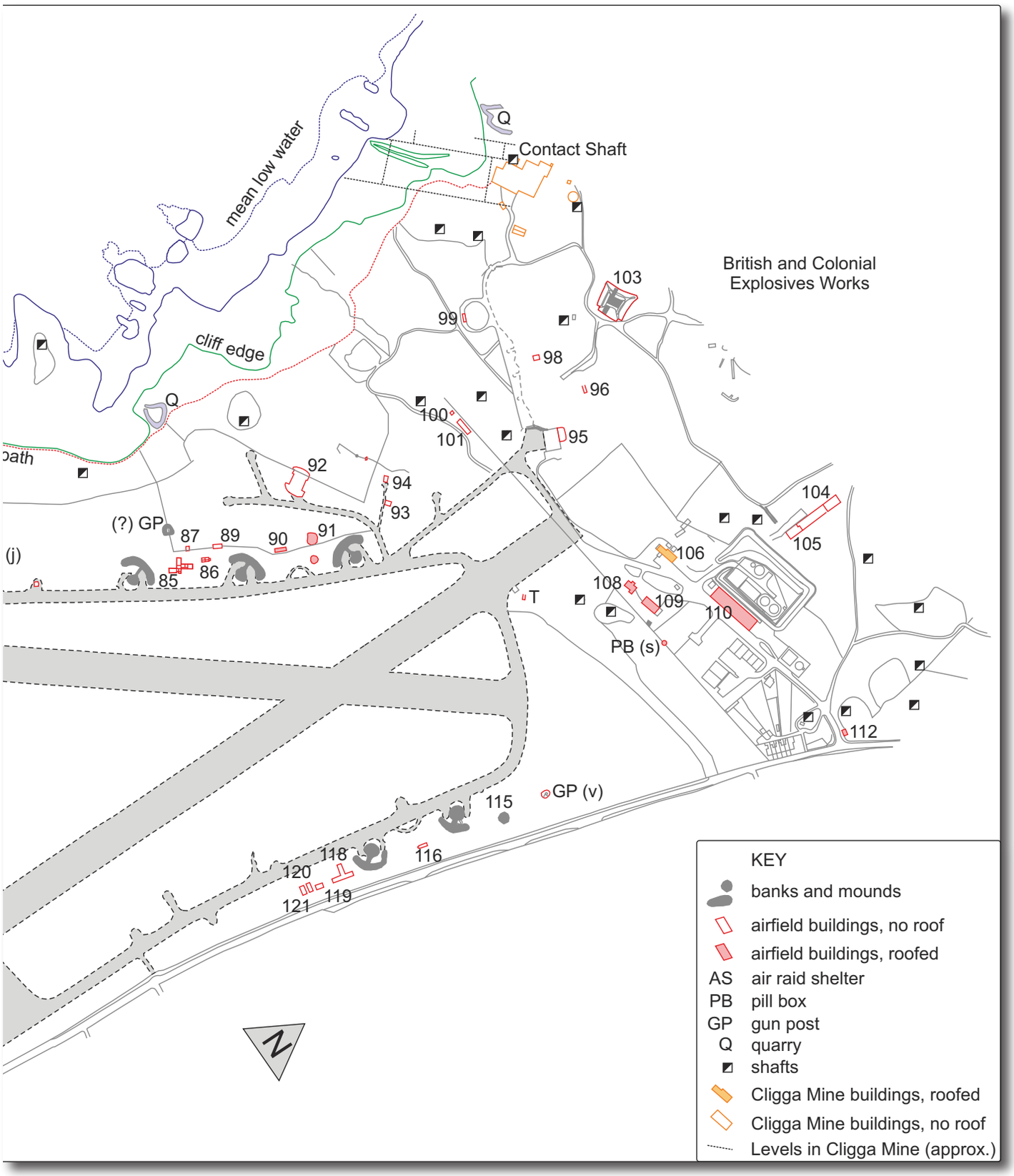

Airfield Area Gazetteer

1. Guard room
2. Link trainer
3. Briefing room
4. Photographic block: Nissen-type building
5. Emergency water supply
33. Central signalling workshop
34. Teeside hanger
35. Fuel compound
36. Fuel compound
38. Implement store
39. Mess, blacksmiths' shop: Handcraft-type building
40. Store: Handcraft-type building
41. Inflammables store
52. Latrine
53. Latrine
55. New control tower
60. Blister hanger
61. Cloud height projector plinth
62. Latrine, drying room
63. Flight office
64. Stores/Handcraft building
65. Pyrotechnical store: Handcraft-type building
69. Blister hanger
70. Drying room
71. Blister hanger
72. Concrete hut base
73. Concrete hut base
74. Concrete hut base
75. Latrine
76. Flight office
77. Store: Handcraft-type building
78. Stand-by feeder plinth
79. Battle Headquarters
82. AA gun site living accommodation
83. AA gun site latrine
84. AA gun site ammunition store
85. Flight office
86. Latrine, drying room
87. Squadron stores: Nissen-type building
90. Night sleeping shelter
91. Stand-by feeder plinth
92. Blister hanger
93. Stores
94. Stores
95. Blister hanger
96. Fuel store? not installed
97. Stores
98. Stores
99. Bulk petrol, 24,000 gallons
100. AA gun site living accommodation
101. AA gun site latrine
102. AA gun site ammunition store
103. Fuse store
104. Blister hanger
105. Bulk oil installation
106. Cligga Mine office
108. Cligga AT office
109. Cligga AT office
110. MT shed
112. Picket post
115. Store
116. Night sleeping shelter
117. Stand-by feeder plinth
118. Flight office
119. Latrine and drying room
120. Rest room: Nissen-type building
121. Rest room: Handcraft-type building

T. Building
W. Aircraft day mark

Friday May 10th afternoon

The Fleet Air Arm moved in with 2 Squadrons of Grumman Avengers, 849 and 850, used in the anti-shipping bombing role together with 816 Squadron of rocket-firing Fairey Swordfish to be used for attacks against E-Boats. The underground parts of Cligga mine were rapidly converted to a bomb store needed for such activities. Having completed their missions by early August 1944, the FAA Squadrons pulled out and the station was reduced to care and maintenance on September 1st 1944.

However, the RAF use of Perranporth was not yet over, as the station was transferred to 46 Group on November 23rd to become the base for staging post personnel awaiting transfer to Europe. With the spring advances by the liberation forces, the various units had completed their moves to staff the newly liberated airfields by the end of April. Special trains were laid on to take the airmen to bases nearer the embarkation points. On May 1st 1945, the airfield again returned to care and maintenance and was decommissioned later that year.

Many signs of the wartime use of Trevellas can still be seen and although time and the elements have taken their toll, the airfield must be one of the best examples of airfield archaeology left in the country.

Figure 6. Perranporth Airfield World War II memorial.

The British and Colonial Explosives Works

This Cornish company was formed by prominent local businessmen. Among these who became directors were Alfred Lanyon who had considerable interests in fuze making and gunpowder, and Captain Josiah Thomas, of Dolcoath Mine. In December 1889 the "British and Colonial Explosives Company" issued 100,000 shares of £1 each. Mr A. Napier Hake, F.I.C., was taken on to select a site for the works and plan the layout. Hake came from Roburite Explosives Co., Ltd.

An area of 100 acres on St. George's Common to the west of Perranporth, which included some of the "burrows" of the old Great St. George copper mine, was selected and leased for building to commence. The intention was to produce up to 720 tons of dynamite a year. At the time the consumption of high explosives by Cornish mines was about 350 tons a year. The capacity would enable the new company to make heavy inroads into their competitors' local market, and enable large export orders to be taken on. It was estimated that the current cost to manufacture a ton of dynamite was about £50, the dynamite selling in Cornwall at about £110 per ton. The site would be well located to supply most Cornish mines. The port of Truro was only 10 miles away, so that the export material could be shipped out without incurring high transport charges.

The terms of the lease to obtain part of the area required that the old Great St. George copper mine should be re-opened and worked for tin, which was now a more valuable metal than copper. To meet this clause some old workings above adit – to avoid pumping charges – were re-opened and equipment set up to mine and dress tin ore. Stamps were set up at Wheal East Cove, along with concentrating buddles and a burning house to clean the tin ore of its arsenical content. The stamps were electric powered, the electricity coming from the explosive factory generator. The lodes did hold a small percentage of tin ore, so some small output could be achieved.

Mr Arthur Carkeek of Redruth contracted to build most of the works. Some special plant had to be purchased, although much was made by local craftsmen, including part of the nitrating plant. The area was fenced off as required by the Explosives Act and this soon caused friction with the locals, who wanted to continue to use the cliff path passing right through the

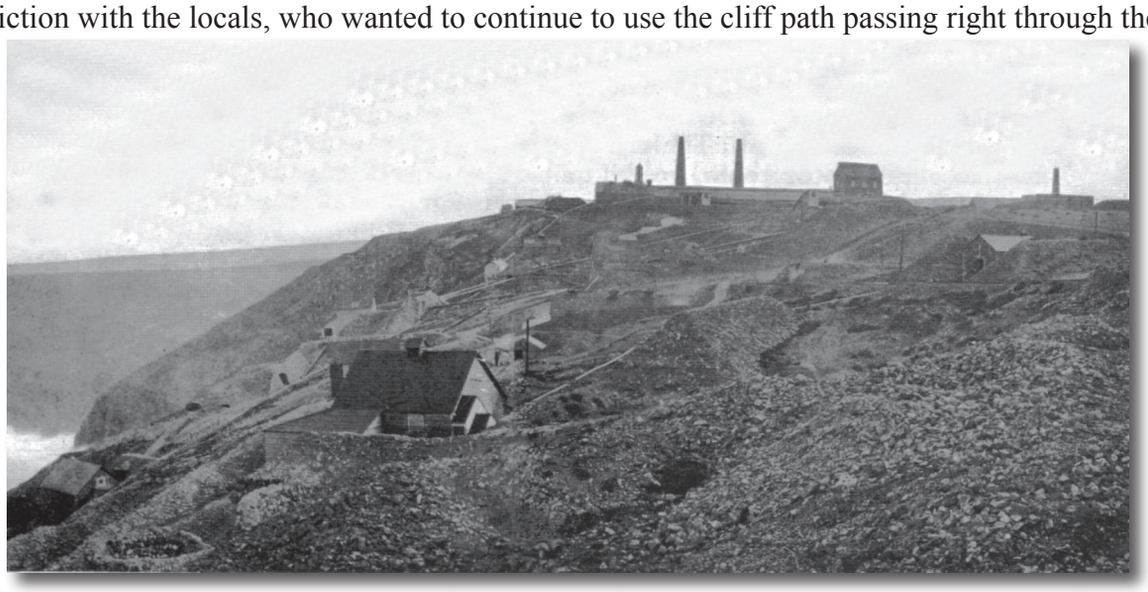

Figure 7. View of the explosives works from north of Cligga Head. Wheal Droskyn is in the cliffs in the background.

Friday May 10th afternoon

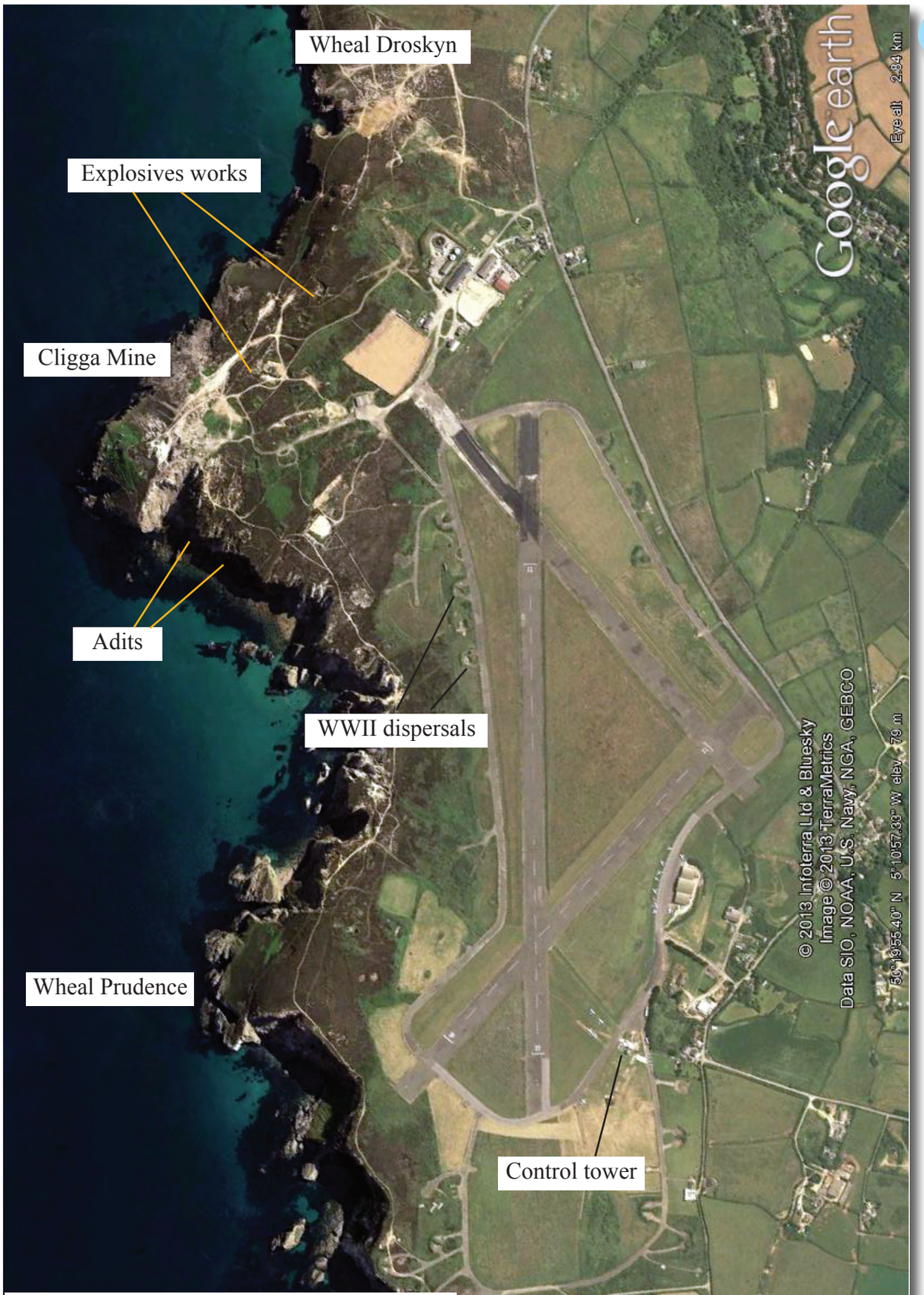

Figure 8. Aerial view of the Cligga Head area sites.

Cligga Head Area Notes

danger area. Hake soon left to take up the post of Chief Inspector of Explosives for Victoria, in Australia. This was an indication of the general disquiet both in and out of the company. Many Perranporth inhabitants had been up-in-arms over a dynamite factory so close by, as the village was now a developing holiday resort. Several attempts were made to try to force the company to move. At the same time comments by members of the "Perranporth Dynamite Company", as it was known locally, only served to stir up feelings.

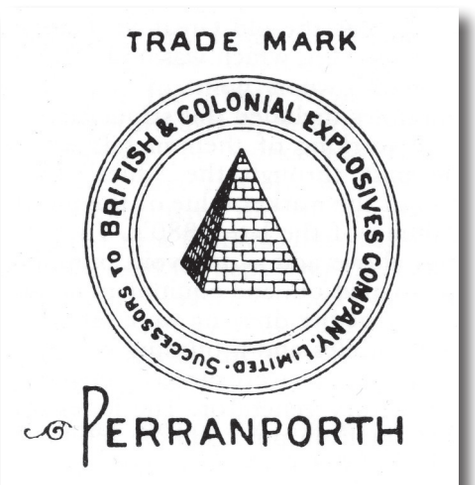

Figure 9. British and Colonial's trade-mark.

Another early leaver was the original manager, Tonkin. Blunt northerner Joseph Vaughan Turner followed, who came to be known as "Dynamite Joe", from his occupation and style of speech. He had previously been with Nobel's in Europe. The atmosphere that came to permeate the works was very different from that in other Cornish Explosives factories. Local residents considered the company's attitude of "unparalleled arrogance" and workers were subject to a barracks-like discipline. The plant was meticulously inspected every day and kept scrupulously clean – at least in theory. In practice there was the usual proportion of minor accidents and explosions from carelessness or disobeying instructions.

The *Mining Journal's* account of the works in its first form is of interest. It covered 110 acres, and had 14 stone and 20 wooden houses covering an area of 40,000 square feet. 50,000 yards of mounding had been worked up. A tunnel had been cut 80 yards through solid rock to enable dangerous fluids to flow from one building to another (the nitrator to the separator). 1,400 yards of hedging and stone fencing, 1,800 yards of wire fencing, 1,000 yards of road, 2,000 yards of tram road, 1,150 yards of wooden channels lined with lead, 1,000 yards of lead pipe, 2,600 yards wooden pipe, 2,000 yards steam pipe and a similar quantity of compressed air pipe making in all four miles of piping, had been laid. In all a total of nearly 115 tons of lead was required for the equipment. Included had to be changing rooms, messes, and police house at the gate.

The central service equipment had boilers for raising steam to be piped to the various buildings for heating, and later to power the steam engines for mixing machines. A Holman Brothers steam air compressor was installed, along with an electricity generating set. Added to these were the preparation houses and stores. Boundary fences were patrolled by a police guard, one of whom, "built on broad-gauge principles", intercepted visitors at the main gate to ensure they had business in the factory and relieve them of any contraband matches, tobacco, pipes and other prohibited articles.

The first Ordinary General meeting of the company had been held on 2 April, 1890, and had made a call of 2s 6d per share on 23 October 1890. The 2nd Ordinary General Meeting was held at the works in January 1891. This meeting revealed that of the £25,000 worth of share capital £19,839 14s 8d had been used up, so that by the time production started very little capital was left. Meanwhile the price of dynamite had fallen to about £65 a ton – perilously close to the estimated cost of production made earlier. By late 1891 the factory was sufficiently complete to start up. The first licence permitting the manufacture of explosives at Perranporth was issued on 9th September 1891. Dynamite manufacture went ahead, but all was not well and the financial position was very shaky.

Sulphuric acid was imported in carboys, which at first came by road from Scorrier station, but after 1902 were collected from the new station at Perranporth. Sodium nitrate was landed by boat at nearby harbours, and was dried ready for mixing with re-concentrated sulphuric acid in the retorts. The acid for the nitroglycerine hill was mixed and stored in large tanks, ready to be taken by smaller acid tanks running on bogies. All the process buildings were interconnected by a narrow-gauge railway, the wagons being hand pushed and pulled by rope.

The girls at the works wore flaming red woollen cloaks, their hair "which droops loose on their shoulders . . . guiltless of hairpins or combs or similar vanities". By October 1892 the factory had 30 such girls, who were searched each day by a matron. Fifty men were also employed at the time, but it was said the factory was still being expanded, and work for more was available. The foremen were mainly time expired NCOs – a typical Nobel arrangement – but the work people were local, and trained by the "works executive".

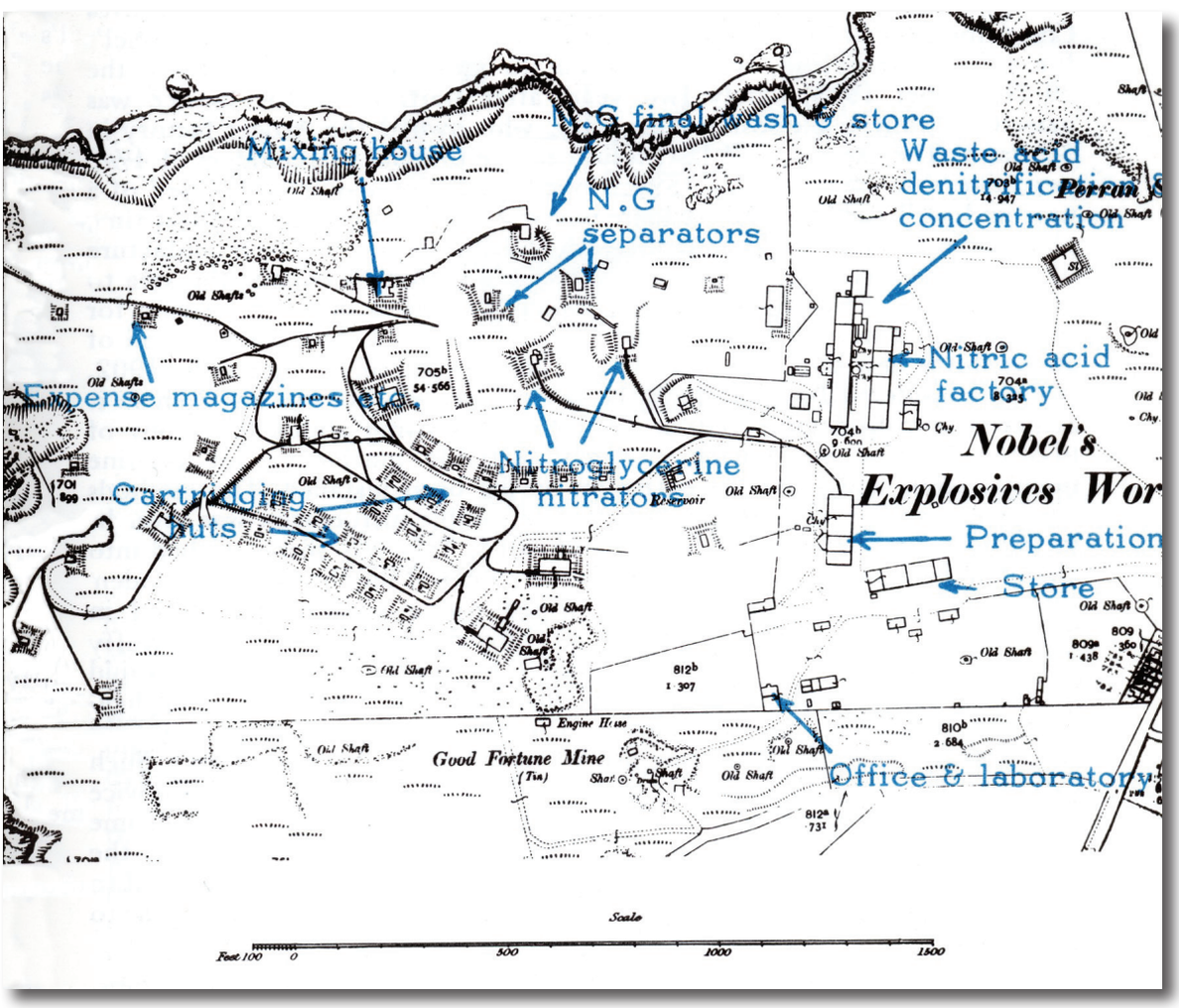

Figure 10. Map of part of the explosives works; Good Fortune Mine is part of the Perran St George sett. This map was made before the more modern workings at Cligga Mine.

In 1893 the company was £2,800 "in the red", and a rescue operation was mounted. The whole undertaking would be transferred to Nobel's for a ten year period, with an option to purchase for £36,000. On the 29 November 1893, the licence was passed to Nobel's Explosives Company, who owned the Ardeer factory in Scotland. The second, final return to the original shareholders of 4½d per share was made in May 1896. Nobel's had acquired a new and well

built factory, and removed a competitor. Soon plans were made to expand Perranporth and to manufacture gelatinous explosives. Ground was acquired to enlarge the area to 165 acres. Thirty new buildings then started, being practically complete by 1902. Nobel's considered Perranporth to be their "reserve" factory, but even so it achieved a considerable output. When in full swing about four tons of blasting gelatine was made per day.

To take heavy loads about the works it was usual to employ a horse and cart, but for heavy work the factory kept a traction engine that could pull up to three trailers at a time. When on outside work this caused some damage to the roads in the district, giving the Perranporth inhabitants even more to complain about. There was the usual crop of accidents. The worst occurred at 11.15am on the 16th January, 1902. Three men were tramming three tubs of jelly that had just been mixed, from the "C" house to an expense magazine. The tram had reached a set of points. What occurred then remains a mystery, but the 533¼ lbs. of blasting gelatine exploded, blowing the men to shreds. Two others were looking on. One, standing only thirteen yards away behind the horse he was tending, was actually talking to the trammers at the moment the explosion occurred. The horse dropped dead in front of him, but incredibly he escaped without a scratch. The other was leaning on a post about twenty yards away outside the mixing house, looking on. He was blown in through the doorway and injured as he smashed against the machinery. A piece of one of the trammers was found in the post that the fortunate mixer had been leaning against. The effects of the blast spread as far as Truro, where there was a "strange opening and banging of doors and windows". One shopkeeper went into his shop on hearing the door open, only to find no one there. The pall of smoke and dust that was thrown up was seen from miles away. It seems that the wagon had de-railed at the points and some of the sloppy thin jelly had splashed over and dropped onto the ground. Whether it was the treading of some of this jelly into the rocky ground by a hobnailed boot or the impact of a tram wheel on it as the wagon was being heaved back on the rails that caused the ignition will never be known.

Normal human weaknesses were to result in some other minor accidents. A fitter caused an

Figure 11. Former explosives works building at the north end of the airfield.

explosion in a wastewater discharge pipe from the wash water settling tank, which emptied out over the cliffs. He was trying to clear a blockage in the pipe by using a wood rammer and it seems a stone had been carried in by the rammer and fired a pocket of nitroglycerine. The pipe exploded, but fortunately without causing serious injury. Another incident occurred with a flannel filter cloth used to catch impurities from the washed nitroglycerine as it was run into the final storage tank in the "C" house. The flannel had been washed out as usual, but it was being dried by hanging it in front of the fire in the night watchmen's mess house, instead of being allowed to dry naturally by spreading it out at a suitable place in the danger area as it should have been. The cloth exploded, but only caused some damage to the mess room. An explosion occurred in one of the nitrators – without causing any casualties. Apparently a small amount of nitroglycerine had drained down with some waste acid and collected at the bottom of the vat. Decomposition had then set in, and the detonation was the result. Again no one was hurt, but a considerable amount of damage was done to the nitrator and its house.

Some unusual problems also came to the company. One was connected with the lights. The plant had the normal outside electric lights, shining in through windows to avoid the risk of sparks firing any explosive. This had the effect of making the factory a mark for shipping, but which could be confused with the Trinity House Lights. After some complaints a series of shields had to be put over the lights and blank them off from the seaward. The closing of the coastal path, a favourite local walk, was an ongoing source of acrimony between the company and the townsfolk, but the steady employment that the company provided, diminished bad feelings as time went on.

With the general industrial recession and the spreading inroads of competition, the factory was put on a care and maintenance basis during 1905, and no more explosives were made, although the magazines were used for a time to store cordite. With the huge demands for munitions that came with the Great War the plant was re-opened but completely changed. Existing explosives making machinery was removed and new equipment installed to fill grenades and shell fuses, as well as "gains" – the booster charge needed for shells and bombs to amplify the initial burst of heat from the detonator so that the main charge of insensitive explosive would fire effectively. At the height of this new lease of life nearly a thousand people were employed, but as with virtually all of the munitions factories, work stopped almost immediately the war ended. Soon after, the business of stripping out the plant and selling off the materials that were rescued went ahead. A few of the more substantial buildings were left, and survived the complete transformation that came when the airfield was built in 1941.

[The information in these notes has been abstracted from *Cornish Explosives* by Bryan Earl (Trevithick Society, 2006) to which due acknowledgment is made and to which those, who would know more, are directed. This comprehensive and definitive work is currently on special offer at a price of £15.00.]

Cligga Mine

This mine is situated within a small granite intrusion which is mineralised towards its northern end. The intrusion is about 600 yards long (N - S), and 300 yards wide (E - W). At this point to the east, a large fault pushes the granite down about 300 feet, to sea level, and the ground further east is in killas (as it is to the south and west). No one seems to be exactly sure how far the granite extends westward out under the sea.

The numerous quartz veins of varying size in the granite and carrying the tin and wolfram minerals were in the centre of bands of 'greisen' (altered granite), the whole mass constituting what is known as a 'sheeted vein complex', with the bands dipping to the north and much of the granite at least partly decomposed (kaolinised). In former times, the presence of wolfram in the ore would have caused separation problems, and mining would have had to be selective and confined to the richer veins.

In the 1830s old, shallow workings in the area resulted in the sale of small tonnages of copper ores, credited to 'Cleggar' mine. Some work at least was being carried out in 1926, recovering tin from beach sands at the foot of the cliff. In September 1938 Cligga Wolfram & Tin Mines Ltd. registered, nominal capital £2,000. The company was set to exploit the many quartz veins within the granite for tin and wolfram. At this stage, it was said an old Cornish stamp mill of 16 heads was being put back in order, and a concentrating plant was to be built. The stamps was presumably the set erected by the explosives company.

By August 1939 small shaft near the cliffs (Contact Shaft) had been reopened, and sunk to about 100 feet from surface (No. 1 level). From this point some 400 feet of cross-cutting had been done, to investigate the potential. A portable compressor was on surface, and a small steam hoist brought ore up the steep incline at the western edge of the cliff. It was said that a small, steam-driven experimental crushing plant was being erected, to carry out an effective bulk sampling of the ore being mined.

At about 200 feet from the top of the cliffs, a level (No. 2 level) was being driven in on one of the prominent veins, and more cross-cutting was going on further in from the cliffs. Further down, almost at high-water mark and about 300 feet from the top (Beach Adit and No. 3 level), a deeper drive in and cross-cut were progressing.

Exploration to date had proved that the granite intrusion carried a mass of veins, varying in width from up to 1 foot down to a fraction of an inch, and separated by anything from a

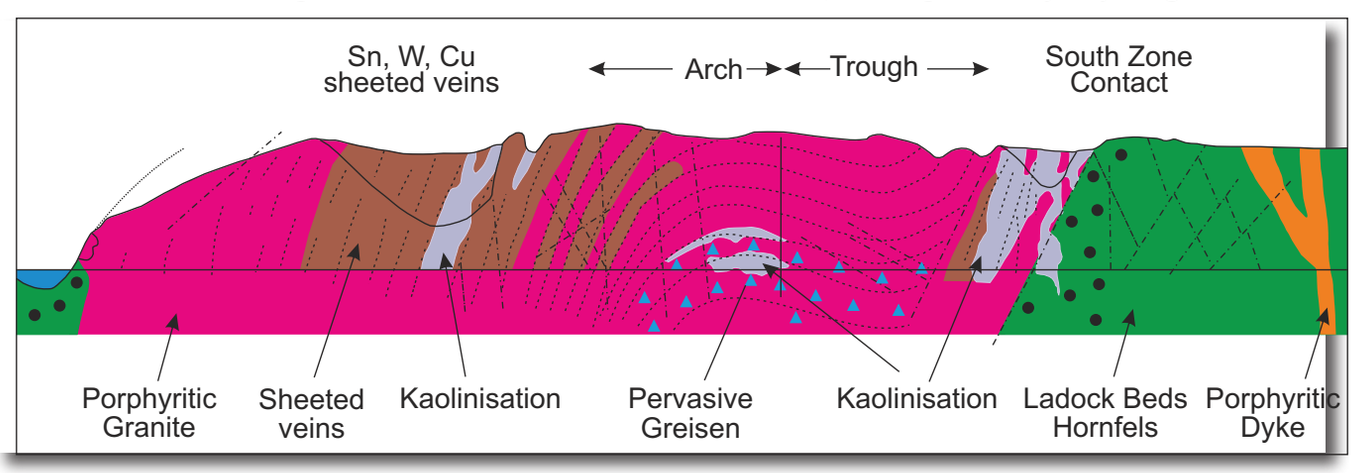

Figure 12. Geological section of the coast at Cligga Head.

few feet to as many inches by altered and often decomposing granite. In fact, it was more like a 'stockwork' type deposit, such as Wheal Prosper or Mulberry Pit, near Lanivet. The whole mass was being carefully sampled and check-sampled, with so far encouraging results, and it was even mooted that, if viable, the entire mass could be mined by opencast methods.

By December No. 1 level was being developed, and Contact Shaft had been sunk a further 100 feet down to No. 2 level. This permitted all hoisting to be done via the shaft, with the inclined skip road no longer used. The crushing and sampling results had proved satisfactory, and a small mill was to be erected, capable of handling up to 80 tons per day. To this end, a compound condensing steam engine, with boiler etc had been erected. This would not only drive the mill, but also an electricity generator for pumping, lighting and final magnetic separation of the mixed tin/wolfram concentrate.

By March 1940 the mill had been running, but a series of cliff falls (the result of severe frosts and nearby blasting in stopes) had damaged the pump column (up which water for dressing was pumped) and cables. In February, a landslide virtually destroyed the whole lot. Fortunately the pump was retrieved and was removed to a more sheltered position round to the north side, where the cliffs were more stable. During suspension of milling, the shaft was enlarged down to No. 1 level. In places, the original old shaft was very small, but the present work had made it larger and of uniform size from top to bottom.

By September extensive development underground was said to be under way, and the mill was again working at full capacity for 16 hours per day, with 'a steady output of mixed tin/wolfram concentrate being produced, however there was no mention of magnetic separation. The shaft was now being sunk down to No. 3 level, and at all three levels (100, 200 and 286 feet from surface) they were cross-cutting extensively, for exploration, in addition to driving and stoping on many of the small lodes.

Several localised enrichments had been found, where the cassiterite was said to occur very rich and as coarse crystals (the largest found on the beach was 1 inch in size). A second air compressor had been installed, and a regular supply of boiler water came from a hydraulic ram pump in Perrancoombe.

By April 1941 an extensive development and exploration programme on all 3 levels was in progress, while stoping was continuing normally. No. 3 level had reached the shaft some time before this. Where drives had been continued eastwards into the killas some of the veins were found to increase in size, offering hopeful future prospects. An increase in the scale of operations, coupled with a considerable enlargement of the pilot mill, was being considered.

In July operations were increased, and the mill was being remodelled to regularly handle 80 tons per day. Meanwhile, all mining, except a little development and milling was suspended until mill modifications were complete. By the end of summer the large wooden headgear from Polberro Tin had been purchased and erected, together with a double-drum steam hoist from the old Lambriggan Mine, while the shaft was equipped with double skip roads for self-dumping skips (previously, all ore had been tipped by hand at surface). A Lancashire boiler from Killifreth had been fixed in place, and a second was to be installed. A further 150 h.p. steam engine from Wheal Busy had also been completed, and the air compressor and electric generator were in position.

In the mill, most of the jigs and concentrating tables were in place, and the heavier bits of the crushing plant were being lifted into position.

Figure 13. Ore chute, known as a 'Cousin Jack' chute, at the east end of the large stope on the ore zone at No. 1 Level. John Manley observes. Photo courtesy of Dave Warne.

The enlarged plant was virtually complete by January 1942. The boilers, winder and both engines to drive the compressor, generators and mill equipment had been under steam for some days, while most of the mill had been given a trial run.

Development and exploration work underground had continued in a small way during these modifications, and it was hoped that production would be resumed very shortly; maximum throughput was eventually increased from 500 to 3,000 tons per month.

Operations were discontinued in August 1944, after about 2½ years running at full capacity. Overall production figures given as 300 tons of wolfram concentrate, and 200 tons of black tin. As previously mentioned, following the mine's closure parts of it were used as underground munitions storage.

In 1961 Geevor Mine, in conjunction with some other mining companies, was carrying out exploratory work at Cligga, with a few diamond drill holes being put down to shallow depth. The results were apparently sufficiently encouraging to warrant further exploratory work, and the next stage had commenced; this involved sinking the shaft below sea-level as well as lateral development on the nearby ore bodies.

Work had continued throughout 1962, and the old Contact Shaft had been deepened to the 500-foot level, where a cross-cut was being driven to intersect a vein located by diamond drilling about 500 feet north of the shaft. Another vein, carrying payable tin values, was cut by the cross-cut before completion, and it was proposed to drive on this, as well as continuing the cross-cut and driving on the other vein when cut. It

Figure 14. Crosscut on No. 2 Level. Note the board only partially covering the top of the stope, the bottom of which is 30m below. Photo courtesy of Dave Warne.

was hoped that results would justify a further stage of diamond drilling and development.

Overall however, the results of the exploratory work had proved disappointing, and underground operations were stopped early in 1964. Drilling on the old Perran St. George sett to the east had also proved disappointing, and that work was also stopped.

More exploration by Cornwall Tin & Mining Ltd in 1973 had been encouraging enough to hope for a later resumption of work, however nothing resulted from this. In 1980, Amax Exploration U.K. Ltd. (involved at Hemerdon for wolfram) withdrew its possible interest in the Cligga site. Attempts to reopen the shaft by Wheal Concord Ltd. during 1984/85 ceased with the tin price crash of October 1985. No sensible work had been carried out.

Much still remains of the concrete loadings of the mill and ancillary buildings. The site of the crusher can be seen at the west end of the site, followed by loadings for dipper wheels, buddles and shaking tables. At the far east of the mill lies a large, circular, thickener, where slimes were allowed to settle out of water to allow the latter to be reused. The layout is quite complicated and is yet to be properly surveyed and interpreted.

Figure 15. The extensive remains of the ore treatment plant; the central feature is the loadings for a double dipper wheel; a buddle can be seen to the right. Everything is made from concrete.

Trevellas Coombe and Blue Hills Mine

The mines of St Agnes, principally Blue Hills, Kitty and Penhalls, West Kitty and Polberro, are characterised by 'flat' lodes. These lodes dip to the north at between 20 and 40 and are heaved to the north by faults (called slides or gossans depending on the minerals they carry) by up to 200 feet. This results in the repetition of the lodes at about the same depth through the mines.

Work began on 21st January 1812, and by the end of April the mine was cleared of water; men were taken on early in May. The mine comprised several properties, including Goonlaze, Pink, Wheal Derrick (Dellick or Delliack), and Poulgeer (Polyear). These three mines, when worked as separate adventures, were famed for the tin which they produced; the Pink especially, was particularly "fragrant to the old adventurers . . ."

In advertising 34-63rd shares for sale by auction in Truro in May 1813 it was stated that the mines comprised the Pink, Wheal Glynn, Poulyear, Wheal Joy, Wheal Delick, Kant Petha and Penhalls. To former adventurers the mine had paid over £400,000 profit (in dividends). There were nine stamping-mills worked by water, and a good course of tin in the bottom of the mine. Private contract would be considered by the vendor, Thomas Teague of Redruth. No buyer came forward, and the shares were put up for auction once more in August 1815, also in Truro.

In 1814 the mine was drained to a depth of 60 fathoms below adit. In October 1818 2-55th shares were offered at auction in Redruth. In May 1819 Penrose sued James Hawarden for arrears of calls on his eight shares, amounting to £824 7s 2d. The Vice-Warden's Court granted a decree for payment in June of the full sum demanded, plus common costs.

The mine was put up at auction in Truro in July and August 1819. In addition to the materials, tinstuff and slimes, the items on offer included 80 fathoms of pumps and two capstans. The 58-inch engine was calculated to keep the water 70 fathoms below the then bottoms, 80 fathoms, and it was claimed that in a former working the mine had produced upwards of £100,000 in profit. The Engine and Whim shafts were 66 fathoms below adit, and Wheal Joy Shaft had been cleared and sunk to the 50 fathom level.

In 1869 it was thought that the mine had been opened about 1800, when black tin was about £35 per ton. At a meeting held in November 1871 the chairman of the company then working the mine stated that it had been closed by an influx of water in 1817 or 1818. Dues were then 1-10th, and sales of black tin were £10,249 in 1818. (With black tin at £48 per ton this would represent about 213 tons). The speaker thought that this had all been raised from the ground about Joy's Shaft.

From 1824 to 1825 the mine was held by the St Agnes Consolidated Mines. According to the prospectus of the Tywarnhayle Mining Association, this mine was "nearly working" in 1825, when the Association acquired it. Little, if any, work appears to have been done by the latter company either, however. In August 1826 the spare materials on the mine were offered for sale by private contract; they included a 32-inch spare cylinder with steam case and parts for a steam engine.

The Blue Hills Tin Mining Company was formed by Edward King in March 1869 and its shares were largely subscribed by the adventurers in the adjoining Penhalls Mine. The inaugural meeting appointed agents, bankers and secretary, and elected a committee, after which it approved the purchase of a 60-inch engine for £560 delivered on the mine. At the time of the meeting there were 31 adventurers, the chief ones being Edward King (1,280 shares), Chester

Figure 16. Aerial view of the Trevellas Coombe area sites.

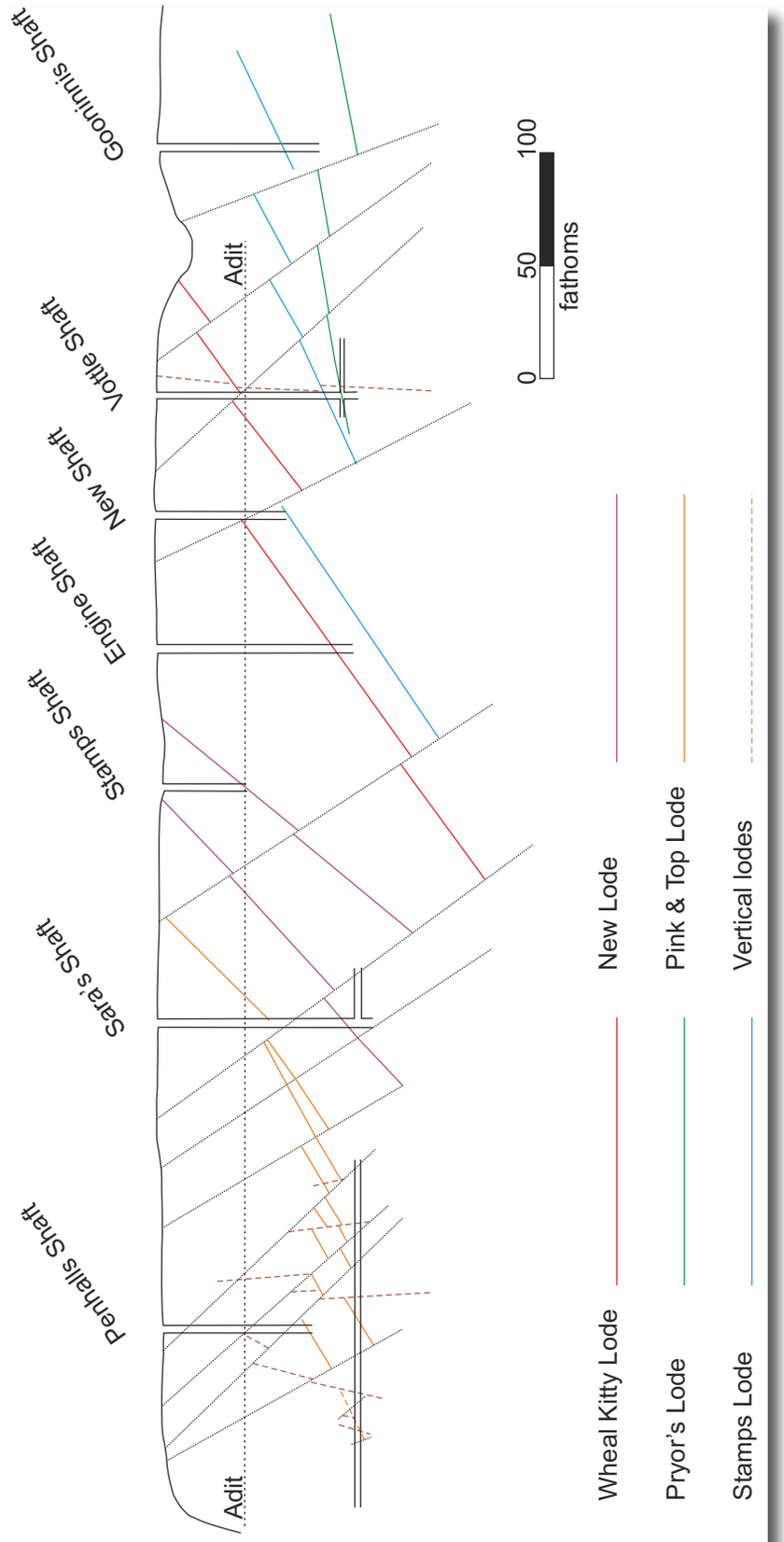

Figure 17. Cross section from north to south through the Kitty and Penhalls sett showing the flat lodes and the effect of faulting.

Cheston (1,078 shares) and James Hickey (482 shares). Harvey & Co. of Hayle held 250 shares, R. H. Pike & Son of Camborne held 100 shares, and Daubuz & Co., the Truro smelters, held 50 shares. Captain Samuel Bennetts, formerly the manager of Caradon Consols, St Cleer, held 10 shares.

Work began at once, and by mid-April 1869 the old workings had been forked to the 40 fathom level, possibly by the engines on the adjoining mines. The mine was said at this time to include the whole of the Wheal Kitty, Penhalls and Polberro lodes, each of which mines were making large profits. The Great Pink and Blue Hills lodes were said to have given a profit of £150,000 and to have been seen to a depth of 50 fathoms in Blue Hills.

In April 1870 "A Traveller" noted that a steam-engine was being put up in the wrong place; a winding and stamping engine were also being erected, presumably where they were supposed to be. The latter, a 30-inch model, drove 16 heads of stamps, and a further 22 heads were worked by a waterwheel. A correspondent reported an important discovery at Joy's Shaft in July 1871, where, a few fathoms below adit, the lode was worth £15 to £20 per fathom, standing whole.

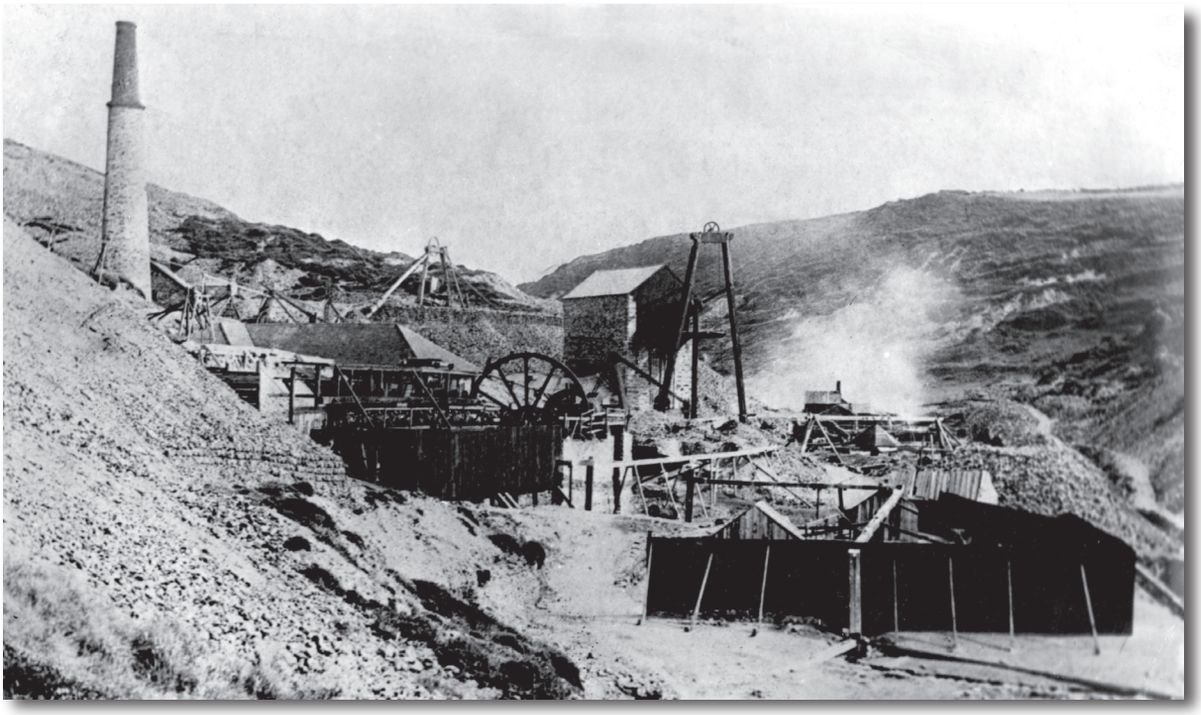

Figure 18. Blue Hills Mine, c.1890. This area lies immediately south of the bridge that crosses the stream.

The sett extended 700 fathoms east of this point and, under the same management as Penhalls, the mine was selling 7 to 8 tons of black tin monthly, which more than paid cost.

In November 1871 the 66 fathom level was being driven north of Letcher's Shaft, and an improvement was reported in Wheal Betsy or Baldhu Lode in the 13 fathom level east of Polyear Shaft. At the same time the pump work had been fixed in Wheal Joy Shaft and the water there was in fork. A meeting was told at the end of May 1872 that the south part of the mine had the continuation of the Wheal Kitty lodes, which had never been seen in Blue Hills; the agents strongly recommended a trial in this part, which had once been known as East Kitty. The recent discovery at Joy Shaft was said to be the best in the village for fifty years. The mine had the run of the lode for about 700 fathoms. Elsewhere, the Wheal Kitty Lode cropped up to surface about half a mile south of Blue Hills Engine Shaft, and could be met if the adit were driven about 40 fathoms; the lode ran for about a mile through the Blue Hills sett and had been opened for three or four fathoms, yielding "capital stones of copper and tin."

In June 1873 dues were reduced to 1-60th during pleasure, suggesting that not all was well with the mine; in the spring of 1874 relinquishments of shares began. Some complication arose over proxies at a meeting held in February 1879 when it was stated that the holder of shares in a cost-book company could only appoint another shareholder as his proxy. The meeting, after receiving objections to an item of £135 for interest on a local coal-merchant's account, agreed that it should be paid and resolved that future meetings of the company should be held every four months.

Captain Rich agreed to supervise Penhalls Mine in June 1879, with the encouragement of the shareholders, and to work the two mines together. At a meeting held at the account-house of that mine in May 1880 it was resolved to dispense with the London office. Best thanks were then voted to the Duchy for reducing dues to 1-60th "during the depression in mining", and the committee was authorised to dispose of forfeited shares. The shares were put up for sale in May 1881 but all 1,800 failed to find buyers. Meetings held in August and September

discussed the question of a merger with Penhalls Mine, but agreed to postpone it for a time as the Penhalls adventurers claimed it would involve selling their mine as a going concern.

In mid-December 1882 the tributers went on strike, together with those at Wheal Kitty and Penhalls, following a reduction by the managers of the price of tin used when calculating tribute, and by cutting down in many cases what had previously been a low rate of tribute. They also increased the returning charges by a shilling a ton on common stuff, to advance in a corresponding ratio with the richness of the stuff. The men said these alterations meant starvation for their families, and that it was just as well, or better, to stop work. The strike appears to have lasted at least a fortnight, though output does not appear to have suffered.

Further applications to the lords and to the Duchy were made in March and October 1883, and about February 1884 the former agreed to forego dues during pleasure. A meeting held in March 1884 authorised the committee to dispose of sufficient forfeited shares to make the capital, then in 3,048 shares, up to 5,000. By July 1885 the capital had fallen to 2,780 shares, and 220 forfeited shares were sold by W. T. Davey, the Redruth auctioneer, at prices starting at 10s and continuing up to 23s. A meeting held in August then resolved to halve the shares, making the capital 6,000. Attempts to sell shares at the London Auction Mart in July 1888 failed to produce a satisfactory bid.

In May 1884 it was noticed that water was coming into the mine at the 50 fathom level from the recently-closed Penhalls Mine, but it was soon brought under control. Wheal Joy Shaft had been cleared to the bottom, the other shafts in use were Engine, Letcher's, and Blue Burrow. In 1888 the mine employed 64 people underground and 43 at surface. In June 1888 Wheal Betsy Shaft was 8 fathoms below the 35, and the 66 fathom level was being worked on the North or Baldhu Lode.

A meeting held in May 1889 was told that the present lease was for 1-15th dues, and 1-18th after the erection of an engine. The lords had been asked for 1-30th in the new lease, and a figure of 1-24th had been finally agreed. The chairman added that they had always received the greatest consideration from the Duchy, and had only paid 1-40th dues for some time past. Meanwhile, Blue Burrow Shaft was drained to the bottom in December 1889; a meeting held in January 1890 was told that the Baldhu Lode had been lost by a fault, and resolved to suspend all work-

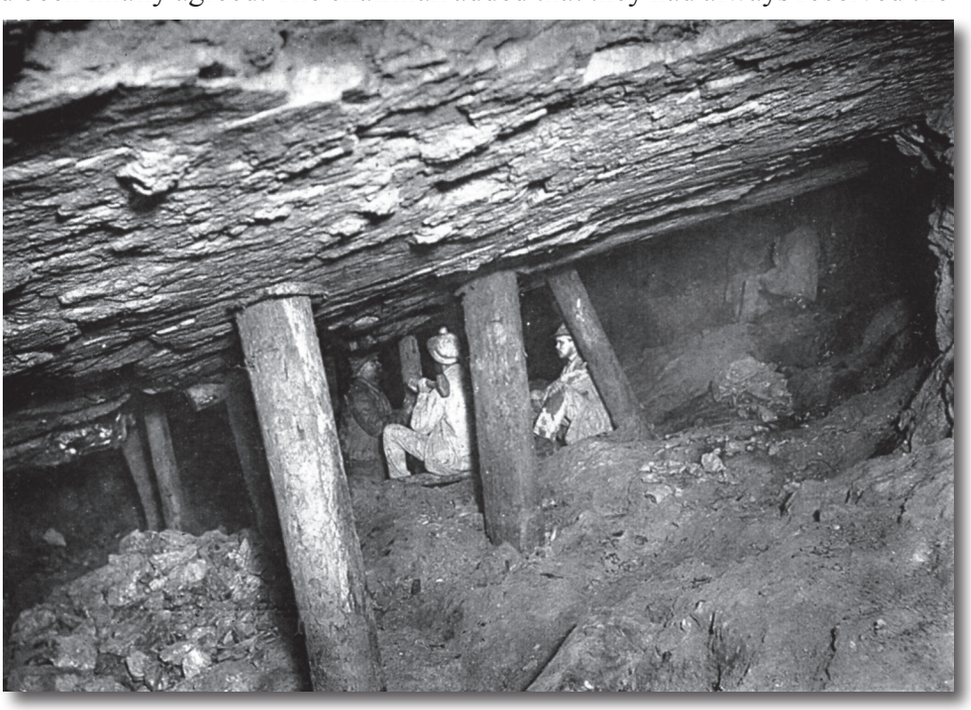

Figure 19. Timber supports at the 66-fathom level in Blue Hills Mine, 1895.

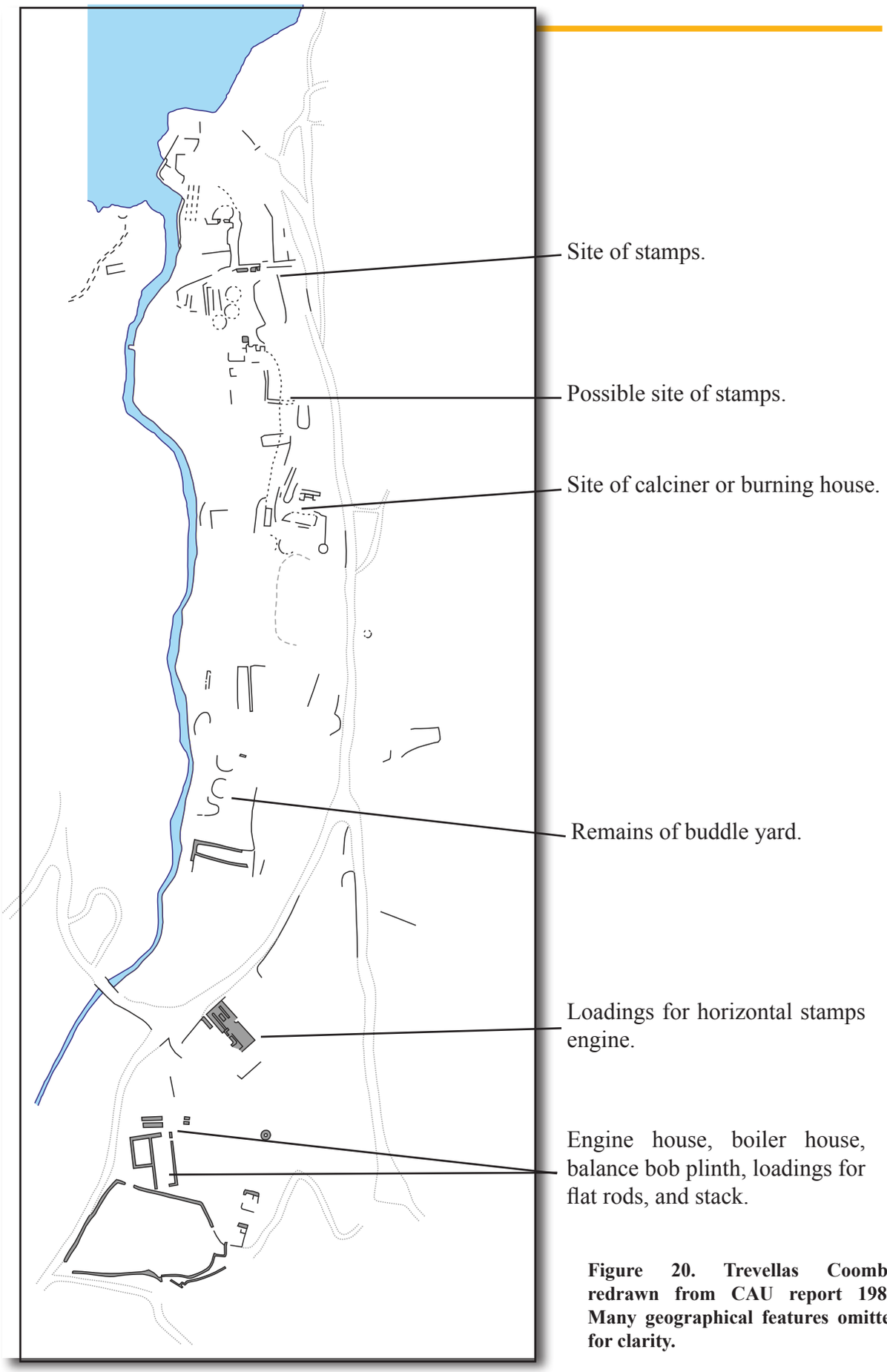

Figure 20. Trevellas Coombe, redrawn from CAU report 1986. Many geographical features omitted for clarity.

Trevellas and Blue Hills Notes

Figure 21. Pumping engine house and stack in Trevellas Coombe.

ings on points other than explorations. In August a brick and cement dam was put into the 40 fathom level west of Blue Burrow Shaft to enable the shaft to be sunk.

In April 1890 it was reported that a rise in the back of the 66 contained a lode worth £30 per fathom, and had been communicated with a winze sunk below the 42. The draft of the new Duchy lease was submitted, showing that the northern part of Penhalls sett was to be divided between Wheal Kitty and Blue Hills. However, a meeting was told in August that the Penhalls lease had not been obtained as it had been renewed for six months to a man who had held it unworked for the past four years. The lease of the whole of Penhalls was finally granted to Blue Hills on liberal terms in April 1893. The engine shaft of the latter lay only about 15 fathoms from the joint boundary; Penhalls had a 60-inch steam engine, but in the last ten or fifteen years' working the adventurers had only sunk their mine about ten or fifteen fathoms. The Penhalls engine shaft was 230 fathoms west of that of Blue Hills.

An arrangement was made with East Blue Hills in July, by which that company was to be allowed to work 50 fathoms west of Gumpas adit, paying Blue Hills a quarter of any profit made. If East Blue Hills were to stop, Blue Hills was to have the option of buying its materials and machinery at a valuation. The East Blue Hills burning-house was to be joint property and used by each company in alternate weeks. Blue Hills was to have the right to build a new burning-house in any wastrel in East Blue Hills dressing-floors. Underground, it was reported to shareholders that a speculative cross-cut had been started at the 66 to seek the Jubilee Lode, which had been seen on the shore at low tide. In January 1893 it was reported at a meeting that the grade of ore in the mine had been 54 lbs of black tin to the ton, but was now only 28 lbs.

In August 1893 the mine was drained to the bottom or 85 fathom level. The lords were asked for a remission of dues and to forego the arrears of dues while the mine was making calls; in September it was claimed that nearly £30,000 had been called up. In November 1894 the mine was temporarily flooded, but was cleared again and reached the 100 fathom level in January 1895. A "grand discovery" was reported on the Pink Lode in May; and about this time it appears that dues were reduced to 1-60th.

The mine was partially flooded in the winter of 1895-96, and output fell off. In May 1896 yet another improvement was reported, this time in the end of the 100 fathom level, where the

lode was said to be 4′ wide and of fair value. At this point it was just under the shoot of rich ore in the 80. Despite these encouraging signs a meeting agreed to close the mine in January 1897. It agreed that the committee should wind up the company, with the purser acting as liquidator. The decision was confirmed at a meeting held in April, when it was resolved to wind up the company in the Vice-Warden's Court.

The Cornwall correspondent of the *Mining Journal* commented in January 1897: "The closing of Blue Hills need not, however, be the cause of any alarm. It is a small concern which has practically been living on the charity of two or three very large shareholders for a long time . . ." If worked again, the concern ought to be properly equipped and the working undertaken vigorously. The writer continued: "They have simply been pottering along with one or two points, while under a limited company and little capital they could open up a long run of ground, with every likelihood of intersecting rich bunches . . ."

Noting that the mine was to be wound up in the Stannaries Court the *Mining Journal* observed in April 1898: "It was a curious mine, such tin as was discovered was taken away at once . . ." The Board of Trade annual report stated that mining operations had ceased owing to the low price of tin and the poverty of the lode, and that the mine was considered to be of no value. Assets had been estimated to produce £863 15s 8d, and liabilities were estimated at £2,286 12s 10d, including a bank overdraft of £1,959. The estimated loss to contributories throughout the 29 years of the company's life was about £42,441 15s 6d, exclusive of the costs of the liquidation.

Remains of tin streams, dressing floors and other mine buildings are scattered along the valley. Just inland from the car park can be seen a wheel pit, denoting the site of a stamps. Another, possible, wheel pit lies a little further to the south-east. Much of the bottom of the valley contains piles of rubble, possibly from final attempts to extract in. About a third of the way from the car park to the bridge can be seen a stack, the remains of a burning house or calciner. There is no arsenic in the sulphide ores of this area, so the burning process was only for cleaning the ore. A few remains of buddles can be seen near the bridge. At the east end of the bridge stands a large, square, structure. This is the loadings for a horizontal engine which operated the stamps as well as winding drums for several shafts (shown in use in figure 18). The large flywheel slot is on the south side while there are plinths on top, with two narrow slots, where the engine was fitted. The stamps were located to the rear.

The bridge itself is a Listed building, as is the house for the 70-inch pumping engine farther south. Associated with the engine house is a balance bob plinth, on the east side of the filled shaft, and a pair of flat-rod supports farther east. The boiler house is on the east side of the house and the stack stands alone a little way up the side of the valley. The stack was probably shared with the boiler for the stamps engine

Blue Hills Tin Stream

2

Figure 22. The derelict stamping mill in the 1940s or 1950s.

This tin-stream lies on the lowest of the three streamworks sites in the Trevellas Valley. After some years of idleness the site of the stream was acquired by Colin Wills and his son Mark, who have worked the stream since 1975; it is now not only Cornwall's only streamworks but also its only tin producer.

The stream produces around ten tons of black tin a year. The stamps and huddle are driven by an 11 x 2½ foot water-wheel, recently (1999) reconditioned, and a small smelter has been put into a building formerly used as a blowing-house, enabling the production of tin trinkets. All the old processes are demonstrated for visitors, including hand-jigging (the forerunner of heavy media separation) and the use of a vanning shovel to make visual assays of ore. The works also has a fine collection of tin-bearing rocks on display.

Figure 23. The stamping mill today.

Trevaunance Cove

Trevaunance Cove lies to the north of St Agnes and has operated, albeit briefly, as its port. The road from St Agnes drops steeply to the north east. Quay Road runs down a valley which widens and deepens to the north and into the Cove. Wheal Kitty and Penhalls Mine lie atop the plateau to the east while Wheal Friendly and Polberro Mine stand on the hillside to the west.

There have been no fewer than five attempts to construct a harbour at St. Agnes. John Tonkin's 'peer' or 'key' was built in 1632, but failed to survive its first winter. Another Tonkin, Hugh, made an attempt in 1684 without success. His second attempt in 1699, assisted by Henry Winstanley of Eddystone Lighthouse fame lasted to 1705, when it was destroyed "by a violent storm".

Thomas Tonkin took up the burden in 1710; his harbour was destroyed in 1736. He wrote, somewhat ruefully, that "a small cove under the coom, called Trevaunance Porth has been an inducement to several of our family to expend great sums of money to build a peer or key" [it cost £6,000].

Figure 24. St Agnes harbour, complete with shipping. The cannon have long gone!

It was 1793 before anyone tried again, following on from "an Act for erecting and making a Pier and Harbour in the Cove of Trevaunance, in the Parish of Saint Agnes, in the County of Cornwall" in 1790. A group of mining adventurers under the name of the Trevaunance Pier Company built a new harbour, at a cost of £10,000, under the cliffs in Trevaunance Cove. Timber loading platforms on the cliffs above loaded and unloaded ships using horse windlasses. Cargoes included copper ores bound for the Welsh smelters and coal from South Wales; local fish were also landed. A 1910 visitor regarded the harbour as one of the greatest curiosities of Cornwall in "a most hazardous situation" and "overhung by crazy old wooden staging" with "apparatus" for "loading from the heights". The harbour remained in use to the 1920s despite one of the harbour walls having collapsed in 1916. A small fishing fleet was based there.

Messrs M. T. Hitchens & Co built four merchant schooners at St Agnes between 1873 and 1877. Two were ocean-going, one in the Newfoundland trade while the Trevellas was often

Figure 25. The opencast workings of Wheal Luna/ West Wheal Luna.

seen in local waters loading china clay from Fowey. She was lost on voyage from Port Talbot in 1930. The last one built was the *Lady Agnes* whose figurehead was bought and brought back from Toronto by St Agnes Museum where it is on display. The site of the 'shipyard' is on the east side of the cove; it seems to have been a yard in name only as ships were apparently built on the beach, outside of the harbour (a saw pit is shown on the 1888 6-inch sheet 47SE).

Just inland from the beach is the site of the old St Agnes seal sanctuary, now moved to Gweek. This area is also the site of a small streamworks shown on the 1907 Ordnance Survey map which seems to have worked until the 1920s.

The remains of the 1793 harbour, confined to the bases of the piers, may be seen at low tide amidst the boulders to the west of Trevaunance Cove. On the coast path above can be seen the 'hutches' where copper ore was stored prior to being loaded on ships. Just to the south-west of the hutches can be seen the cavernous excavations of the ancient Wheal Luna. The mine was also known as West Wheal Luna, and appears thus on Barnicoat's tin bounds map dated 1838. By 1870, the sett was part of the Polberro Mines. The open works, shafts, and waste tips are visible on air photographs. It is possible that this area represents one of the early mining sites in Cornwall as adits at sea level gave access to 300 feet of 'backs' on the west side of the Cove.

Wheal Kitty and Penhalls Mine

This is an old mine, active in the early years of the 19th century. A 58-inch engine had been put up, probably around 1813, which pumped from several shafts using flat-rods. At this time there were several water stamping mills used for dressing. In the early 1830s James Sims erected a 32-inch high duty stamps engines, with the then long stroke of 9 feet. These engines were the first stamps engines to be used without intermediate gearing between the crankshaft and the stamps axle. The engine normally worked at 7-10 strokes per minute, and drove a battery of 72 heads, quite large for the time. The mine was over 50 fathoms deep in 1838.

The mine closed in 1842; at the public auction the materials included a 40-inch engine with 2 boilers, 32-inch stamping engine with 2 boilers and 72 heads complete, 16-inch whim engine and boiler, 16-inch whim engine without boiler, 2 horse whims and several buddles, racks, frames and kieves.

The mine was worked in the depression days of the 1840s, but not primarily for tin, as the principal stimulus for its reworking was the finding of 'a large and valuable copper lode' in the adjoining Trevaunance Consols to the west. The mine reopened again in 1852, though this was caused by a rise in the price of tin. A 50-inch pumping engine was built for the mine by Copperhouse Foundry in this year.

By September 1856 the outlay had totalled £48,621, of which the adventurers' calls had been £22,475 27s 8d. The following year the Penhalls sett lying immediately to the north was taken up by the Wheal Kitty adventurers, albeit as a separate mine. This was to be the beginning of a prosperous period in the working of the mine. In 1860 the mine sold £4,380 worth of black tin, making about £1,200 profit.

In 1865 the Wheal Kitty was 110 fathoms deep (adit 45 fathoms) and had a 50-inch pumping engine, 24-inch whim and 30-inch stamps. William Teague of Tincroft Mine was the manager, who also managed several other concerns at this time. In 1874 there was a fire at the stamps in November, which completely gutted the engine house.

Figure 26. Wheal Kitty, Sara's Shaft and engine house.

In 1876 Sholl's pneumatic stamps were erected on the mine. The stamps, built by Harvey of Hayle, were twice tried publicly by mining engineers and mine agents with tinstuff from Great Wheal Vor and Providence Mines respectively. During the very wet winter of 1876/77 Penhalls was flooded out up to adit level for 2 weeks. An extra contribution to pumping in the mine was made by the adjoining Blue Hills.

There was a brief 'tin boom' during 1880-82 with high prices but by 1884 the price had dropped back. Some 3,601 tons of black tin had been sold since 1858 though the overall losses were said to have been around £20,000. In February 1884 the deficit was about £12,000 but the adventurers decided to keep the mine going for a few months longer, the dues having been given up entirely. Later that year all three engines, with 64 heads of stamps, were advertised for sale and the mine suspended, although pumping seems to have continued.

The 50-inch subsequently went to Trevaunance United. The Blue Hills adventurers asked permission to work Penhalls above adit by tributers (the Blue Hills engine was draining part of the sett) but permission was refused.

Permission was finally granted in May 1893, but a massive tin crash was approaching, with Blue Hills subsequently closing in 1897. In the middle of the great tin slump Wheal Kitty stopped pumping, and confined all operations to above adit level. Wheal Kitty and West Kitty were the only mines left in the St Agnes area, the former on the verge of being totally abandoned, with all pumping and deep working stopped. However, by the end of 1898 the price of tin had risen to some extent, and it was widely hoped that the disastrous depression of the past few years was coming to an end.

The company stayed in existence somehow, no doubt aided by the rising price of tin around

Figure 27. Wheal Kitty 'new' dressing floor. Dipper wheel in the centre with loadings for shaking tables behind on left. In the background is the stack for the two calciners.

and after 1900. The sweep rod on the stamps broke on the 3rd of May that year, causing the stamps to be idle for several days. Coupled with a shortage of workers on the dressing floors, this meant a drop in tin returns. Wheal Kitty was cited as an example of prudent management, since it was a mine that would be paying dividends had not most of the money been ploughed back into the mine for the future.

On 14th December 1900 the adit under the dressing floors, which carried water to the stamps pump, collapsed and the stamps were idle for a week, reducing the output once again. In February 1902 there was a major problem as one crank of the stamps engine had broken and it was expected that half of the stamps would be out of action for several days.

In June 1905 the stamps engine house was burnt out, one of a series of several serious incidents at Wheal Kitty. Interestingly, according to Barton, the stamps engine bob was temporarily suspended from shears while the bob wall was rebuilt under it. On the dressing floors 5 Wilfley tables, 3 round frames, many new buddles, a 22-foot dipper wheel and an impact screen had been added, as well as many minor improvements. The pumping engine was working purely to supply water for the stamps and dressing (though keeping the mine drained to the 80-fathom level) and all mining was above adit level. Consequently, mined ore was in short supply, giving only 40% of that necessary to feed the stamps, the remainder being drawn from burrows, very low grade material.

In 1904 the old cost book company came to an end 'after some years of losses'; the adjoining sett of Penhalls and, later, Gooninnis, were acquired. The mine had been purchased by J. H. Collins & Sons in 1904, who formed a new cost book company. A new central shaft was projected, which had already (by June) been sunk and equipped to a depth of 100 fathoms. It was hoped to work the continuation of the Wheal Kitty Lode which had been cut off in depth by a large slide and never rediscovered by the previous company. During 1906, a time of high tin prices, the decision was taken to convert to a limited liability company. This was called Wheal Kitty and Penhalls United Ltd, also including the moribund Gooninnis to the south as well as Wheal Vottle, Wheal Pink, Goonlaze and other small mines.

Sara's Shaft came to be regarded as one of the biggest and best-equipped shafts in the district; it was 15 feet by 7 feet within timbers. In 1907 the stamps had a new Lancashire boiler, a pulveriser had been installed to cope with a large accumulation of burnt leavings and two calciners had been erected. The quality of Wheal Kitty black tin was usually exceptionally good and habitually realised 10% above the average price at this time.

By early 1910 an additional axle, with 12 heads of stamps, had been added to the battery, making 48 heads in total. This increased stamping capacity would enable them to treat the considerable quantities of slightly lower grade ore that had been developed but kept back. At this time Gooninnis sett was acquired, on a one-year lease from the Duchy. The object was to test the possible continuation of a lode going towards Gooninnis. The Goonvean China Clay Company had held the sett for some years, but had surrendered the unexpired term of 12 years.

The company bought the 65-inch pumping engine that had been standing on Tindene Mine for some years. The engine had originally been built by Perran Foundry about 1852, and had been at Deer Park Mine (where it was never erected) before going to Tindene. This engine was to be fixed at Sara's Shaft and would replace the temporary drainage system by which the water was pumped by a small horizontal engine to a large cistern placed in the shaft, where it is automatically discharged into a travelling tank, raised to adit, and there run off. The old Wheal

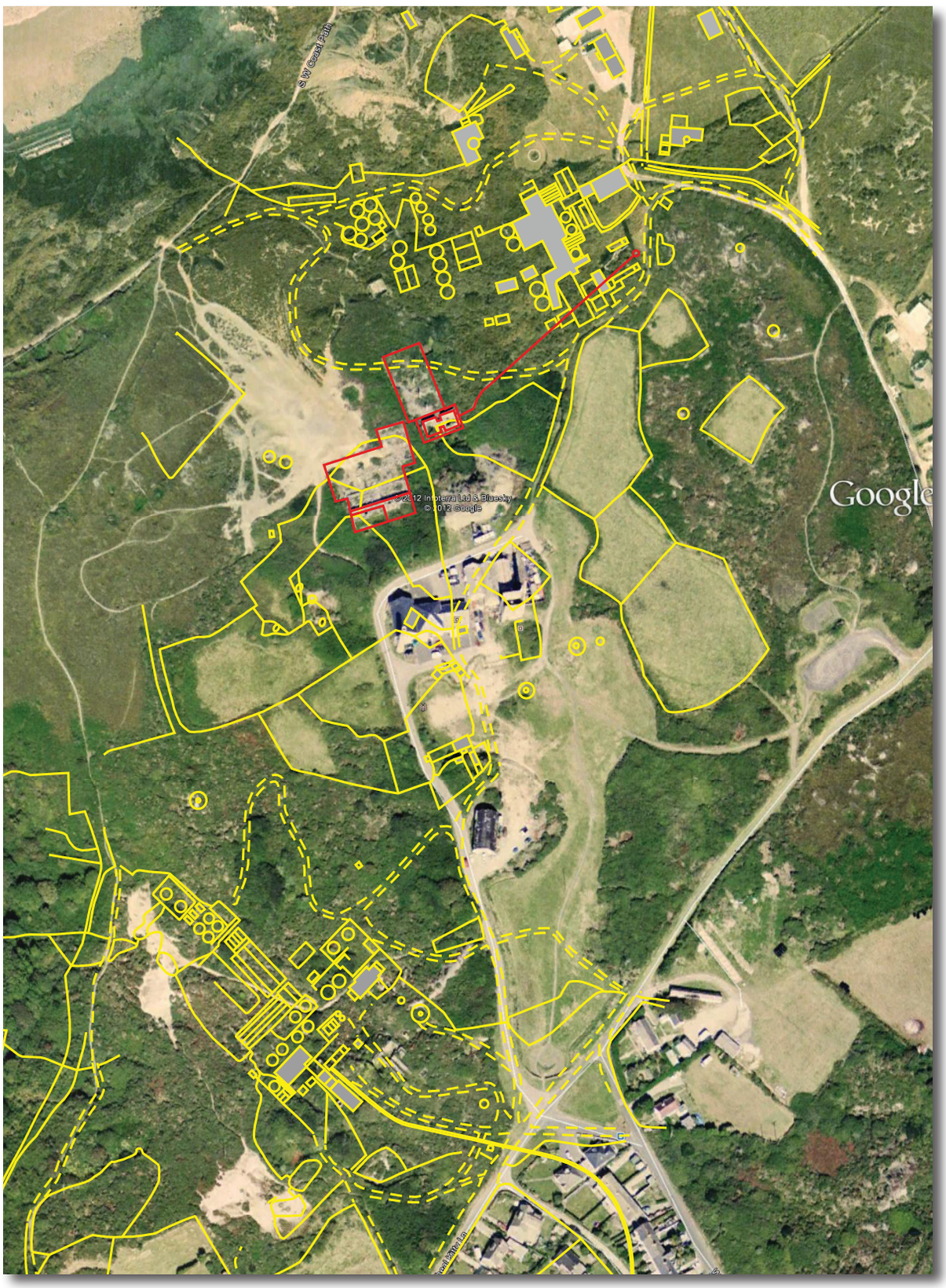

Figure 28. Composite GoogleEarth aerial photo with overlays from the 1st and 2nd series Ordnance Survey maps showing the two older dressing floors. The older floor, to the north, is on the Penhalls sett; the newer Kitty and Penhalls United floor is to the east. The outline of the present floor is in red. Trevaunance Cove is top left.

Wheal Kitty and Penhalls Mine Notes

Kitty 50-inch engine went to Parkandillack clay works, and was there given a new cylinder by Bartle's Carn Brea Foundry.

The fall in the price of tin at the outbreak of war affected all Cornish mines. At Kitty and Penhalls it was decided to erect a battery of 20 heads of Californian stamps, phasing out the old Cornish type. Amos Treloar had recently been appointed the local manager. By November the foundations for the new stamps were well advanced.

Underground operations had been greatly hampered by the absence of the best men, who had left to join the army, and it had been necessary to curtail development. Eventually, no less than 60% of the workforce was lost. Like the rest of the Cornish tin industry, Wheal Kitty was struggling under a heavy burden. A lack of labour, a 30% rise in the cost of coal, increased costs for other materials and a £7 per ton fall in the concentrate price.

Figure 29. Sara's engine house. This engine house has been stabilised and restored and is now a small office block. The interior floors are supported by a steel structure so that the original walls are not damaged.

In 1916 J. H. Collins died and, in September, work was largely suspended. Because of the weak financial position, H. E. Fern was appointed receiver and manager on behalf of the debenture holders in July. The unduly high proportion of the underground workforce called up for military service had seriously damaged the company. In March 1918 a serious pitwork breakage occurred, and the main workings in Sara's section, which had been looking good, were flooded before it could be repaired. Wheal Kitty was the only working mine in St Agnes parish, employing 63 people underground and 32 at surface.

In 1925, the price of tin rose again after the depression, and Wheal Kitty was restarted in July. The group of mines comprising Wheal Kitty and Penhalls, West Kitty and Wheal Friendly had been taken up by the Anglo-Oriental Group with an ultimate view to joint working on a considerable scale. Firstly though, it was intended to unwater Sara's section and conduct exploratory work. The pumping engine was being overhauled and would be set to work as soon as possible.

By January 1926 the details had been completed and a new company, Wheal Kitty Tin Ltd., had been formed. The sponsors were named as the Eastern Tin Trust and Tin Selection Trust. A new mill site had been chosen, north of Sara's, on sloping ground to allow a free flow of ore

from the mine, minimising transport and haulage costs. Josiah Paull, of South Crofty, was in charge of operations. The former mill had been conveniently located for the old company but this was no longer the case.

The policy was to unwater Sara's Shaft to 730 feet and install an electric pump. At that level they intend to haul to Wheal Friendly Shaft. In addition, a tunnel was to be driven into Wheal Friendly, to reduce the height of hoisting by some 120 feet. Later, Sara's Shaft would be sunk 314 feet and Wheal Friendly Shaft 200 feet. The company contemplated putting the idle 70-inch pumping engine on Harvey's Shaft, Tincroft Mine (built 1890 by Harvey's Foundry), but after moving the lighter parts of the engine to St Agnes, they decided not to go ahead with the purchase, with the result that the cylinder and bob were left derelict in the engine house at Tincroft.

By October 1926 the mine was again unwatered, and exploration and development were taking place on the 730-foot level and above. Work was also continuing on the new dressing plant. The company intended to make use of electric power and a transmission line was to be constructed from the Cornwall Electric Power Company's Carn Brea distribution station. In spring the following year it was reported that the original 20 heads of Californian stamps were to be doubled, and that James tables were then being installed. Milling started in May, and by June was in full production, treating about 60 tons per day.

Ore output since May 1927 to the end of the year was about 17,000 tons, averaging 19lbs. per ton. Some 6,000 feet of development had been done. The Company was working in descending order the Pink, Stamps, Wheal Kitty, and West Kitty lodes, and the general line of development had been to the north through the old Penhalls sett. Sara's Shaft had been sunk to the 880, and owing to the succession of upthrow faults to the north this would probably be sufficient depth to follow these various lodes by means of crosscuts as far as at any rate the ocean. The management were installing a second mill which will give an additional 20 heads of stamps. The mill had been completed and the tin yard commissioned, and a calciner was in operation though there was not sufficient arsenic in the ore to warrant the employment of condensation chambers.

The dominant feature on this site is the engine house on Sara's Shaft, restored and now used as a small office block; some of the other buildings nearby are original mine buildings. About 80m to the north-west is the modern mill, comprising loadings for Californian stamps, shaking tables and dipper wheel; vanners of some description were almost certainly also used. To the east of this mill is a pair of brunton calciners, joined by a 120m-long flue to a concrete stack to the north-east. The remains of a scrubbing tower can be seen next to the stack. To the north of the calciners is a smaller floor, for producing the finished concentrate. Immediately north-west of the main part of the mill is large area of barren waste material. This remains unvegetated because it was produced by froth flotation and the flotation materials do not support plant growth. The remains of other mills can be seen to the north and north-east of the modern mill and a second, later, mill to the west of the track leading to Sara's Shaft. The engine house is Listed Grade II while the modern mill is a Scheduled Ancient Monument.

St Agnes Museum

The Museum was established in 1984 and moved to its current location in the old Chapel of Rest in 1990. The Chapel was built in the late 19th century to cope with the increasing mining population of St. Agnes. Although the graveyard is still in use, the Chapel was unused for some years before the Museum took on the lease from the Parish Council. In June 2011 the hard work and dedication of the volunteers in preserving the local heritage of St. Agnes was recognised by Her Majesty awarding the Queens Award for Voluntary Service.

The collection tells the story of the parish of St Agnes, its history and its people, from mining to fishing. Highlights include a huge leatherback turtle, and the Whitworth Collection depicting five generations of local village doctors from one family. There are also important paintings by two local nineteenth century artists, a self portrait by John Opie R.A. and a portrait by Edward Opie R.A. of his father which the museum was able to purchase with the help of grants from The Art Collections Fund, The V&A Arts Purchase Fund and The Cornwall Heritage Trust as well as local donations.

There are also items relating to agriculture, a colourful natural history display and a fine mineral collection as well as a detailed model of the former harbour and our fabulous Lady Agnes figurehead. The Museum holds a total of about 6,500 artefacts, many of which can be viewed on a computer in the study corner. The Museum also holds information on many local families, including a list of the graves in the graveyard outside. The extensive family history records are also available for research in the new study corner both as hard copy and on the computer database.

Don't forget to visit the shop before you leave!

Figure 30. The entrance to the St Agnes Museum.

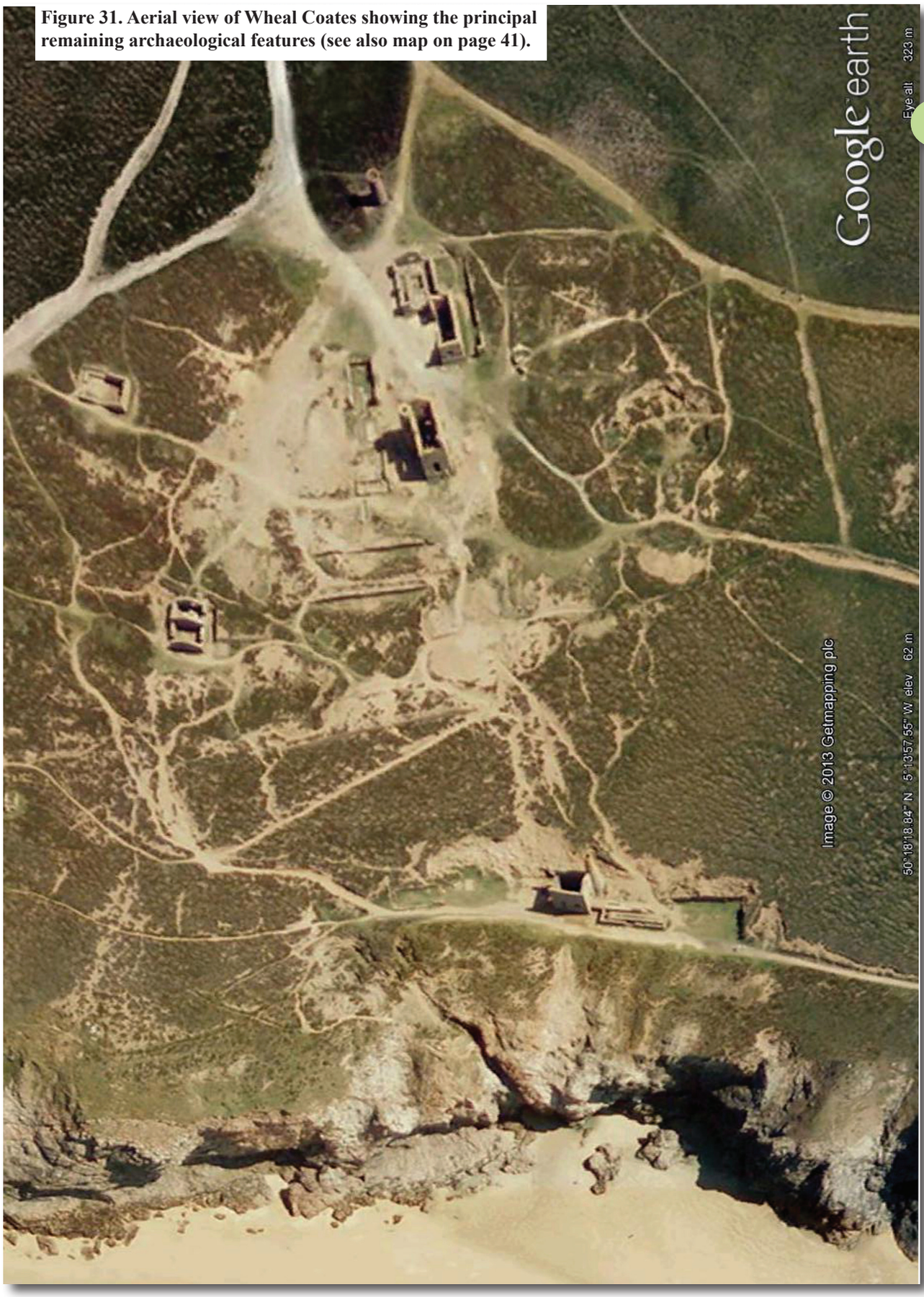

Figure 31. Aerial view of Wheal Coates showing the principal remaining archaeological features (see also map on page 41).

Wheal Coates

Kenneth Brown, quoting the Enys papers, states that the earliest reference to this mine dates from 1692, when details are given of the sale of "candels", "roape", "pick hilts and bills"; "shovells and shovell staffs", "boards", "coales from Hayle" and iron to men at the mine. Describing Whealancotes, Tonkin stated that "where the load has not been three inches over, yet it hath turned to great account, being worth ten thousand of white tin to the hundred sacks…", about 141 lbs of black tin per ton. The mine also sold black tin in about 1725. A share in Wheal Coates was put up for auction in August 1795 when the mine was in 16 shares.

In 1812 the mine was in 48 shares and William Stephens was purser. In 1814 William Phillips noted that a 3-inch vein in the mine had been found to be worth working. In 1819 the mine was said to have "afforded large quantities of tin, with a handsome profit to the adventurers". Beds of growan, with a slight northerly underlie, contained several parallel east-west tin lodes. A shaft was sunk 60 fathoms deep in soft growan; the mine was still working in 1832 and was a well-known source of twin feldspar crystals.

In 1841 the manage, Captain James Rouse, was killed in an accident that year and replaced by a Captain Hoskin; William Carne was the purser in 1844. In December that year a public auction was held of the mine and materials; this included a 60-inch steam engine, two bobs, 28' x 2' waterwheel, pitwork, capstan and shears, two whims and an air machine. By this time the mine was also well-known as a source of cassiterite pseudomorphs after feldspar.

In 1854 small-scale operations were being carried out and in 1855 the mine sold 1 ton 5 cwts 1 qr 2 lbs of black tin for £80 1s 6d. Between 1856 and 1861 the mine was under the management of John Taylor and Son. In 1856 the mine was "working only in a very slight degree". By July 1857 the deep adit had been driven nearly 300 fathoms and the water in the old workings had been tapped. The previous year the mine had sold black tin to the value of £88 2s 5d. In 1864 the burrows of the mine were being stamped and in 1866 the mine was being worked on a small scale, having been idle below adit level for many years. In 1866 and 1868-69 sales of black tin were worth £1,229 9s 5d; there were no sales in 1867 or 1870.

At the end of 1871 the mine was acquired by the Wheal Coates Tin Mining Company, Limited. The company was initially in 3,958 shares of £2 10s. "Spirited operations" were begun soon afterwards on a large lode in the western part of the sett, where the ancients were thought to have raised large quantities of tin. Preparations were made in May 1872 to erect pumping and stamping engines and some tin was sold at £100 per ton.

The statutory meeting of the company was held in May 1872. The company advertised at that time for two sixteen-head stamps axles. The pumping engine went to work in October, and tin dressing began in March 1873. By this time the engine shaft had been sunk some six fathoms below the 10-fathom level, and two winzes had been sunk below the 10 fathom level;

Key for map opposite:

Red circles: shafts
Orange circles: outcrop working pits and small shafts
Black circles: prospecting pits
Blue lines: leats
Green lines: track boundaries
Black lines: buildings, field boundaries and excavations

Wheal Coates area, redrawn from HES report 2010. Many geographical features omitted for clarity. Note that this is a different scale to the figure 31 on page 39.

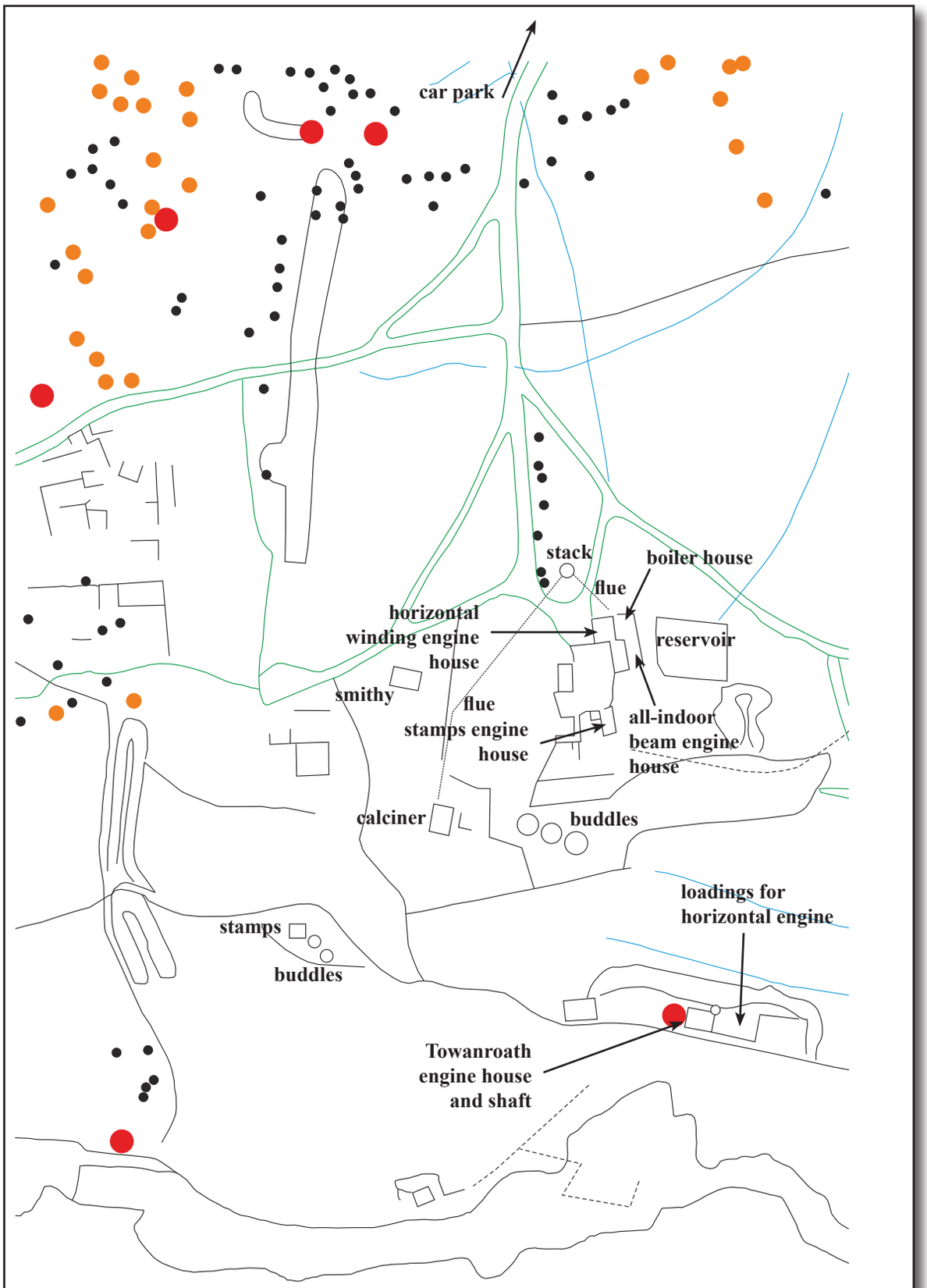

Figure 32. Archaeological features at Wheal Coates.

Wheal Coates Notes

it was intended to drive northwards at the 20 fathom level to the Towan Wrath Lode. A meeting held in January 1874 authorised the directors to borrow up to £4,000 in 10% Debenture Bonds of £10 or more, convertible into Ordinary shares in two years from 1st May 1874. The meeting also authorised the board to increase the capital from £12,000 to £20,000 by the creation of new shares.

The second annual general meeting was held in May 1874 by which time the mine was able to make regular returns of tin. A year later returns were said to be increasing, and a description of the Towanrath (sic) lode was given by Dr C. Le Neve Foster, who described it as a stockworks. In January 1876 the mine was reported to be paying cost, but in December it was only almost paying cost from the 30, 40 and 50-fathom levels. The property was acquired by Wheal Coates United Mines, Limited, in February 1880 although this company did no work.

At the end of January 1882 the Wheal Coates Mine Company was set up to continue the working of the mine. The company was floated by John Burall Reynolds, a shareholder in the previous concern, who had bought the property by tender. The sett comprised Wheal Coates and St Agnes Well setts, and the purchase consideration included £3,000 payable out of the first profits before a dividend was declared. The mines were held from the Duchy and the lords of Tywarnhayle Tyas, and the company operated on the no-credit system.

After visiting the mine in May 1882 J. B. Reynolds reported that he was very much pleased with what he had seen. "Wheal Coates has been worked by some persons or other for a long time past ... I was not aware when I took the mine into this office that the immediate prospects were anything like so good as they are . . . The pumping-engine was made in the year 1800", he told a meeting, "(a laugh) and is, therefore, about 82 years of age, I think the winding machinery is also of a very ancient type, as is the stamping-engine and all the machinery . . ." Nevertheless, all the machinery was adapted for the mine's requirements, and no great outlay on it was expected.

Figure 33. Wheal Coates: house and stack for horizontal engine on left and stamps engine house on right. In the far background are Godrevy Point and lighthouse, St Ives and the West Penwith Moors.

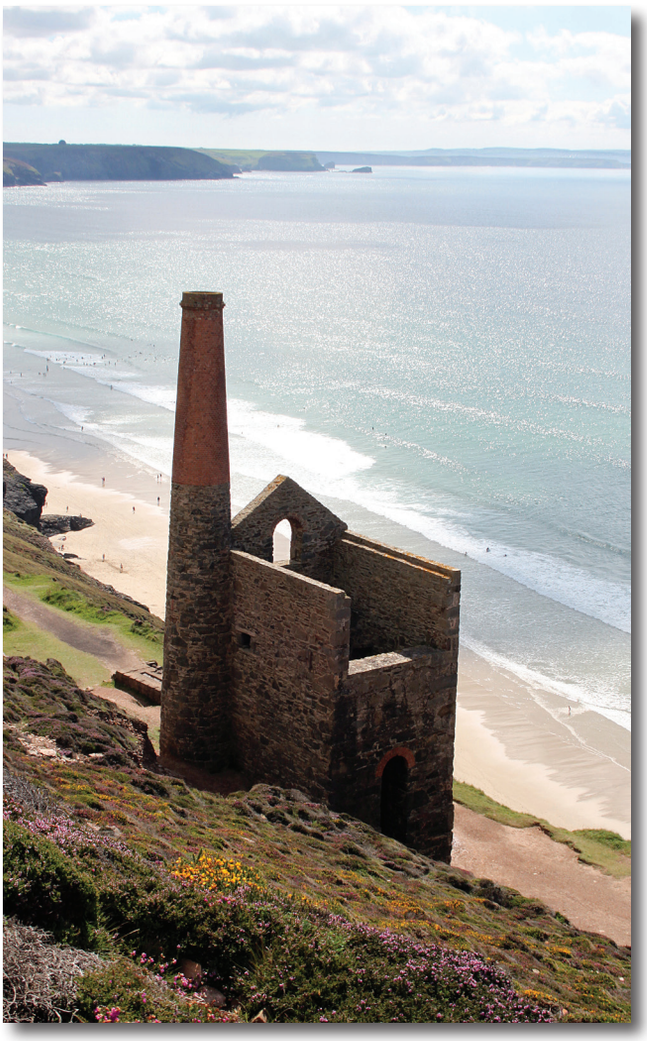

Figure 34. Looking down on the Towanroath Shaft engine house. The boiler house, to the rear, was later demolished to build the plinth for a horizontal engine.

About April 1883 the cross-cut driven south at the 80 fathom level was found to be wet, and was abandoned. Over 3,000 tons of tinstuff averaging about 17 lbs. of black tin per ton was raised from the Old Lode, on which it was proposed to suspend work. Operations were then transferred to the South or New Lode, which averaged 42 lbs per ton, worth £20 per fathom, and from which some 200 tons had already been raised. Tutwork on the Old Lode was suspended in July, though tributers continued there. About £100 worth of copper ore had by this time been raised from the 70 fathom level west.

Work on tin was suspended in February 1884 as the metal price was only £50 per ton, and attention was transferred to copper. The West Kitty Lode was being sought in the 80 cross-cut south. Dues were suspended in June. In August 1884 the mine was inspected by Captain White of Wheal Peevor, who reported favourably on it and suggested driving the 80 fathom cross-cut south to the copper lode, the engine being capable of taking the water.

A meeting was told in April 1885 that the time had not yet come to resume active operations. Work had recently been largely confined to the western part of the mine, to the neglect of the eastern part, which adjoined Trevaunance United.

In May 1887 it was announced that the mine was to be sold as a going concern, but a week later the decision was reversed. In July the property was advertised for sale, and it was noted that operations had been stopped when black tin was £43 per ton; it was then over £60, The mine was put up at auction in one lot later in the month, and the equipment on offer included a 50-inch pumping-engine, a 24-inch stamping-engine with 32 heads of stamps, a burning-house, a 20-inch winding-engine, boilers, skip-roads, smiths' and carpenters' shops, the account-house furniture, and other items. No buyer appeared, and a further auction was held at the beginning of October, first in one lot and then lotted. At the end of the month the Mining Journal commented that the machinery, erected at considerable expense, had been scattered to the winds, apart from the three engines, and the setts, which had a few years to run. The remaining items were offered separately at auction a few days later, without reserve.

"Echo" commented in November 1887 that in fifteen years' working the mine had not only paid its way but had also paid for the machinery, plant, and costs of development. "But for the waste of capital in heavy promotion money payments and excessive management payments"

it would have paid dividends. The last four months' agency costs represented an eighth of the full costs.

In the middle of February 1889 Wheal Coates United Mines, Limited, began operations. Almost immediately there was a change in the share issue, with 12,000 £1 shares being offered. In March the manager reported that repairs to the boiler were being carried out as fast as possible, and that foundations for a winding engine were being cleared. This involved taking out eight feet of rock, so as to enable water from the engine-pond to be used to feed the boilers and for condensing. The water was then to be used for the stamping-engine, after which it was to go over the dressing-floors. The winding-engine was set working in mid-August.

The *Mining Journal* understood in April 1881 that the company had obtained from the Duchy the grant of St Agnes Hill and part of the Wheal Freedom sett. This would give the company a run of half a mile eastwards on the course of the Wheal Kitty and Pink lodes, and a boundless extent of ground westwards under the sea, whilst both the lodes could be attacked from the 70 fathom level. The Kitty Lode had been carefully traced the whole way to its outcrop at St Agnes Hill, and the Pink Lode was seen in the cliff close to the Wheal Coates workings.

In December 1881 it was reported that the company had failed as a limited liability company and to be turned into a cost-book concern. The conversion could only be made with the agreement of every individual shareholder. The liquidator was empowered to purchase the interest of the dissentient member, or to abstain from carrying the resolution into effect. At this time the company was returning about 8½ tons of black tin a month. This was unsuccessful and the mine and materials were put up for sale by public tender in December 1881. Besides a 21-year lease of Wheal Coates from June 1872 there was also a lease for 12 years from June 1881 of the St Agnes Well sett. The equipment included a 36-inch pumping-engine, 24-inch stamping-engine, 18-inch winding-engine, 105 fathoms of pitwork, 32 heads of stamps, dressing-floors, carpenters' shop, burning-house, &c. The mine was in full working order and producing tin, and application forms were available at the company's London office.

At the end of January 1882 a meeting voted 10,891 shares out of 12,000 to liquidate the company. The tender of John B. Reynolds, a small shareholder was accepted, after which he floated a cost-book company to work Wheal Coates and St Agnes Well setts. The issue of 12,000 shares was oversubscribed, and the purchase consideration was £3,000, payable out of the first profits. In September of that year the purchase consideration was still unpaid, and in October a meeting was held to consider the balance sheets.

Between 1901 and 1912, 15 tons of tinstone were sold from the mine for £26. Cornish Minerals, Limited, was formed and registered in January 1907 with a view to dewatering the mine prior to the formation of as larger company to work it, however no more work took place at Wheal Coates

The Wheal Coates site is, given the right weather, extremely photogenic and the Towanroath pumping engine house has graced many photos and calendars. This engine house was partly rebuilt by the National Trust and is now in good condition. Formerly it held a 36-inch pumping engine, while the later horizontal engine was built by Holman Brothers. Towanroath Shaft is at the front of the house, now grilled over. At the top of the cliff is the tall stamps engine house, all-indoor whim engine and boiler houses, stack and calciner. To the north of the stamps engine house lie the remains of more buildings, while terraces of the dressing floors lead downhill to the west. All engine houses and the stack are Grade II Listed.

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