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A VISIT TO THE KOLAR GOLD FIELD, INDIA

Lynn Willies

Abstract: The visit was made at Christmas 1990. There is much equipment remaining from the late nineteenth, and from the first half of this century, dating back to the re-establishment of the mines by John Taylor and Sons of London, c.1880. Difficulties of mining at depths exceeding three kilometres are described.

INTRODUCTION

Kolar is about 70 km from Bangalore, and 300 km from Madras in southern India. The visit was made as part of an investigation of ancient mines in the area, which is to be described elsewhere. The Kolar Goldfield is about eight kilometres long, little more than one wide, and at its deepest, three deep. The ore occurs mainly in quartz veins within amphibolitic rocks, of moderately steep hade near outcrop, but almost vertical after about 2000 m. depth. Our party was able to visit numerous sites including survey offices, mine surface-plants, compressor houses, rescue station, and were able to go underground at two smaller shallower mines of late last century, as well as into the deep Nundydroog and Champion Reef mines.

SMALL SCALE MINING

Working for gold was certainly still taking place in the 19th century when John Taylor's agents came to investigate ancient workings there, though this was mainly either alluvial, or reworking of old tips on a very small scale by individuals or very small groups: this practice continues today, usually more-or-less tolerated rather than legal. We were able to observe the practice in water filled hollows dug in the stream bed below the tips of Roadblock Mine, which was worked by a German Company earlier this century. Small groups of women either recovered quartz off the old tips, dug into the ground for it, or panned sediments directly. Tools were very simple - an iron hammer on a crude anvil stone to crush quartz, riddling to separate waste or sediment into different fractions, and use of a circular steel pan. The panning resulted in a very small amount of gold within a black sand of magnetite and manganese minerals, which was carried off in a small piece of cloth. The mixture was apparently sold to a series of middle-men, who generally use acid to dissolve the impurities, and fetches perhaps 100 rupees (35 rupees to the pound sterling) to the panner out of the eventually value of about 300 rupees a gramme locally. Our informant told us her earnings were about 12-15 rupees a day - which compares reasonably well with women labouring on the roads, but less well with the standard rate of about 21-24 rupees a day for (mainly male) labourers at the mines. Obviously it was not possible to ascertain the gold values of the material being worked, but it can hardly have been more than a few grammes per tonne, and may well have been less less than this. It did however illustrate for us what low levels of gold extraction may have been considered economic using hand methods in the past, and it illustrated the shallow diggings, small heaps of riddled waste, occasional anvil stones, and larger but still visually insignificant waste-heaps such working produces. The process, with stone mauls and wooden "muriyas" instead of steel hammers and pans must be largely unchanged since pre-historic times.

REDISCOVERY ABOUT 1880

The area was one of those which was observed by Lt. Nicholson in his travels about 1820 as gold-bearing, but the intensity of ancient working was such as to cause others somewhat later to observe that the chance of economic working was remote. At Kolar all the lodes known today were clearly defined by the ancient working, and it took but a few days for prospectors to observe there was a main vein, which quickly became known as the Champion Lode, with four or five other major but less continuous lodes, generally striking north-south.

Modern prospecting began about 1860, and intensified in the 1870s, with men with gold mining experience such as John Munday from Victoria (Australia) being brought in to assess prospects: he seems to have followed a Mr Linden, and was recommended by Mr Brough Smyth, the Government Mining Engineer. The late 1870s and early 80s saw the development of a gold mining boom in southern India, with almost weekly letters and articles, and by 1880, advertisements for investors in the Mining Journal: by this date the importance of both California and of Australia as investments was waning, and India seemed the new *Eldorado*. Such sources, though fragmentary, should eventually allow a fairly complete picture to be built up of

Schaws Incline Shaft - c.1880.

Kolar's early development.

The result of Munday and Linden's initial work was to lead about 1874 to the setting up of the Orregum Gold Mining Company of India to carry out mining trials on the Oorgaum (Ooregum) Block, roughly half of an area about "three and three-quarter miles by half a mile" (6 x 1 km), through which the Champion and other veins passed. Ownership of the company seems to have been mainly English colonial administrators and military men based in Bangalore and Madras. Amongst them was Sir William and his son Col. William Arbuthnot, of Arbuthnot and Co, Madras, who were managing agents with wide commercial interests: Sir William was chairman also of the Madras Mining Company

This company by 1880 had sunk a shaft to about 90 feet depth, with a level off at 80 feet (all dimensions on the Kolar Field are still in imperial measurements today), that is just below the ancient workings. The vein gave very promising results with assays at over 5 oz per ton (over 160 g/tonne) , and subsequent working which produced 26 tons yielded 2½ oz per ton.

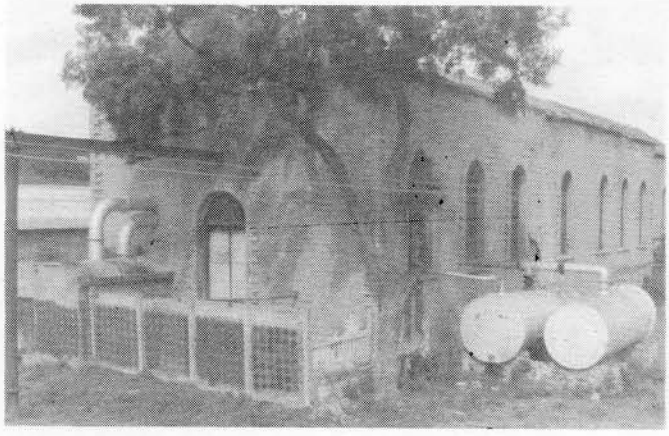
A. Hay Anderson, who in his letter gave this information (*Mining Journal* 20 Nov. 1880) was clearly impressed by Kolar. He had a house in Wynaad, which at the time was the main alternative area for investment in Indian goldmining. He however recommended Kolar as a far better proven area (even on this very limited evidence), which was more salubrious, and with the railway only four miles off, much better linked, so goods could be received in Kolar only six weeks from leaving England. He was however a director of one of the Kolar companies being set up. Other accounts vary slightly from his - but the story told is substantially the same, and he was of course more than proven right in all his claims.

Even before this, other concerns were sending their representatives to the field: John Taylor and Sons despatched William Bell Davies, one of their engineers in late March 1880. His report, some four months later, endorsed all that had been said before (except that the Ooregum Companies results were a little less), and added the information that the (old) Ooregum Company had been defeated by water in the old shaft, but had since put down an incline from an old working, and had again intersected the vein, before being overcome by water whilst using only hand-pumps. At the time of his report, they were erecting a pumping engine on the vertical shaft, and putting in stamps. The story is taken further in Anderson's letter, by which time the company had raised some 1000-1500 tons of quartz. The lode had improved from about 18 inches wide as originally found to some four or five feet.

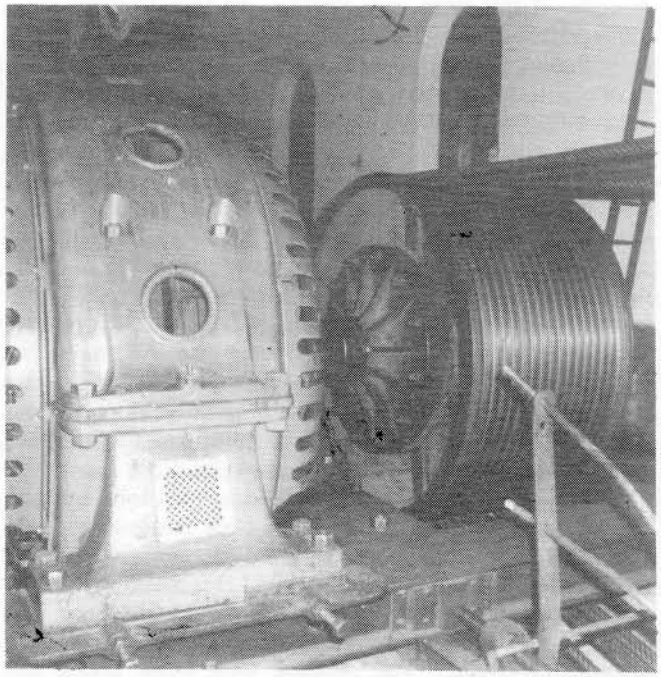
Several companies were set up from July 1880 onwards. First was the Mysore Mine, with 750 acres of the adjoining block, advertised in the Mining Journal (10 July 1880). This was a company set up by John Taylor and Sons, with nine directors: apart from John Taylor Junior and Richard Taylor, at least four had India experience, and one, Captain William Bell McTaggart (no doubt related to William Bell Davies) had almost certainly been associated with the earlier Ooregum finds. His name, plus of course Taylor's, and that of other directors Archibald S. Schaw and Charles Tennant MP, survive in shaft names on the Mysore Mine. The directors' names also have a distinctly Scottish flavour, perhaps because of the Tennant of St Rollox (chemical) works connection, and include John Hunter Blair and Hew Dalrymple Hamilton Fergusson. Altogether an imposing list of directors, as Taylors' undoubtedly intended. Within a short time the other mines of eventual substance had been aquired by Taylors, and lesser blocks by a variety of others, including Anglo-Indian and foreign concerns. The initial capital for these companies was fairly high, £150,000 for Nundydroog for example, and even more for eventually less successful concerns.

Initial excitement soon declined, and it took some five years of persistent effort, and almost abandonment before success. For this John Taylor received much praise, and nowadays he, or his portrait is referred to as "The Founder".

Initial attempts to locate the main lode had run into difficulties, and it would appear the lie of the lode had been miscalculated. Taylor appears to have persuaded his fellow directors to carry on, and a drive in the other direction gained success. The results were spectacular, with total dividends from the mines before 1950 totalling some £26,000,000 (the Taylors' reports are kept at the mines today). Subsequently they have gone into decline, despite the boost given when the fixed parity of $38 to the ounce was abandoned. The depths are enormous, with consequent



McTaggarts and Schaw's Compressor House, c.1904



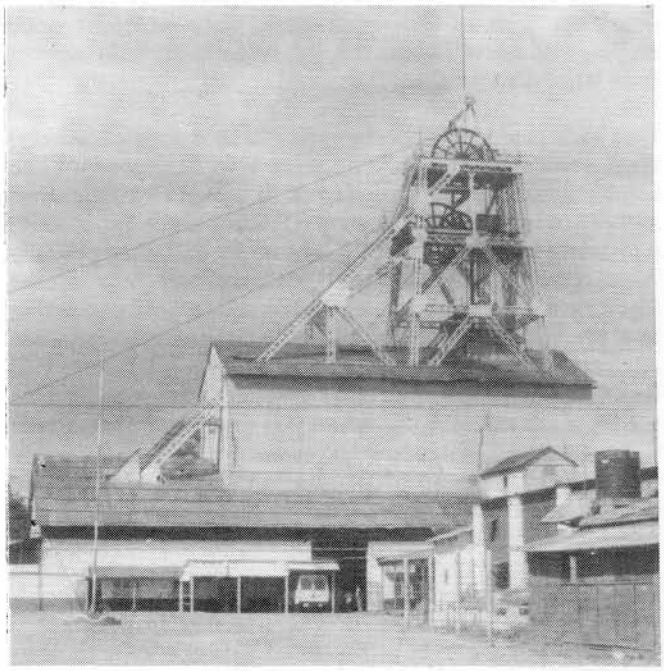
Electric motor and rope drive to compressor

high temperatures and rock instability, and the workings, very modern in 1940, are ill adapted to modern methods. Currently, and for more than a decade, the mines have been threated with closure, but unemployment consequences have ensured their continuance, whilst a new Shallow Mining Project is brought into full action, some 40 km away.

THE MINEFIELD TODAY

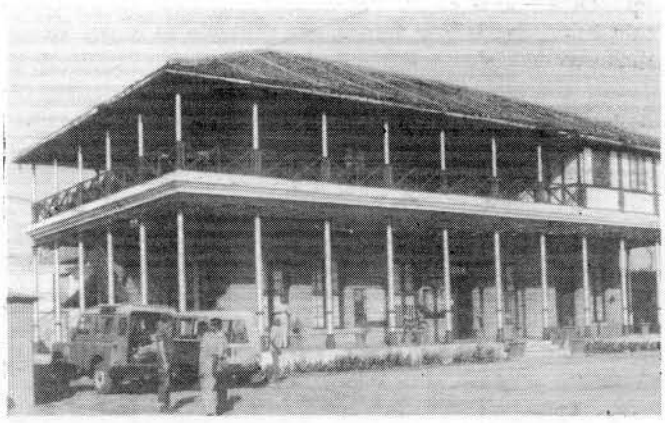
The principal features seen on the orefield are the shaft-headgears, of which there are a large number. The earliest were either shallow vertical shafts, or inclined shafts driven on the dip of the lode (usually around 50° to 70° at shallow depths, but near vertical at depths more than 5000 feet or so). These, such as McTaggert or Schaw Shafts, have a ramp with a self-tipping mechanism into a hopper for a skip which runs on rails. The skip, by means of a lift-up section of rail can be run out of the shaft, and a man-rider run in (by which we descended). A small shaft near the portal can be used to let in gravel or other materials. Originally these were steam-powered, but following an extensive hydro-electric scheme about 1904, were converted to their present systems.

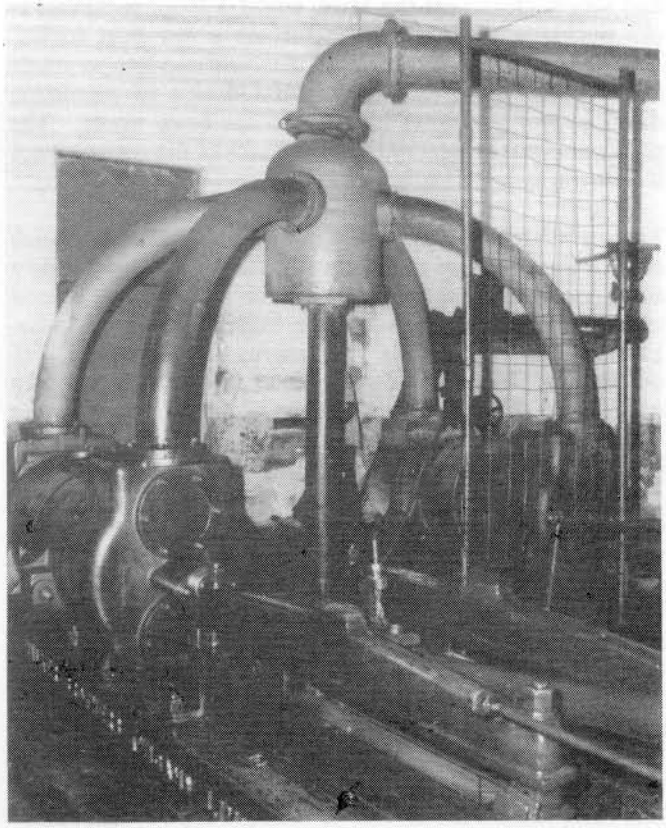
The declines in the upper sections pass through badly weathered ground, often to a depth of 30 m or more, which was difficult to sink through. They are mainly brick arched, occasionally, if later, of concrete, with a pass for the skips, and another for climbing on either steps or ladders as appropriate. They are generally maintained today for ventilation, but there have been and are planned several small projects for shallow mining of blocks of ore once uneconomic, or for other minerals such as scheelite.



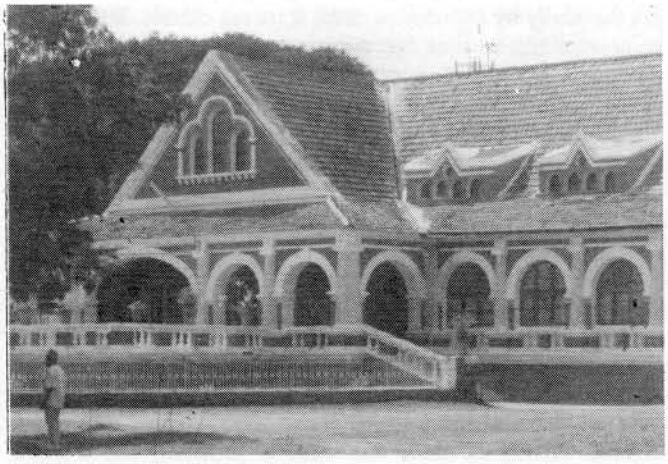
Gifford Shaft headstocks on Champion Reef Mine. 6563 feet deep, it leads via sub-levels to a total depth of 10,300 feet below collar.

(below) The Mysore Mine Offices - prefabricated colonial style.





Walker and Co. Wigan, Compressor



The Kolar Goldfield Clubhouse - donated by Taylors

Workings seen in the upper parts were generally open stopes, with a few timbers left, but remarkably little support over large distances.

One such project was being explored by a (comparatively) short vertical shaft which we were able to descend. The former steam winder was adapted to use an electric motor, and the old guides, still in good condition since about 1920, had a two man cage fitted. The shaft had only partially been cleared, and pipework, plungers and pole of the former steam powered pumps were still in position, sitting in a much rotted wooden box on a beam in the adjacent compartment. Electric pumps had been used from still lower levels. This part of the mine had considerable workings open, and water inflow was depositing spectacular stalactites etc., the calcite presumably derived from the decomposing metamorphosed basic rocks. At surface the low ruins of the walls of the engine house were still apparent, though covered with dense vegetation.

This first generation of shafts, as the lode proved still rich at depth, were succeeded by others further from outcrop, sunk to reach the lode at depths of between 2000 to 4000 feet. There were obviously less of these sunk. We were able to descend Richards Shaft which is part of the Nundydroop Mine, in the Company of Mr K. Balan. He is the Chief Surveyor to all the mines, and, if he will forgive the statement, himself also a vital part of the Mines' history.

Richards Shaft was sunk 1904-6, to a depth of 2000 feet, and now functions as an upcast shaft. The top section has subsequently been lined with concrete, but most of the shaft still has its original timberwork framing and guides, installed by Italian shaftsmen, which we were able to examine from the cage. The headgear is steel, lattice-type. The winder is electric, and it was possible to make "brass rubbings" of the manufacturers data on the induction-type motor: this was made by the English Electric Company of London, serial number X770705, operating at 3100 volts. Many such early motors are found on the mine, though some have subsequently been rewound in-house.

From this shaft we were enabled to follow the strike of the lode for the best part of a kilometre. At this depth the stopes had much more support. In places large diameter short timbers - whole trunk sections - had been left in, and mortared granite blocks had been used to make walls for additional support. Much of the water entering the mine today is pumped from this level, preventing it penetrating deeper. The air is extremely humid, heated by the great depth of the mine, then rising up the shaft it cools adiabatically by expansion, until it forms clouds, and begins to precipitate, so that everywhere near the shaft is wet. Of the great variety of stopes visible, we were able to see a section of a folded portion of lode at the 440 (feet depth) level near the Nundydroop boundary with the Tank Block, where stope widths of over 30 feet had been possible in a "chamber", yielding, as such locations usually did, particularly rich ore.

Another descent into the mine was made by the main Champion Reef shaft, known as Giffords Shaft, after the then general manager of the mine. This shaft was deepened about 1939 to its present depth of 6563 feet, and further underground shafts descend from near it to the deepest levels of the mine at some 10300 feet or over 3000 metres. Giffords Shaft has what is probably the world's largest winder on it, with a biconical drum of about 30 feet diameter - winding nearly 100 feet per revolution. It is pleasing to report that it, and the two underground winders we saw, all British made, were being kept in immaculate condition, one at least using the Ward-Leonard winding control system. For lightness the cage is made of duralumin. The very bottom of the mine nowadays has water in it, and is considered economically worked out, though there is some belief it might have been revived had massive investment been made.

Grades of ore are low, with a cut-off around 3.5 - 4 g/tonne, and the gold is found in both quartz vein and wall rock. About 600 tonnes per day is mined, winding on one shift only, limited both by economics, and the tub capacity of the cage. Technical problems are heat and rock pressures, and risk of fires. Air is refridgerated at surface, and again in the lower workings, but temperatures of well over 100° are normal, and considerably higher in blind ends. Rock temperatures can exceed 140°, at which temperature metal can scold like hot water, so the hands need protection. Clothing is worn to protect the body from the heat. It is very dry indeed, and there is little apparent perspiration and salt can be brushed from the face. The other danger is of rock bursts, so that the very mininmum area of stope is kept open at any one time. Access drives are kept parallel and a considerable distance from the lode, which is then reached by long crosscuts. To minimise stresses the working of the lode is done symmetrically, with a limited number of workplaces kept open for the minimum time. In some parts of the mine there is almost total infilling of stope using mortared granite blocks, but in the section seen by us, concrete is placed immediately after ore is extracted. Normally, apart from levels which are close-timbered with short lengths of eucalyptus, only a section of 15 feet by 8 x 8 feet is removed, using hand held stopers and explosives before filling. Even so rock bursts still occur, and we saw the effects of a small one near the current working at adepth of 9650 feet (103 level) which had totally closed off the level, whilst a large rockburst in old workings had rocked the surface a few days earlier. With the extensive use of wood, fire in these temperatures is a constant fear, and very careful design of ventilation districts, and provision of refuges has been made. The problem is not helped by the propensity of the rock to burst if water is sprayed on it.

The surface at KGF has a vast amount of equipment, much of it in fine working order, though old, and we saw only a small fraction. Near the shafts are the mine offices, several of which have fine colonial-style buildings with verandas. Each major mine has its survey department, with continuous plans and records since 1880, and huge map collections. The mine models are of great complexity, by far the most impressive I have ever seen, and there are superb diagrams and models of mining methods.

Compressed air is produced in central compressor houses, with steel air-receivers ouside, and with large bore pipes crossing the landscape. The Mysore has one of several such houses, built on much the same pattern as turn-of-the-century houses in Cornwall. Inside are two large compressors, made by Walker Brothers of Wigan (Nos. 12384 and 11608), and powered by electric motors - one of 600HP by the General Electric Co. of New York (No. 77322), and the other of 250HP by the Lahmeyer Electric Co of London (No. 604), running at 2000 volts, 25 cycles. The compressors are driven via multiple rope drives, rather like mill-engines.

A further compressor house nearby at the Hancock Incline Shaft had another, similar, Walker Brothers' machine in the main house (No.12367, with a General Electric Motor No. 27953), and outside a somewhat later Bellis and Morcom Ltd of Birmingham self-lubricating compressor (No. 691 with a Sandicroft motor, No. 206512.1094), which was direct drive and placed in an added lean-to. Some idea of the scale is that the drive pulley on the Walker's compressor had 16 sheaves, and was 25 feet 4 inches in diameter (7.7 metres). Each part of the compressor and pipework was sequentially numbered to allow easy identification for on-site erection. Outside were two 21 feet by 6 feet diameter air-receivers.

We also were able to see the Mysore Mill and nearby Cyanide House. Ore from the Champion Reef, and from reworking of tips is passed through crushers into rod mills, though until about 1981 an 80 stamp California-type mill was still in use, and it substantially survives (Sandicroft Foundry). From the rod mills it is classified, and the fines pass over fixed blankets, leaving a heavy sand containing the gold on them. This is periodically washed off, and passes over secondary blankets, and then into a dewatering cone. Finally, in this much simplified description, it is passed over a James Table, the gold running off the top of the table in a constant stream into a plastic bucket. About one kilogram a day is produced in this way, though ore-capacity is at least six times higher. The fines are then piped to the cyanide operation, and run into large tanks agitated by compressed air, in which cyanide and lime to maintain alkalinity dissolve remaining gold. The pulp is run-off after about 3½ hours, then filtered, and the solution run-off. Gold is collected by activated carbon, which is then burnt to recover its content. About 20% of the gold is recovered by cyaniding.

Kolar also has its "club", a typical feature of mines with expatriate specialists (Indian graduate engineers and chemists were not recruited until about 1925). This was presented to the mines by Taylor and Sons, and later a Mining and Metallurgical Institute was added, with papers presented in it, and published much as the London IMM (These are available in the IMM at London - though the series is no longer being published). It is a very fine example indeed of its type, still in excellent order, with hundreds of photographs of the mines and miners, and many records. It was pleasing for Paul Craddock and I to give a talk there.

Taken together, Kolar is probably unique in the world. It is one of the "great" mines of the world, now in its final years, though revival, if only in shallow mining in the wider district, is always a possibility. The survival of so much, now sadly dated, equipment is a fortunate accident of development as the company struggles, very successfully, to maintain work for the population whilst it diversifies into new fields, such as mining and general engineering equipment manufacture, and contract mining. There is an opportunity to record the very best features of a now largely lost system of mining, with important shared links with India's colonial past, and some of the finest British and Indian skills and equipment still discernable.

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