Gold recovery in cones in Laos - the term 'dulanging'

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About the Author

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Purpose of study

The article is a Short Note to clarify the special character of a dulang and how it has been buried in the blanket term of 'panning'. The term 'panning' is useful in colloquial English to cover all manner of hand-driven gold recovery devices. Yet within the multitude of panning devices the dulang is distinctive. The term 'dulanging' is proposed to ensure the distinctive nature of operating a dulang is not smothered by the term 'panning'.

The dulang is a single solid piece of wood that on the outside is a cone tapering to a blunt point and on the inside is a dish-shape.

The dulang is used extensively by artisanal and small-scale miners (ASM) in South-East Asia, notably for recovering gold, platinum, tin (cassiterite) diamonds and gems from placers by manual wet washing.

Two types of dulang are reported in the literature. Firstly a shallow cone hosting a correspondingly shallow dish for recovering very dense minerals such as gold and platinum. Secondly a steep-sided cone containing a deep dish that is multifunctional being able to recover not only very dense minerals but also lighter valuable minerals such as diamonds.

Although dulang are in daily use by hundreds of thousands of artisanal and small-scale miners (ASM) in South-East Asia, no technical studies of the dulang seems to have been conducted.

Figure 1.

*An artisan using a dulang to recover placer gold from alluvial material mined nearby and carried to the shallows – the dulang is clearly conical Mekong River in Laos. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com** [1])*

Dulang and batea – what is the difference?

The term 'dulang' and 'dulong' are synonyms. In this article the term 'dulang' is used.

A **dulang** has a dual morphology, having a conical exterior tapering to a blunted point, and a bowl-shaped interior carefully cut inside the cone. The conical dulang predominates in much of South-East Asia, notably Indonesia, Malaysia and Laos.

A **batea** has a simpler morphology, having a dish-shaped exterior and interior. The dish-shaped batea predominates in Latin America and – possibly – in parts of South-East Asia and Africa.

Confusion between dulang and batea

In the literature the term 'batea' has been applied rather indiscriminately regardless of whether the devices are bowl-shaped (batea *sensu stricto*) or conical (dulang). A particular problem is that, unless viewed from below or side, a dulang looks like a batea. Accordingly most photos in articles and on internet sites are ambiguous regarding the true nature of the device they illustrate. Reports on artisanal and small scale mining (ASM) propagate the uncertainty by rarely describing the device adequately. This widespread confusion and uncertainty merits investigation being important from cultural and technological perspectives.

According to www.cerrilloshills.org/mines/terms.htm a batea is a 17-18th century Spanish mining term for *"a prospector's pan; a wooden bowl used to sample the amalgamation mixed with water, similar to the gold pan of later years. This term is probably of Latin origin. In Georgius Agricola's 1556 "De Re Metallica" the batea is an oval rock carrying tray."* This definition correctly avoids suggesting a batea may have a conical external appearance

According to www.answers.com a batea is *"a conical-shaped wood unit (12.3 inches or 31 centimetres in diameter with about 150° apex angle) used to recover valuable metals from river channels and bars."* This definition seems to be confusing a batea with a dulang.

Dulanging – a proposed new term

The author proposes the term 'dulanging' in order to permit a narrow technical description of the process of using a dulang for gravitational recovery of heavy minerals (gold, platinum, tin, diamonds, gems etc.). By adopting this term it helps reduce confusion with the broad term 'panning' as exemplified with the operation of the North American gold pan.

The term 'panning' retains merit as an everyday expression for all manner of gravitational washing devices that are directly driven solely by hand movements; but overuse of the term 'panning' debilitates proper technical assessment of devices as diverse as the batea, dulang, lotok, bucket, ribbed mat and washing-up bowl.

Figure 2.
The dulang is made of a single piece of wood. From above it could be either a dulang or batea. Mekong River in Laos. (photo: compliments of HoboTraveler.com – **www.hobotraveler.com**)

Figure 3.
The view favoured by photographers is for the 'pan' to be tilted towards the camera, unfortunately making it impossible to decide if it is a dulang or a batea. Lotoking is a group social activity in the Mekong River in Laos. (photo: compliments of HoboTraveler.com
– **www.hobotraveler.com**)

Figure 4.
Even in an oblique side view the conical shape of the dulang is not apparent if the water is turbid. Mekong River in Laos. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com**)

Dulanging – some eye-witness accounts

The author confesses to not having seen a dulang in operation; he made a desk study of the literature to gather eye-witness accounts. Most articles about dulang term it panning and fail to describe the dulang or its use.

The clearest account of the dulang known to the author is given by Clive Aspinall [2] who notes that conical round *"pans"* made from a single piece of wood are commonly used for recovering placer gold in many parts of South-East Asia, and that in Malaysia and Indonesia are known as 'dulang'. In his words, *"a shallow conical wood device is called a dulang. This dulang is carved from one piece of wood, generally a section from a tree trunk. For gold, the angle on the basic dulang is about 25 degrees, and the outer diameter of the dulang rim can be as much as 50-60cm"*.

Clive Aspinall [2] also reports from Indonesia a smaller type of dulang 30-40cm in diameter, *"which has flatter angle and is almost like a flat fruit dish"*. It seems that this shape of dulang invites comparison to a typical bowl shaped batea, and it seems possible, even likely, that intermediate local designs exist.

In Malaysia the term 'dulang' is synonymous with artisanal manual washing to recover cassiterite (SnO_2) from alluvial tin ore. As noted in 'Tin Mining In Malaysia - Present and Future' [3], *"Dulang Washing is practised by small mines in Perak, most of them are run by a family without employees. This is a simple method of extracting alluvial tin in streams by panning. A dulang is a wooden pan of diameter 50cm. Tin-bearing material from under the stream is scooped into a dulang and the dulang is twirled just below water level. The lighter sand particles are washed over the edge of the dulang while tin ore remains at the bottom. The dulang washers normally sell their products to larger mines."*

According to the online 'Dictionary of Mining and Mineral Related Terms' of the University of Hacettepe [4], a dulang is a Malayan term for a *"hardwood pan shaped like a section of the surface of a sphere and used as a miner's pan in prospecting, sample washing, and manual concentration of cassiterite."* This definition seems unclear as "a section of the surface of a sphere" can be interpreted in various ways.

In Borneo in Indonesia, a dulang is said to be made from a large tree root, and two variants exist [5]:

- a small dulang *"with only 15cm depth"* that is used solely for gold recovery; and
- a bigger dulang *"65cm in diameter and 25cm depth"* for simultaneous concentrating of diamonds, gold and platinum.

This accords with Aspinall's claim [2] that diamond dulangs have *"about 40 degree angle at the cone, and have a 50cm diameter"*. He also noted *"a good diamond panner generally takes 4-5 minutes to wash 4-5 kilos of gravels to quartz-zircon-corundumchrome-concentrate."*

Overall it is apparent that the smaller dish-style dulang is more appropriate for concentrating gold fines, and is preferable for calm flowing streams.

Figure 5.
*The bank of the Mekong River in Laos, showing three dulangs by the water's edge and in the background artisanal miners digging in the gold placer. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com**)*

Figure 6.
*Artisanal miners digging the gold-bearing silt exposed by the edge of the channel of the Mekong River. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com**)*

Figure 7.
*Having brought the ore to the edge of the Mekong channel, the artisanal miners use dulangs to recover the gold. The conical shape of the dulang is clearly visible on the right. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com**)*

Style of operation

As well ease of manufacture from local timber, the dulang is buoyant. The device is supported by water when used by the artisanal miner either squatting by the water's edge or standing in a metre of water. The author suggests that the conical shape of the dulang may offer stability while rotating the device, creating favourable conditions for recovering fine gold.

A good dulang operator takes three to five minutes to pan five kilos of gravel to a black sand-gold concentrate according to Clive Aspinall [2]. He also notes that the dulang-type of gold mining usually takes place after the river has flooded and then subsided, *"on the upstream side of river sand or ox-bow bars."*

The dulang for recovering diamonds in Kalimantan in Indonesia was described by Ronald Seavoy [6] as *"a large conical pan"*, *"about a meter in diameter and about twenty centimetres deep and is made of light wood so it will float. It is always painted, usually black, in order to reduce wear, but also to present a smooth surface that maximizes the weight differentials between minerals so that the heavier ones quickly sink to the bottom of the cone."* He stated that *"the dulang was used by the earliest Indonesian and Chinese miners who first commercially exploited the tin deposits of Bangka and the placer goldfields of north-western Kalimantan (in the Chinese district), as well as elsewhere in the Malay archipelago."*

The operation of the diamond dulang is described by Seavoy [6]: *"The man who does the panning stands waist deep in water and continually agitates the concentrate with a circular motion which gradually brings the lighter minerals to the top. Then the pan is tipped on its side so the lighter minerals can be discarded with a few gentle motions. The heavy minerals remain in the bottom of the cone. The water is care-fully drained and a search is made for large diamonds. If none are found the concentrate is dumped into a can and taken to the village where the small 'diamonds are recovered, which are then sold to independent dealers in Martapura or to one of the two jewel cutting factories there. A final panning recovers any gold or platinum present."*

The operation of the tin dulang is a women's issue of past and present: *"The method is simple but requires some skill. A shallow wooden dish, about 30" in diameter, and 3.5" deep in the centre, is dug into the sluice or stream bed, and a quantity of sand and water is thus put into the dish. This is now subjected to a peculiar motion, more or less of the nature known as vanning, by means of which the waste material is washed over the edge and the ore remains. It is arduous work in the heat of the day, entailing as it does continual standing in water with the back bent. 7,800 Dulang women were employed in 1935, mostly from Kheh Clan from China. They have a very hard life, standing in the water all day, washing for tin ore, and it is no unusual thing to see a woman work with a baby strapped on her back. Their bright sarongs are a very attractive sight. In the evening they cut firewood, cook the food, and do the housework".* [7]

Figure 8.
*A young artisanal miner tilting and swirling the conical wooden dulang. The wicker basket is used to carry the placer ore down to the water's edge. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com**)*

Figure 9.
*Tilting the conical wooden dulang to view the contents, remove oversize and check for any nuggets. Hand movements are considerable. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com**)*

Figure 10.
*Two operators are tilting their dulangs to flush water in and muddy water out, and the central operator has paused to inspect the contents and seems to removing some oversize by hand. (photo: compliments of HoboTraveler.com - **www.hobotraveler.com**)*

Dulang as candidate for BAT

Best Available Techniques

No previous assessment seems to have been made to determine if the dulang is a candidate for Best Available Techniques (BAT) for artisanal miners, and implicitly also for recreational miners.

Operational advantages

The conical dulang offers advantages to artisanal miners, particularly in remote areas where metal pans are difficult to purchase and purchasing power is low:

- zero to minimal capital cost (e.g. make it yourself);
- low operating cost if labour is cheap;
- easy to remove washed oversize from the dulang by hand and check for any large nuggets;
- circular motion easily creates and maintains water flow around the dulang, enabling suspended fraction (especially clays) to be removed by deliberate decanting (spillage);
- much of the ordinary low density sand and silt removed during gentle dulanging;
- streak of dense minerals ('black sands') left as a smear on bottom of the dulang;
- easy to see coarse gold in the bottom of the dulang (assuming good illumination and good eyesight);
- no risk of dulang being lost by sinking, being made of wood;
- easy to use buoyancy of water to support the dulang; and
- very easy to shift location quickly, and at minimal cost.

Operational disadvantages

Like other manual gold recovery devices, the conical dulang has its limitations:

- labour intensive;
- requires skill;
- requires moderate strength and stamina;
- fine gold is impossible to see without a good hand lens (x20);
- very fine gold cannot be seen without a microscope (x100);
- black sand can sit on top of fine gold in the bottom of the dulang, completely hiding the gold from view; and
- difficult to use in cold weather.

Environmental factors

Environmental factors for the conical dulang are similar to those of other manual methods of gold recovery:

- risk to topsoil resource – not a direct factor;
- risk to mineral resource – oversize is removed manually, ensuring large nuggets are detected; but still a risk of poor gold recovery if dulanging is not done properly, if too much sticky clay is present or if the gold is very fine or flat;
- risk of dust generation – not a factor;
- risk of sheet runoff and effluent discharges – not a factor;
- acidic waters rich in heavy metals – tiny risk with placer but greater with hard-rock as:
  - acidic waters may result by oxidation and hydration of sulphide minerals notably pyrite (FeS_2); and
  - heavy metals may endure acidic leaching and be liberated.
- risk to surface waters – risk of acidic waters and heavy metals from dulanging sites.
- risk to biodiversity in general – disturbance to wildlife by noise, muddy water and waste; and
- risk to freshwater ecosystem – fish feeding, migration and spawning, and the freshwater ecosystem overall, may be affected by an increase in turbidity and bottom sediments, especially if many dulangs in a small slow stream; and
- risk of poor land reclamation – ground may be left damaged, particularly by hummocks, shafts and tunnels abandoned by miners, and to a far lesser degree by dulang tailings.

Key factors in BAT determination

The key factors in assessing the conical dulang appear to be:

- probably good % gold recovery (but no tests reported);
- risk of effluent of muddy silty water;
- tailings with heavy metals (but stable if from normal placer);
- if hard-rock ore, a significant risk of acidic waters and leaching of heavy metals;
- risk of water-related illnesses are a concern; and
- physical injury from strains is also a concern.

Comments on BAT and dulangs

Proper assessment of the conical dulang awaits field observations of artisanal miners in a range of sites differing in geology, environment and culture. The most important field observations required is to determine is the cumulative impact of many people dulanging in a sensitive area, and to observe if mercury or other chemicals are used with the dulang. In addition, a technical assessment is required of the percentage gold recovery achievable in stringent laboratory testing using tracers. Technical assessment should focus on the percentage of fine gold and flat gold that the conical dulang is capable of recovering, particularly in comparison with other wooden gold recovery devices such as the batea and lotok as all three can be made from the timber.

BAT assessment of dulangs

Pending detailed field observations and technical study, the provisional assessment of conical dulangs made of wood is that they are potential candidates for BAT (Best Available Techniques) for manual recovery of gold [10], subject to a set of stringent conditions:

- if the stream is at its low-stage, do not use unless the stream is very wide even at the low-stage;
- never use in ephemeral or tiny streams (but brief prospecting is acceptable);
- limit the number of users in a single stretch of a stream;
- never use mercury (Hg) in the dulang or before or after;
- do not process ore that contains significant mercury (Hg);
- do not process ore that contains significant cinnabar (HgS);
- check for fine gold by hand lens (x20);
- check for very fine gold by binocular microscope (x40, preferably x100); and
- if the ore has pyrite (FeS_2) or other easily decomposed sulphide minerals, then:
  - dulanging away from water-courses or springs;
  - avoid making large accumulations of waste;
  - avoid mounding of waste, to minimise acidification;
  - seal waste using clay, to reduce water ingress and minimise acidification; and
  - ask specialist to determines where and how to dump waste to minimise acidification.

Discussion

The dulang belongs to the group of gravitational recovery devices that are directly powered by hand [8,9] whose operation is colloquially known as panning. Within this group, the closest relative to the dulang is the batea and it is likely intermediates exist. The desk study showed the dulang and batea are frequently confused as the dulang's conical shape tends to be overlooked by eye-witnesses and is rarely apparent in photographs.

It might be thought that the conical shape is purely stylistic, with cultural resonance with the conical hats favoured by many rural people in the same regions. But the conical shape of the dulang inflicts a weight penalty, a major consideration for artisans who usually travel on foot. Some authors say a dulang is of light wood, presumably to cut the weight. Even so the weight penalty is significant and its bulkiness adds to the inconvenience. This is partly offset by a small hole near the top of the dulang for tying a string to enable it to be carried.

The author draws attention to a technical advantage in having a conical external shape (regardless of the internal shape) in that it should bestow additional momentum to maintain the speed of rotation of the dulang for longer than otherwise, and dampen any tendency to wobble. Such advantage may also apply if the device is rotated clockwise and anticlockwise in rapid succession. The more consistent and stable the vortex inside the dulang, the more controllable the washing.

A second advantage of the conical shape is that when the operator tilts the device towards him/her, it will rock to the operator's left and right; not toward and away. This ensures smooth horizontal turning on the ground or supportive water, not possible with a batea or pan.

Little was found in the literature about the technical capability of a dulang. Yet the device is used by hundreds of thousands of people in South-East Asia to recover gold, platinum, tin (cassiterite), diamonds and gems as their source of income. Technical study is required – is the dulang is better or worse than a batea or a North American pan at recovering valuable minerals? [10]

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