Notes on Recovering Gold and other Minerals in Placer Mining

Miner's Methods Agree in Principle with Larger Operations

By J. Hume Robertson

THE SMALL amount of gold or other minerals in placer deposits necessitate inexpensive means of handling and treating in securing the minerals from the dirts.

In handling, with small scale operations, manual energy supplies the means. As the extent of operations increases, according to conditions obtaining, mechanical appliances are brought into play—mechanical shovels, dredges, etc., hydraulicking—each class of operation has a special application of the means employed.

In treating; i.e., in the separating of the minerals from the dirts, water is the important element. It carries out volumetric sizing and classification, and brings about separation by means of the differences in the specific gravities of the minerals and encasing dirts. It is used to break-up and carry-off the lighter particles such as sand, stones and clay, thereby leaving the heavier minerals. Various gadgets may be introduced to assist, but water is the main factor, and getting it to do the work effectively is an important feature in economical recovery.

As the procedure by the individual miner, or small group of miners, embodies all the underlying principles used on large scale operations, which virtually are extensions of same, let us examine the small operations in some detail.

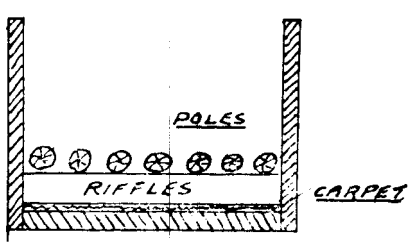


Fig. 1.—Section of Sluice.

Operations by Individual Miners.—When a small stream of water is available, it is coralled and made to flow directly through a sluice. The sluice is a trough made of planks as per sectional view Fig. 1. It is set at a slight slope or grade of 1 to 12 to 1 to 24. The size (cross section) is according to the volume of water available and size of stones to be handled—there must be sufficient water flowing in the sluice to transport the stones being shovelled-in. The longer the sluice is, the better the recovery. To assist in breaking-up the dirts, separating and trapping the minerals therefrom, wooden cross-pieces are fixed at intervals along the bottom. These are termed "riffles". (Vide fig. 2).

Cleaning-up to Recover the Minerals.—When an appreciable amount of mineral has collected behind the riffles in the sluice, the flowing water is shut-off, and the mineral removed with a spoon or other convenient implement. A small flow of water is then allowed to pass down the sluice, and the riffles at the bottom end are taken out. The clean-up begins at the lower or bottom end and works towards the upper. The water plays on the concentrations that have been trapped by the riffles washing away the lighter ingredients—sand, small stones, etc—and leaving the heavier—the minerals. A wooden "paddle" is used to push the concentrations up the sluice against the flow of the water, thereby assisting separation. This is largely a matter of experiment to discover what gives best results.

Accumulations of dirts and minerals between the riffles serve as cushions for the stones trundling down the sluice, and so save wear on the bottom planks. In instances, to save wear on the riffles by stones round straight poles cut from the adjoining bush are laid longitudinally in the sluice (above the riffles). (Vide fig. 1). The spaces between them allow the smaller dirts to get to the riffles. Riffles are sometimes made of "notched" blocks of wood, as per fig. 3, set in the bottom of the sluice. Stones set on edge are occasionally used.

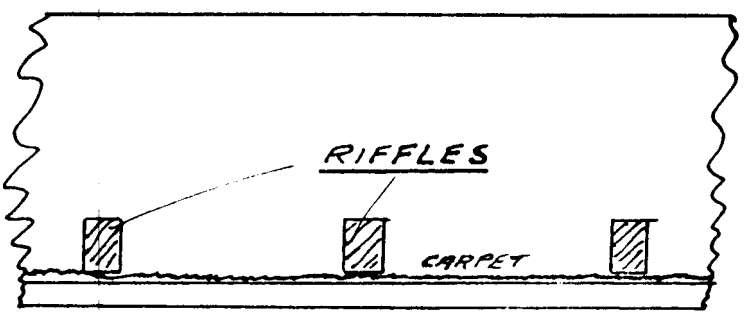


Fig. 2.— Longitudinal Section of Sluice.

The Effect of Riffles.—By obstructing the flow of water and dirt passing down the sluice, a rippling effect is set-up (hence the term). This helps in breaking-up the dirts and setting free the minerals. The particles of mineral, on account of the specific gravity, work through the mass flowing in the bottom of the sluice to the lower stratum of same. This stratum travels at a lower velocity, and coming in contact with the obstruction (the riffle), the velocity is still further impeded. Immediately behind the riffle; i.e., on the downstream side of same, a sort of "slack-water" is created. Into this the mineral drops, and remains . . . the riffle serves as a trap for the mineral. The spacing of the riffles

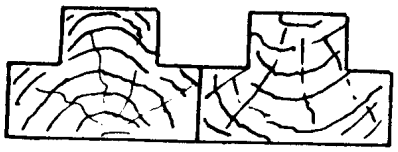


Fig. 3. — Block Riffles.

process goes on up the sluice to the upper end, collections of mineral being removed as they accumulate.

If a blanket or carpet is used in the bottom of the sluice, as is sometimes the case, most of the mineral will be trapped therein, and the flowing water will remove most of the sands, etc., so then it is a matter of removing the carpet, beating and washing it in a tub of water to secure the minerals therefrom, which settle in the tub, from which they are removed later.

The concentrations removed by the foregoing means in the case of gold placers are made up of gold, magnetite, other heavy minerals, and sand. Separation of the gold from these is often made by panning. In some cases mercury can be used, but frequently placer-gold is covered by a thin skin of oxide ("rust"), which prevents the mercury attacking it. Grinding in a mortar is sometimes resorted to to remove the skin and allow the mercury to act. Recovery from the mercury follows the usual procedure, if in a somewhat crude way, with a "shammy" and a frying-pan.

A Modern Modification.—Of recent years, in hand operations, with the advent of small readily transportable gasoline engines, the corralling of a stream of water to pass through the sluices has given place to pumping the water. As the volume of water available by this means (usually a 1½" or 2" centrifugal pump discharge) a modification in the method of its application has been introduced. In place of shovelling the dirts directly into the sluice, and letting the water handle them, they are shovelled on to a screen or grizzley on to which the water from the pump is allowed to play. Figs. 4 and 5 show the arrangement.

As can be seen, the dirts are shovelled on to the grizzley from both sides. The stones roll off the grizzley and fall at the sides of the sluice: the sands with the minerals and the water pass through the bars and pass down the sluice, in the bottom of which is spread a blanket or carpet. Cross pieces at intervals keep the carpet in position and act as riffles; sometimes expanded metal or nests of further riffles are used. The minerals are trapped by the carpet and the riffles. Cleaning-up is done by removing the carpet and washing it in a tub (as mentioned previously).

It is a very effective contrivance for "free" dirts; i.e., dirts without a lot of clay, and is much in use by miners in certain districts, where it has replaced the "rocker" on account of its effectiveness in recovering the minerals, and the greater volume of dirt that can be handled.

The foregoing procedures, though seemingly crude, embody all the underlying principles of separation of minerals from dirts by water. To get the water to do the work, it must have power. The power may be a matter of "flow", due to fall or natural head, as with a corralled stream, or supplied through a pump. Treatment by water effectively applied is the economic way for recovery of minerals from dirts, and there is no simpler means of application than in a sluice, provided there is sufficient sluice-area for the water to get in its work.

Large Scale Operations.—Coming to large scale operations, the general principles are the same. In hydraulicking, the principle of the miner with his small sluice, sending all the dirts with the stones through same, and with dredging, utilizing the modification of removing the larger stones before bringing the sluice into operation.

In hydraulicking, water under pressure is directed through a nozzle to break down a bank, and "slush" the dirts into a sluice. The sluice may have steel plates in the bottom to prevent wear, and the riffles are usually angle-irons.

Common practice, when dirts carry moderate sized stones up to 6 or 8 inches, is to us $2\frac{1}{2}$" x $2\frac{1}{2}$" x $\frac{3}{8}$" angles, spaced 5-inch centres (see fig. 6). When larger stones have to pass through the sluice, either larger angles are used, or the angles are backed by timbers. Sometimes rails are laid longitudinally on top of the angles, à la the miner's poles, to save damaging the riffles. The rails help in the transporting of the large stones through the sluice. The coefficient of friction is less than on the angle-bar riffles.

The action of the angle-bars is similar to what has already been described. The fact of being angles has no advantage over flat bars set on edge in obstructing and causing the mineral to settle out from the

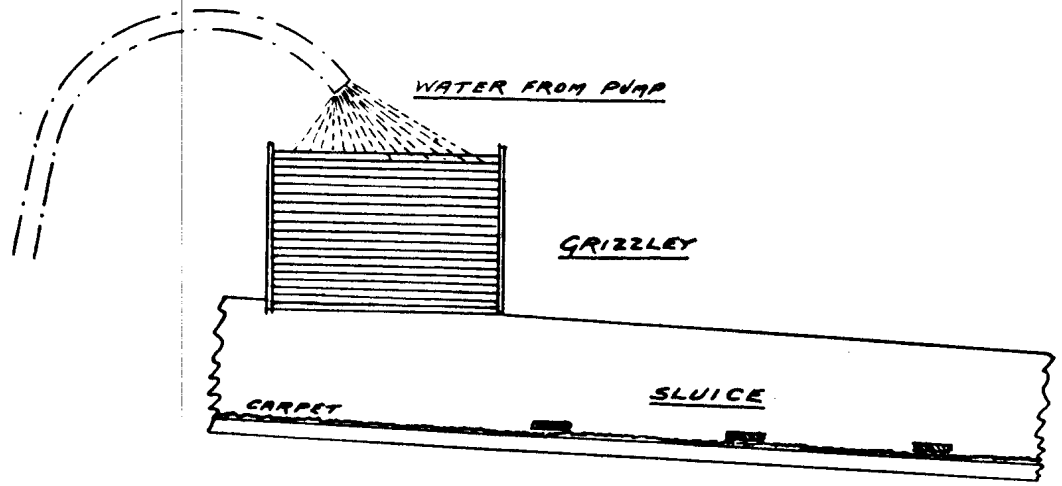


Fig. 4. Arrangement of Grizzley and Sluice.

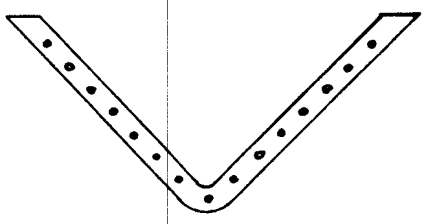


Fig. 5.—Diagrammatic Section of Grizzley.

mass flowing in the bottom of the sluice, but their flat surface provides a "paving" over which the stones can trundle, thereby saving wear on the bottom boards of the sluice. The claim that angles create a better "slack-water" is doubtful. The "clean-up" follows the procedure as already described.

Undercurrents.—These are often used when water is abundant. A grid or grizzley is fixed in the bottom of the sluice near the outlet end. The bars are fixed ¼ or ⅜ of an inch apart, and extend across the width of the sluice. The water flowing in the sluice carries the small and heavy dirts (with the minerals) through the grizzley, and slushes them to a set of auxiliary sluices with riffles, where further concentrating and trapping is effected. These auxiliary sluices or tables are made as wide as possible commensurate with the volume of water which has passed through the grizzley. The objective is to secure a sluice area as-large-as-possible. Under certain conditions undercurrents are very effective. The term "undercurrent" is probably due to the fact that the first auxiliary sluices used in this way were placed under the main sluice.

In dredging, the system described under "A Modern Modification" is used. The stones are removed by revolving trommels or screens; jets of water play on the dirts inside the trommels. The screenings flow on to a series of sluices or tables with riffles which trap the minerals. It is inadvisable to screen down too fine. To secure good separation of the mineral the presence of various sizes of stones keeps the sluice "live". A sluggish sluice with packed riffles—i.e., with the spaces between the riffles tightly packed—gives poor recovery. There has got to be the rippling action for separation. The interstices in the screens are usually ⅜" or ½". The "clean-up" as described.

Jigs.—Recently, with placer-gold dirts, there has been a move to apply jigs in conjunction with sluices, and there have been attempts to utilize jigs alone for separation and recovery. There are two general types; those with moving water and stationary screens, and vice-versa. There are numerous different designs. The success of jigs in the handling of alluvial tin-ore in Malaya is responsible for the move, but the problem in respect of gold is not so simple as at first appears. There are pros and cons.

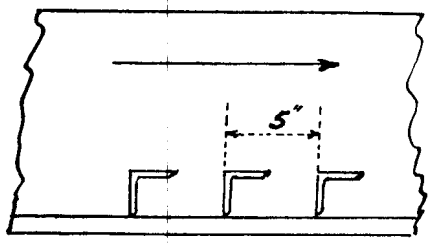


Fig. 6.—Angle Riffles.

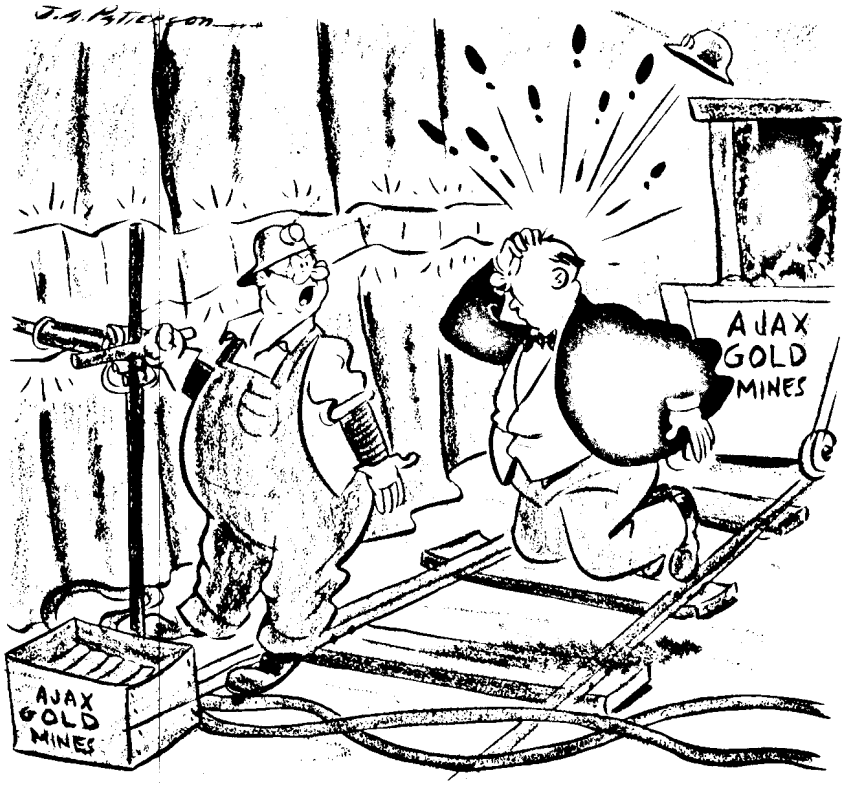
The matter is in its initial stage and controversial.

Recovering the Gold from the Concentrates.—This is done by either passing them over Wilfley tables or by amalgamation. It sometimes happens that there is an appreciable amount of the platinum group of metals present, in which case the Wilfley secures same.

Amalgamation.—The concentrates—minerals and sand—are put in a revolving barrel with mercury. As pointed out, very often placer-gold has a skin of oxide which prevents the mercury acting on it. The concentrates tumbling about within the barrel scour themselves, so amalgamation takes place. Recovery from the mercury is in the usual way.

Summary.—These notes give a general idea on the procedure of recovering gold and other minerals from alluvial or placer deposits. It will be noted that what obtains for small operations is applicable to large.

The processes may appear to be somewhat rough and ready, but it must be borne in mind that the treating of quantity is the important consideration. With deposits carrying less than 10 cents value of gold per cubic yard, which with modern appliances can be made to yield good returns on moneys invested, there is little opportunity for finesse. A percentage of mineral may be lost, but quantity of dirt treated compensates.



"I could go a lot faster, sir, if it wasn't for this darn streak of hard shining stuff always poppin' up."