SOME NOTES ON PRACTICAL SAMPLING.

(A Paper read before the Sydney University Engineering Society)

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BY CH. P. ALLEN.

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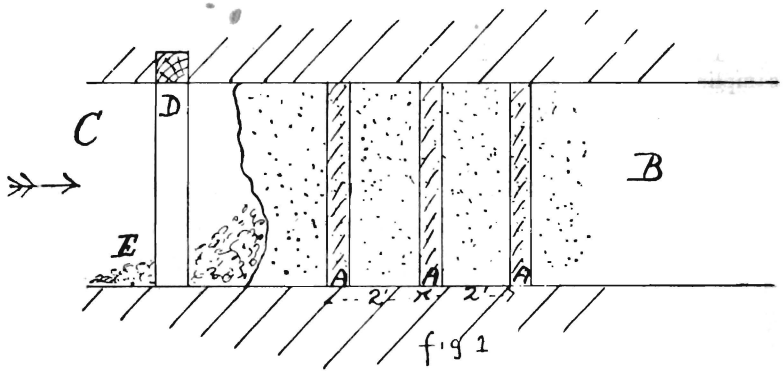
WHETHER ore be in the form of crushed grains or in bulk at the face, we can always distinguish between the two methods of sampling as defined by Le Neve Foster in his chapter on sampling (*vide* "Ore and Stone Mining"), viz., those samples which are taken from the whole portion of the ore at given intervals of time, and those samples which are a portion of ore taken all the time.

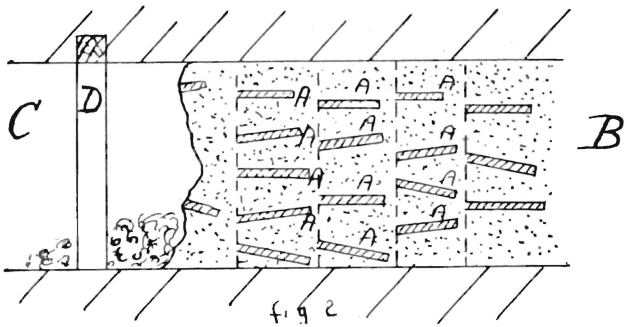
This may not be at first apparent, but if at every face of stone which is made in a drive (say, every two or three feet), we cut samples in the manner shown in the sketch—



A, A, A, A.—Section of portions to be taken from face in order, as drive is continued (greatly enlarged).
B.—Proposed route of drive along lode.
C.—Timbered drive.
E.—Broken stone from face.
D.—Stullpiece and cap.

we approximate to the first definition, while if we take borings from three-foot holes in the face, we in reality sample continuously, taking a

portion of the ore all the time, which fulfils the requirements of the second definition. *Vide* sketch.



A, A, A, A, etc.—Section of boring holes in tunnel.
B.—Proposed continuation of tunnel.
C.—Timbered drive.
D.—Stullpiece and cap.
E.—Broken stone from face.

In this case the ore and rock is sampled the full length of the drive.

It is also easily understood that, if driving, we get a better sample of the contents of the drive by this method, as, say, the lode lies between parallel walls of hanging and foot rock, narrowing and widening inconsistently, more than it occurs in patches, one boring in the face must always tap the ore body. Again, if the latter condition exist, a section intermittently across the lode would not give an accurate sample, as a large body of ore could occasionally lie between the sections.

The first method also requires the services of a man engaged in sampling alone. The second needs but little extra labour, as portions of every drill-hole can be easily collected.

The great point I would like to bring out in sampling is that continuity of samples with work done or laid out should be aimed at in selection of a sampling method.

A sample by borings approaches to a miniature drive, in fact.

This taking of a sample is specially emphasised, I think, in a mill, where undoubtedly it would seem that those samples which take a small portion of ore *all* the time are distinctly preferable to those which cut out a bulk lump at intervals of time.

Professor Foster remarks in the above book that the former is apt to select the coarse grains unfairly to the fine, or *vice versa*. Even granting this as a correct view, what does it matter when our requirement is to know the distribution of the mineral in the ore? And I do not see that this result is influenced by taking all the ore at intervals to such an extent that we should abide by this method.

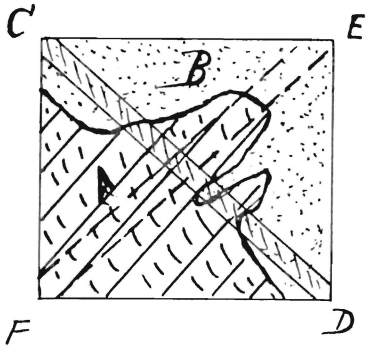
The large grains can be assumed to contain their share of mineral (unless the mineral be gold, and the gold coarse) as much as the fine, so

that if a continuous sample tended to give an unfair result in this respect, it seems immaterial.

As a matter of fact, on a cone, as is generally used in an automatic sampler, why should the coarse grains run more to one side than the others? And, further, it seems to me that in crushing, the stream of ore could contain mineral in patches, which, by a combination of chances, could be nursed many times by a sampler taking the complete portion at given intervals.

It appears that in sampling we have the main factors—the value of the different classes of stone, and the quantity of each or several.

Now, by cutting a diagonal channel in the face of the drive for a few inches deep, breaking this sample by degrees, and quartering, we lose sight of a very important fact, which is shortly this--we give equal values to the rich stone and the mullock. This is shown by an explanation of the following sketch :—



A.—Valueless rock.
B.—Ore.
C. D.—Diagonal channel.

C D, the diagonal channel, it will be noted, runs through mostly ore body, and this is taken as a sample of the drive, which it certainly is not, for there is an equal quantity of rock which dilutes the contents of the face to half the assay value; and we see that the second factor in obtaining a correct sample is not fulfilled, for the quantity of ore is not fairly proportioned to the rock by this diagonal channel. Nor should it be if a second channel (E F) be included in the sample, for that would increase the quantity of rock to mineral unduly.

Boring samples, on the other hand, could be situated proportionately in the face according to the different qualities visible, and their number defined by the respective quantities of each.

Further, suppose, for the sake of argument, we have mullock showing a trace of gold, and an ore at an assay value of two ounces to the ton. Well, if we take an equal quantity of each we obtain a sample from, say, one ton of stuff, with a value of one ounce to the ton, which is quite reasonable; but, unless a method of sampling is adopted which allows for the relative proportion, inconsistent results are found.

If the quantity of lode stuff overbalance the rock either more samples should be taken, or we should give a proportionate weight factor to the larger quantity, to obtain an accurate result, and the contrary rules if the opposite conditions occur.

This is certainly taken into account by squaring down the whole face, but not by cutting diagonal channels, which practice leaves room for considerable error.

Sampling, as a portion of the assayer's work, is a far more important matter than the later reduction of the gold in the sample. The latter is simply a question of necessary metallurgical knowledge, with practice in fluxing and weighing, while the sampling requires great judgment, and no rule to suit all cases can be given.

The main guide is to note the various formations to be worked upon, and to take larger samples from the large portions, and smaller ones from the small ones.

These can be then all mixed and quartered in the usual way, with some hope of obtaining a reliable result.

The same method can be used for sampling heaps of broken stone and ore.

Generally speaking, a heap of stone contains varieties of ore. These should be judged (as far as possible) as to their relative quantity, and proportionate samples taken from each. The practice of merely digging out the surface with a shovel in various places is not to be advised, but some judgment should be used in selecting spots for sample-taking, and these should be supplemented by sloping cuts down the sides of the heap from top to bottom. This method has been found by the Author to give consistent results in a heap, which was afterwards carted away, and samples in the centre gave no variation in the assays.

It is obvious that there is much that is of interest to the investor in a knowledge of proper sampling, for occasionally he may have invested in a heap of tailings or a pile of stone at grass, which was estimated as payable from assays, and the treatment of the heap gave a shortage in value.

It may here be given as a rule that assay results alone must be accepted with caution, and only used as a guide to a partial extent. If it were possible to increase the assays to an indefinite number, only then should we obtain an actual valuation fit for definite calculations.

The conditions of sampling for assays must be as far as possible understood. These latter involve no technical training, but only what are called generally common-sense principles. After that an estimate may vary from the result, but not so much as to be injuriously on the wrong side.

From sampling of solid stuff we come to loose material, as stone in the form of sand. Now, sand samples must especially be selected with regard to the conditions of the deposit. After sand has been treated by a battery we have so many factors which alter the face of the heaps and the distribution of the mineral in the heaps, which factors continue

to act so long as the sand lays untouched. We have the action of the wind, which more or less helps to separate the poorer portion from the heavier or mineral part. There is also the action of water to be reckoned with, which causes similar variations in a greater degree.

The sand, again, may have been deposited in a lake, which at the time of sampling is dry. The consequence is, that samples taken from the surface give no value of the deposit, because the richness has concentrated at the bottom, while the water held the lighter sand in suspension.

Again, the inlet of a dam of tailings will assay richer than the outlet of the same, on account of a similar concentration by running water.

After variations have been noted, we can, as a matter of detail, take samples uniformly, by selecting portions along a radius at even distances, if the deposit be roughly circular, or if rectangular, then along one of the half diagonals.

If the tailings be in a state of motion from a shoot into a dam, then we may take samples periodically in a dish, and after having allowed them to settle, pour off only the clear water, take a fresh sample in the bucket or dish, and proceed as before.

Or, again, if we prefer to have a continuous sample from the above, a 2″ gas-pipe, laid at an angle lengthways under the falling tailings and if a few small holes be drilled on the uppermost side, these will admit a small continuous sample to the interior of the pipe, which may lead into a suitable bucket. It must be noted that the contents of the receiver must be allowed to settle before any water is emptied from it, or concentration in the receiver will result. In the latter case, two receivers would be necessary. Next to taking a continuous sample, it seems that taking a large number of samples approximates to this condition; but we must always bear in mind that no method of sampling and assay can give a result to agree with that obtained by treating the complete body of material in question. At the best it can be compared to picking a white ball from 1,000 red balls, and we must always remember that the common assumption is that the red balls, as analagous to the mineral, are uniformly mixed with the white ones, which, as regards the mineral and gangue, is not the case; but assaying a sample is the best guide we have up to the present for valuation beforehand. Further, as regards the continuous sample, it seems to me that this method tends to eliminate this varying factor of the distribution of the ore.

Mining men always recognise—and the greater their experience the more they are convinced—that no man can see in front of a pick, and that starting defined operations, and in a concentrated way, is the only true test of value.

The distribution of the ore in a face of stone can never be allowed for. We can only approximate to it, as the quantities of metal-earning material can only be measured by the surface appearances. What differing portions are existent beyond is only found out by experience

in crushing the material and winning the contained metal, if gold be sought.

With a passing remark on the possibility of samples when opened collecting gold from gold slimes, which always are blown about in the neighbourhood of dry crushing plants, or from slimes which are rich in gold being dried for smelting, I feel I have said enough to justify the title of this paper, and conclude by hoping that, after hearing it read, you will perceive there are many points in the apparently simple process of sampling, and I have no doubt there are more which each man in the business has had brought under his notice in his own individual experience.