INNOVATIONS IN GRAVEL PUMP TREATMENT PLANT—II.

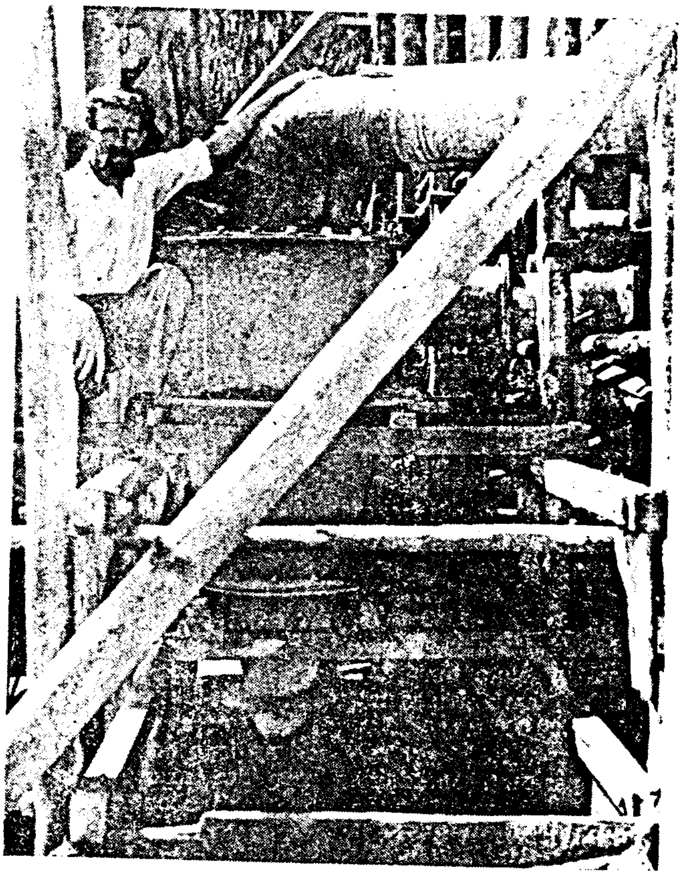
Tin Treatment Plant in Malaya

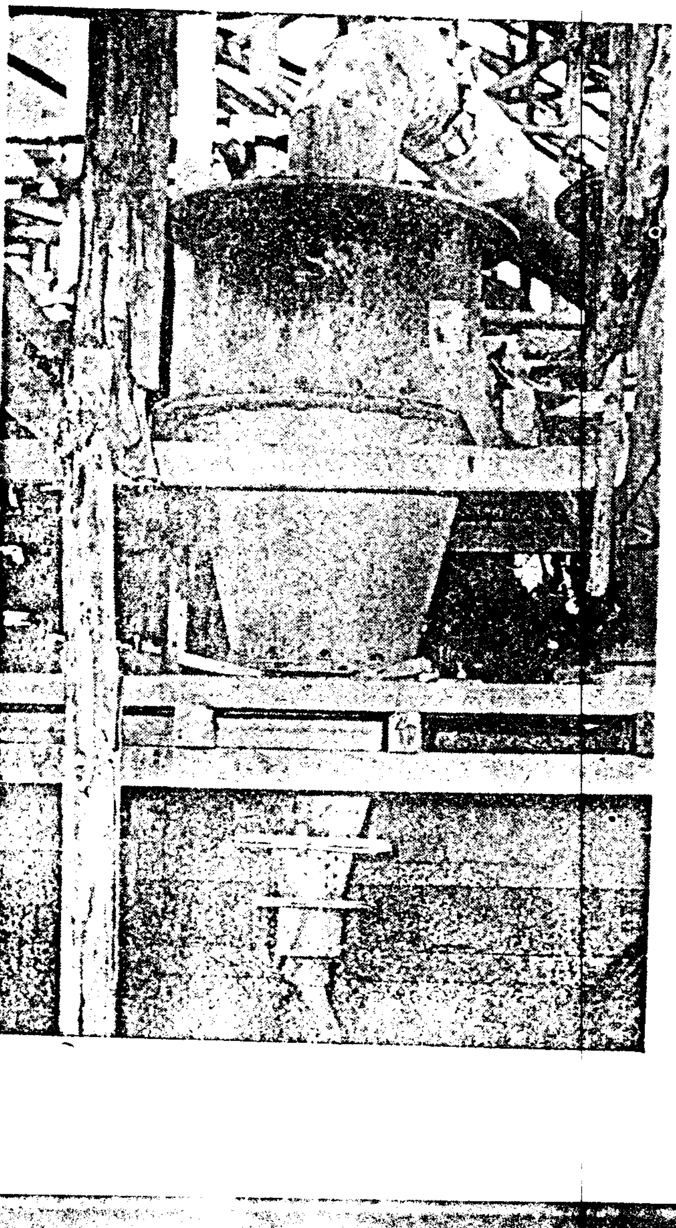
This article is the second of the series presenting "Innovations in Treatment Plant for Gravel Pump Tin Mines in Malaya", by J. H. Harris, Chief Research Officer, Department of Mines, Federation of Malaya. The article, in its entirety, is published by permission of the Chief Inspector of Mines with the authority of the Minister of Natural Resources of the Federation.

THE problem remaining was to de-slime and de-water the resulting ¾ in. feed, which was being delivered at the rate of 3,000 gallons per minute and at a pulp density of 10 to 15 per cent solids. It was decided to attempt this in one stage by means of a large low-pressure hydrocyclone. A 27 in. cyclone was constructed with a 27 deg. cone and a 3 in. underflow spigot, to be operated at a feed pressure of 5 p.s.i.

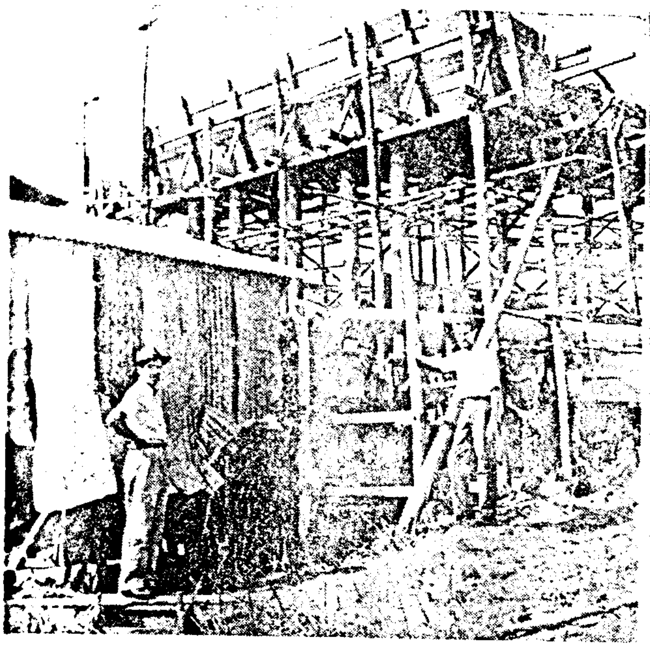
On trial, first with a pumped feed and later with a gravity feed, taking about a third of the output of the mine, this cyclone showed that the project was feasible. The overflow was substantially all −300 mesh and carried only a small amount of cassiterite of such fineness that its recovery would normally be regarded as impracticable. (The existence of such fine cassiterite had hitherto not even been known, since it had never been recorded by the methods of sampling and valuation in use.) The underflow proved to be an excellent feed for a jig, and, moreover, was found to contain fine cassiterite, down to 300 mesh, which had formerly been lost.

A Yuba jig with two 42 in. cells was available and this was installed to test the cyclone underflow. The jig was found, however, to have a capacity in excess of that of the one cyclone, and the decision was made to turn the whole of the mine output into the experimental plant. Five 30 in. cyclones were designed, constructed, and installed, operating by gravity with an effective head of 13½ ft. Of these, three were found sufficient at first. Later modifications reduced the requirement to two. The latest design of 30 in. cyclone evolved by the Research Division handles about 1,500 g.p.m. of feed, with the available head of 13½ ft. It rejects 1,400 g.p.m. of surplus water and slime, 90 per cent of the solids in the overflow being finer than 300 mesh. The underflow is 100 g.p.m. at 30 per cent solids, only 15 per cent of which is −300 mesh.





Above is the high-capacity development for the Research Division's low-pressure 30-in. hydrocyclone with experimental 5¼-in. underflow. Alongside, at left, the second cyclone with normal 3-in. underflow. Capacity of these cyclones is 1,500 g.p.m. at 5-6 p.s.i. The feed contains rock up to ¾ in. size. Overflow is −300 mesh



General view of the hydrocyclone plant, showing header box and five gravity feed pipes, two of which are in use

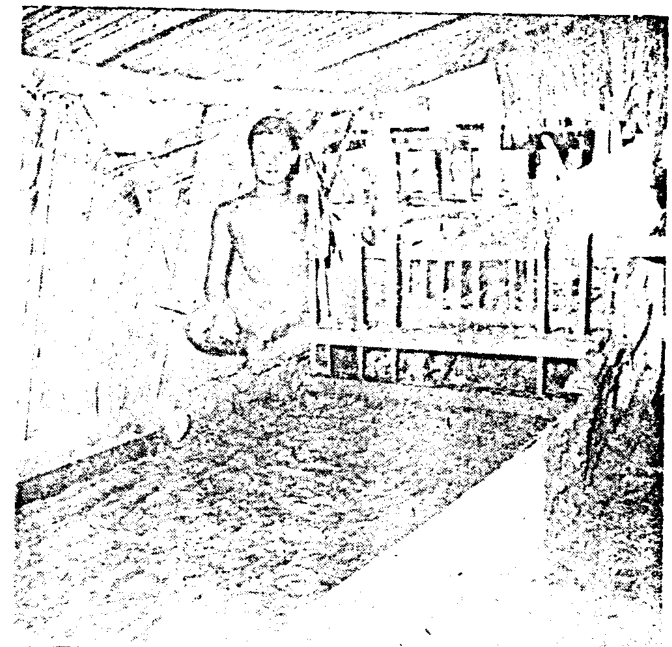
A typical screen analysis of the underflow is as follows:

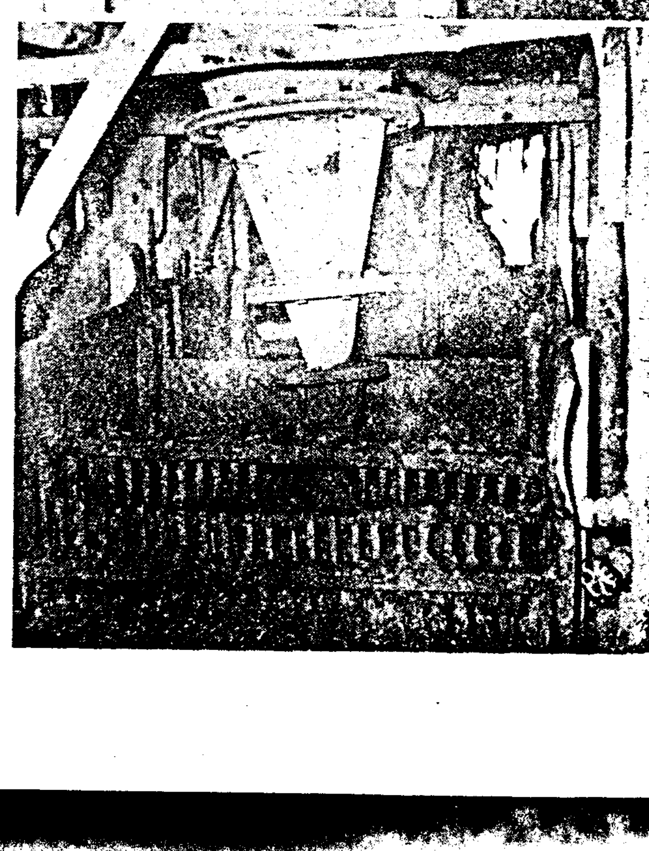
Through	*On*	*Per cent*
1 in.	½ in.	3.0
½ in.	¼ in.	8.0
¼ in.	10 B.S.	11.1
10 B.S.	60 B.S.	47.7
60 B.S.	100 B.S.	8.5
100 B.S.	200 B.S.	3.6
200 B.S.	300 B.S.	1.5
300 B.S.		16.6
		100.0

In another test, the distribution of tin in the cyclone products was found to be:

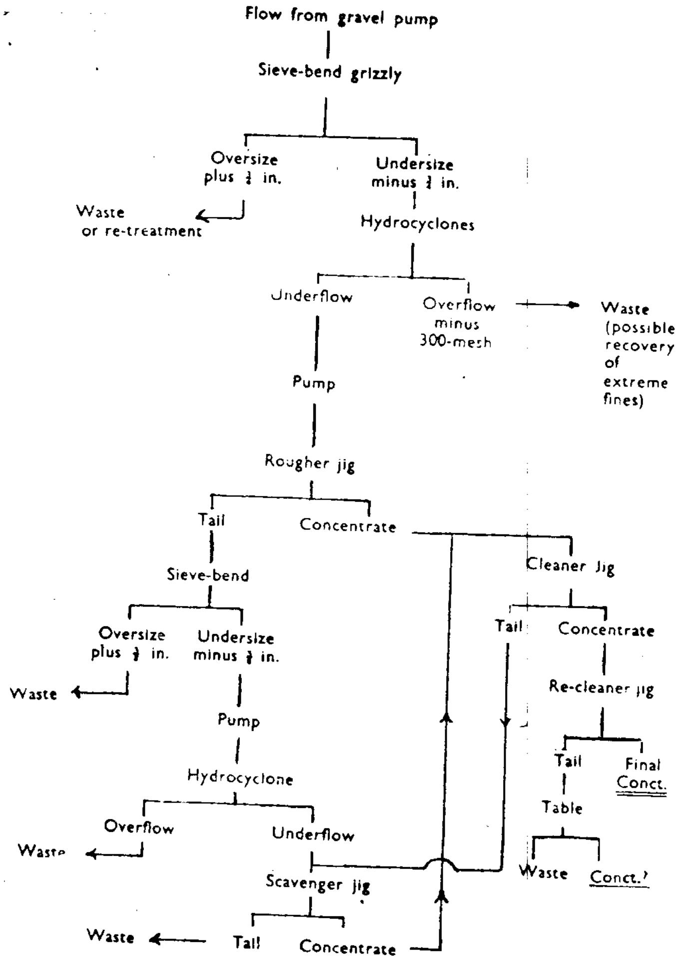
Mesh size		*Underflow*		*Overflow*	
Through	*On*	*Wt. per cent of feed*	*Distribution of tin, %*	*Wt. per cent of feed*	*Distribution of tin, %*
	85 B.S.	32.2	65.2	0.7	1.1
85 B.S.	100 B.S.	0.3	1.1	0.2	0.9
100 B.S.	150 B.S.	0.9	3.7	1.5	1.8
150 B.S.	200 B.S.	0.5	1.2	1.4	1.0
200 B.S.	240 B.S.	0.3	0.7	1.1	0.6
240 B.S.	300 B.S.	0.3	0.4	1.8	0.7
300 B.S.		7.0	2.1	51.8	19.5
		41.5	74.4	58.5	25.6

The bed formed on the jig by the coarse underflow from the cyclones acted gratifyingly as an efficient trap for cassiterite, while the high density and non-slimy nature of the feed increased the capacity of the jig to a figure far in excess of that expected locally. It was noted that a high recovery could be obtained with this jig, only two cells long, at a feed rate of 25 cu. yds./hr. The jig tailings still carried fine cassiterite, but it was clear that no useful pur-





At right, from top to bottom : top, flow over a Yuba jig taking cyclone underflow at 25 cu. yds. dry solids per hour; centre, observing the hutch product of the Yuba jig; and below, the scavenging operation



pose would be served by extending the jigging process *on the same material.* Since it would still be necessary to move 1 in. gangue, it could only be expected that fine mineral would continue to move with it into the tailing. The theory was developed that, if coarse gangue were screened off, the residual tailing would be amenable to jigging since the size and mass relation between gangue and remaining mineral would have changed. Furthermore, the screening could be done without loss of oversize free cassiterite since that would already have been caught in the original jigging.

Scavenging

This, in fact, proved to be the case. The screening was performed with a second coarse sieve bend which, again radically different from established practice, performed well at a size split of about ⅜ in. The undersize was re-jigged on a locally made two-cell 4 ft. by 7 ft. jig with excellent results, which were later improved by the addition of a pump and cyclone to de-water the feed to the jig.

Cleaning and Re-cleaning

The rough concentrates from the two jigs were cleaned on a locally made 2 ft. by 7 ft. two-cell jig, and these concentrates re-cleaned with the aid of a Denver jig and a locally made two-cell 14½ in. by 36 in. jig. Various re-cleaning circuits were tried and a shaking table was put in to test the tailings. A typical flow sheet is shown above.

At this particular mine the final concentrates were of good grade and could be prepared for shipment with a minimum amount of final dressing by conventional hand-dressing methods. At other mines the final concentrate would consist of a complex heavy mineral assemblage which would best be treated by flow sheets combining gravity, flotation, magnetic, and electrostatic separation. The Research Division has already pioneered many innovations in this direction, resulting in improved recoveries, in work extending over the past seven years. (*Bulletins 1-4*, Department of Mines, Research Division, Federation of Malaya.)

Safety in Indian Coal Mines

THE recent explosion at Chinakuri Colliery, near Asansol, the mine fire at Kothagudium Collieries, and the drowning of miners at the Central Bhowrah Colliery, all in India, have focused the attention of the public, the industry, and the Indian Government on the necessity of taking a survey of the safety measures existing in Indian mines.

The Indian coal-mining industry today is producing about 40,000,000 tons of coal per year and employs over 590,000 persons. If the rate of accidents in Indian mines has been low hitherto, it is not owing to any big technical planning or any vigorous campaigns of safety, but is rather due to the good geological conditions, shallow depths, and slow tempo of work obtaining in the country. Out of over 800 mines, 40,000,000 tons a year are produced; whilst Poland, with 100 mines having much similar conditions, produces 95,000,000 tons.

The Indian Mines Regulations appear at once to be inadequate. A few glaring deficiencies are mentioned below.

No standby or reserve main mine mechanical ventilator is prescribed by the regulations. No "ventilation men" are required to be appointed under Indian regulations in gassy mines. No "stone-dust barriers" are required to be erected in mine roads as safeguard against explosions. No fire doors are prescribed by our regulations to be erected near the pit bottom of a down-cast shaft, which can be closed or opened from both sides.

One rescue station is required by the Indian Coal Mines Rescue Rules to be located at Dhanbad for the Jharia coalfield (Bihar), which has an area of 175 square miles, and another at Asansol for the Ranigunj coalfield (Bengal), which has an area of 500 square miles. The rescue rules require that where the total number of persons employed at a mine underground is not more than 500, there shall be employed not less than one trained man, and where the total number of persons employed is more than 500 but less than 1,000, there shall not be less than two trained men to co-operate with the rescue station in rescue work.

In view of the fact that several of the Indian mines are located far away from any towns or railway lines, and sometimes without any other mode of conveyance, it is essential that every mine should maintain a mine rescue brigade of its own, consisting of at least three troops, each troop comprising a leader and four rescue men. Also, there should be a "help plan", prepared by the central rescue station, according to which two or more neighbouring mines belonging to different mining companies mutually help one another in case of serious mine accidents.

As seams at shallow depths are worked out, seams at greater depths will have to be mined. It would be wise to go through the statutory safety requirements that are in force in the various mining industries of Europe.