neighbour to the eastward—the Great Barrier Gold and Silver Company—is a small reef from 8 in. to 2 ft. 6 in. in width, strike magnetic east and west, and dip 72 deg. south. This reef we call the "Lee reef," in honour of its discoverer, Thomas Lee.

The ore of the Lee reef at the surface is a silver-ore carrying gold, but in depth the percentage of silver decreases and that of gold increases, so that it becomes a gold-ore, with the gold-values much in excess of those in silver. The silver occurs as sulphides, stephanite, pyrargyrite, and proustite. The gold seems to be nearly all contained in the copper-pyrites. The ore is light in colour, except where banded by black streaks of stephanite. In appearance it much resembles that of the Comstock lode, Nevada, United States of America. The gangue is mostly quartz, with a little calcite.

The shaft was sunk 214 ft., and a cross-cut made to the reef. The reef was cut 50 ft. from the shaft; it was 18 in. wide, and good ore. This was about the 18th February. Work was then stopped at the shaft and confined wholly to the low-level adit. On the 31st March it was into the hill over 600 ft., and work has been continuous in driving it since that date. We expect to get the Lee reef about 800 ft. in, and then drive 300 ft. east on the reef to connect with shaft cross-cut. The adit will cut the reef about 350 ft. below the surface at that point. The shaft is in a gully near a creek, and is about 150 ft. lower.

The work of making connection from the present adit to the shaft cross-cut will take until November to complete. I wished to work both ways, from the shaft as well as from the adit, in making this connection, but the directors decided that the saving of time would not compensate for the extra expense of handling rock and water through the shaft.

THE PERMANGANATE GOLD-RECOVERY PROCESS.

[By Professor Black, Otago University, Dunedin.]

This is a French invention, and is now being patented in all the Australian Colonies, the United States, South Africa, and Europe. It is a leaching process very similar in the plant required and in the manner of working to the now well-known cyanide process. It differs from the latter, however, in the chemical nature of the solvent solution, the rapidity with which it dissolves the gold, the method of precipitation or recovery of the gold from the solution, and in the important fact that it does not extract the silver from ores of that metal. If, however, the pulverised silver-bearing ore be roasted with from 3 to 5 per cent. of salt the permanganate process leaves the silver in a condition in which it is very amenable to the very cheap hyposulphite-of-lime leaching process.

The permanganate process can be used only on ores free from iron-pyrites or other sulphides or arsenides. Ores, therefore, that contain such refractory ingredients as these must undergo a thorough roasting process in a reverberatory furnace with a good current of air passing through it; and the roasting must be continued, with constant stirring, or rabbling with an iron tool, till all the sulphur is burnt away as sulphurous-acid gas or converted into the higher sulphate of iron. In this roasting the arsenic is oxidized and blown away as arsenious-acid fumes. Before removing the charge from the furnace it must stand the following test: Portions of the ore in the furnace are taken out from different parts of the charge so as to give a fair sample; these are mixed, and ½ oz. or so of the mixture is put into, say, a wine-glass, and covered with twice its bulk of the Etard permanganate solution, with which it is to be stirred up and then allowed to stand for ten minutes. If the purple-red permanganate still retains its own red tint the charge in the furnace is sufficiently roasted; but if the red tint is entirely bleached it is an indication that the roasting is not completed.

The presence of copper-pyrites or other copper compounds is no objection in the use of this process. Several samples of ore containing from ½ per cent. up to 6 per cent. of copper have been treated very successfully in quantities of 15 lb. to 40 lb. in the laboratory. One sample of copper-pyrites, containing 21 per cent. of copper, was roasted with salt to a dead or sweet roast, and on being treated with the permanganate solution behaved admirably, not reducing the colour of the solution, and giving up the gold just as well as if copper had not been present at all. No difficulty was found in treating parcels of 40 lb. of the most refractory parts of the Monowai ore, consisting chiefly of zincblende, galena or sulphide of lead, copper-pyrites or sulphides of copper and iron. With much galena in the ore it is better to begin roasting with a low temperature in the furnace, and a strong draft of air, letting the temperature rise gradually, and finishing, as in all other cases, with a strong red heat.

The lead and zinc of such ores as the Monowai become oxides of these metals in the furnace, and, beyond consuming more acid, these oxides have no injurious effect on the efficiency of the process, as they do not interfere at all with the permanganate, and therefore do not prevent the solution of the gold. The lead is retained in the leaching-vat as insoluble sulphate of lead. The zinc and copper pass out as sulphates and chlorides of these metals, accompanied by some of the iron as higher salts of iron, and none of these solutions has any deleterious effect on the gold-solvent.

When there is much antimony-sulphide in the ore the roasting is more difficult to carry out with satisfactory results, because this mineral melts or fuses at a comparatively low temperature, and in the fused state does not allow the air to get free access into the interior of the mass, and in this condition it is apt to obstruct the passage of the air, and protect the other refractories from the oxidizing action of the draft. To meet this difficulty common salt should be mixed with the ore before roasting, weight for weight with the sulphide of antimony supposed to be present, and a strong blast of air should be passed through the furnace, finishing with a long-continued high temperature. This treatment will carry away most of the antimony as chloride of that metal,