

adequate ventilation for the mine, in addition to the necessary compartments for cages, ladder-ways, and pumping. When the Bendigo shafts were commenced it was never anticipated that such depths would be reached by them, the geologists of the period treating with ridicule the idea that auriferous quartz would contain payable values at such depths as are now attained. This vertical shaft has reached a depth of 4,300 ft., and from the 37th level (4,254 ft.) a winze 328 ft. has been sunk to a "saddle," at a point 4,492 ft. below the surface, being the maximum depth at which auriferous quartz has ever been mined. Upon descending to the 37th (4,254 ft.) level, where "stopping" was being carried out, I found the atmosphere warm and very humid, the temperature of the rocks being officially recorded at 110° to 110.5° Fahr.;* nevertheless the air was tolerably pure, owing to natural ventilation produced only by the increased temperature of the mine with depth, the air being directed by doors and brattice round the working-places. In some Victorian mines Root's blowers are employed to produce ventilation, and they are spoken highly of for mines where exhaust centrifugal fans are inapplicable, owing to absence of return air-ways. On descending further to the deepest point—viz., 4,492 ft.—similar conditions prevailed, the temperature of the rocks there being 113° and of the air 86° Fahr.* In Bendigo it has been ascertained that the rock-temperature increases at the rate of 1° Fahr. for approximately 75 ft. in depth below the zone of invariable temperature. In Victoria, by the mining statutes the temperature of the metalliferous mines shall not exceed 83° Fahr. by the wet-bulb thermometer. In West Australia the limit is 85° Fahr., except under conditions where it is impracticable. The amount of ventilation required by law in the former State is a minimum of 70 cubic feet per minute per person under ground, and the maximum of 500 cubic feet per minute where noxious gases exist to a dangerous degree; but it has been found that in the deep mines 70 cubic feet per minute per man is not an adequate amount.† At this mine baling is sufficient to keep the mine dry, and throughout the whole field mining operations are favoured by the small quantity of water encountered. With the exception of the levels, little timber is used or required, and, considering the great depth, there is less pressure generally in the mines than might be supposed. This no doubt is due considerably to the arched strata above the saddles supporting the superincumbent rocks. I was much impressed by the excellent precautionary measures taken to prevent shaft accidents—superior, in fact, to anything I have ever seen either on the American, African, or Australian mining-fields.

The New Chum Railway Mine, the total depth of which is 4,289 ft., was visited and descended. At a depth of 4,164 ft. a "saddle" was being stoped, and there I saw free gold associated with mispickel on the footwall at the apex, the reef being at that point about 15 ft. wide, the most recent crushing from which averaged 17 dw. of gold per ton milled. The temperature of the rocks here was 110° Fahr. and of the water 114°.

Equipment.—Horizontal direct-acting non-condensing winding-engines of local manufacture, fitted with Corliss valve-gear, and coupled drums with post brakes, are mostly employed on these goldfields; but no provision is made to counterbalance the great weight of winding-rope in use, consequently the engines are subjected to very irregular loads. For this purpose, in the great British collieries, conical drums are always installed. Two cages are employed, of one-truck capacity each. Dial winding-indicators are geared to each section of the drum independently, so that in the event of one section being uncoupled its indicator remains stationary.‡ Safety cages and detaching hooks are required by law, and, in addition, safety catches or "keps" are fixed in the head gear at a depth of about 15 ft. 6 in. below the bell or ring; these catches consist of pieces of timber 9 in. wide by 3 in. thick, and the full length of the winding compartment, at each end of which they are attached by strong hinges, permitting the catches or "keps" to open upwards in the event of an overwind being operated by the ascending cage; but they are immediately closed again by strong springs pressing against them, and in this position they will arrest the falling cage in the event of the safety hook failing to hold in the bell or ring. When so closed they form a bearing of 3 in. wide on each side of the cage. The catches are fixed to a platform upon which the occupants of an overwound cage may descend to the ground by a ladder-way. This arrangement I consider well worthy of general adoption in this Dominion.§ The speed of winding is regulated by statute to a limit of 500 ft. per minute when men are being hoisted, or when nearing the surface 200 ft. per minute.

Winding ropes and chains, together with safety cages, hooks, and all other equipment, are frequently examined and tested, and such tests recorded in a book at the mine, so that every precaution which appears possible is taken in Victoria to prevent shaft accidents, and notwithstanding the immunity from shaft accidents in this Dominion I believe that some of the aforesaid precautionary measures may with advantage be copied.

Treatment of the Ore.—Owing to the free-milling character of the ore, together with the conservatism of some of the mining companies, the treatment of ore has not generally kept pace with modern practice, and in this branch of mining New Zealand is considerably in advance of Victoria.

The largest mill in Victoria is Lansell's Bendigo Battery of 110 heads, and this mill, which crushes for the public, was visited and inspected by me. I will describe what I saw at this typical Victorian mill. The ore for treatment is brought in tip-drays and deposited by them on the ore-floor, which is at the same level as the dies of the mill; it is then shovelled into the mortars in lumps in size up to that of a man's head, one person thus feeding fifteen stamps. Punched iron screens, with 175 apertures per square inch, are employed, but the height of the discharge is not regulated by chock blocks as the dies become worn, and no attention is given to this important matter. The pulp, after passing over the amalgamated plates, travels over a concentrator and a

* Annual Report for 1907 of Chief Mining Inspector, Victoria. † In this Dominion the minimum quantity of air necessary for each person employed underground in a metalliferous mine is 100 cubic feet per minute. ‡ This is a very important safety precaution, and human life has already been saved thereby; at the new Blackwater Gold-mine, in this Dominion, I recently observed a similar arrangement. § A somewhat similar safety "kep" is in use at one of the Reefton mines, New Zealand.