

A modification of the ordinary bord-and-pillar method is that of the panel, which is followed in the Blackball Mine, with a view to reducing the loss from spontaneous combustion of the coal and from uplifting of the floors.

"The panels are 200 yards in length on the level, and extend to the rise till the old workings are nearly reached. At 50 yards on either side of the centre-line of each panel well-timbered headings (usual grade 1 in 6 to 1 in 8) are driven in the main or lower seam, and 18 ft. bords with 48 ft. centres are set off on either side. The inside bords are driven till they meet in the centre of the panel, but the outer bords are stopped about half a chain from the boundary. Thus a 66 ft. pillar is left between the panels.

"All or nearly all the bords in a panel having been driven, the pillars are drawn as quickly as possible. This work starts from the boundaries of the panel, and the coal is removed in 'lifts,' each about 30 ft. long, this being the width of the pillars, and a convenient length for handling trucks.

"When a panel has been worked out, stoppings are put in all the headings. These and other stoppings intended to wall off fires are built of stone with a fireclay centre. As the weight of the roof comes on the stoppings, they are so squeezed as to become airtight, if not so before."

On the Westport field the seams are "more or less variable in dip, strike, thickness, and quality, subject to rolls, intersected by numerous faults and stream-valleys, &c.," and the workings are therefore somewhat irregular. "The coal is won in the first place from bords" (Bulletin No. 17) "16 ft. to 18 ft. in maximum width, driven on the average 1 chain apart. They are sometimes broken away with a width of 12 ft. but in many cases are begun with the full width of 18 ft. The bords are connected at intervals of 1 chain by cut-throughs, ends, or stentons, which are usually of the same widths as the bords. Thus the pillars are normally 48 ft. square, but in practice there is considerable variation. Where the seam is thick, head coal is dropped, usually simultaneously with the working of the pillars, which are removed in 'lifts' or slices. In the Mangatini section of the Millerton Mine, where the coal reaches 50 ft. and more in thickness, the pillars are first split, then a small slice or lift is taken off each end. The top or head coal is then shot down (blasting-powder being the explosive*), and after the broken coal has been filled, another lift is removed in the same way as before. Great falls of coal often take place, and a pair of miners have been known to fill coal for several weeks from one place without ever having to break coal from the face. This process of working the pillars is continued until it is deemed unsafe to proceed any farther. In very thick seams there may be two or even three drifts one above the other, but there cannot well be more than one set of bords and of pillar workings. Necessarily a large percentage of the coal cannot be recovered from those portions of the seams with thickness exceeding, say, 16 ft. or 18 ft. Only by a filling-in method could all the coal be removed without frequent loss of life, but the cost of such a system renders it impracticable for the Westport district or any other locality in New Zealand until the selling-price of coal increases very considerably."

Although the use of machines for cutting and holing is now common in the collieries of the United States of America, New South Wales, and other coal regions, this work is still done by hand in our mines, except in parts of the Taupiri Extended Mine. Machines were introduced by the Westport Coal Company into their mines and used for some years, but were ultimately discarded because of the men's objection to the contract system under which they were worked, and the introduction of the eight-hours bank-to-bank rule rendering them a costlier method than hand-hewing. Machines were also used in the Westport-Stockton mines for some years, and abandoned owing to the difficulty of fixing a rate of pay for the men working the fillers.

The ventilation of the mines is regulated by statutory enactment, which prescribes a certain standard; so, too, is the method of lighting, which varies with the character of the gases. Where naked lights are used, carbide or colza-oil are the common illuminants. "Taken as a whole," says one authority, "the atmosphere of the mines more than favourably compares with that of the general run of workshops, mills, factories, &c." (Inspecting-Engineer Hayes, in "New Zealand Mining Handbook," p. 386.) Inflammable gases are present in some of the mines, and there have been three colliery explosions with large loss of life—at Kaitangata, February, 1879, thirty-four deaths; at the Brunner, near Greymouth, in March, 1896, sixty-six deaths; and in the Taupiri Mine, 1914, forty-three deaths.

Timbering is also regulated by law, the amount required necessarily varying with the nature of the roof, walls, and floor.

The legislation requiring lighting, ventilation, timbering, safe and dangerous places, &c., is strengthened by an elaborate system of periodical Government inspection, and of "check inspection" by employees of the unions, as well as by the daily rounds of the underviewers and the vigilance of the men themselves and the underground mine-managers.

(vi.) *Haulage*.—The transport of the coal from the face to the pit-mouth has already been described. More unusual and noteworthy as engineering feats are the systems of haulage from the pit to the point of rail embarkation, particularly at the three bituminous mines near Westport, and, until the opening of the Ngahere Railway, at the Blackball Mine. In the former case the coal is lowered over steep inclines from a height up to 2,000 ft., and in the latter it was conveyed by an aerial tramway over three miles long.

(vii.) *Wages and General Conditions of Work*.—Both the piecework and time-wages principles are applied in mine wages. The miners or hewers are generally paid so-much a ton for hewing (see Chapter V), this standard rate being varied according to the industrial agreement in operation, to allow for differences in height of coal, width of drive, amount of stone or water, &c., as the work

* "Permitted" explosives are now used.