

other, never less than 50 ft. from the average line of the north wall of the lode, and some connecting tunnelling, a permanent return air-way will be formed at a cost no greater than that of the old system of working out each block with two vertical winzes and a western wood block air-way and the eastern paved air-way, as the large saving in the temporary western air-way in the form of a 3 ft. to 4 ft. steel pipe over the wood block air-way formerly used, is more than sufficient to pay for the tunnelling between the top of one permanent upcast winze and the bottom of the next, and that connecting the temporary winze with the permanent. There is another advantage in this system, namely, that when it is completely established we have a second permanent way into depth from horizon 17 down. It was difficult to determine the point at which the improved system should commence, but for various reasons No. 23 winze offers the best opportunity for an independent upcast air-way, and consequently it has been decided that the new system should commence from this point.

The benefit of the proposed alteration in the ventilating system will not be felt on the blocks of mineral to be worked out from horizon 17 up, but from 17 down. Those of us who have been responsible for the re-opening of this mine from surface to its present depth of 5,826 ft. have had the opportunity of realizing the steady rise in temperature as the depth has increased and have been frequently reminded of the difficulties in store for the company, especially at such times when an inadequate volume of ventilating air had been passing over the stopes or through explorations, caused by the partial closing of air-ways, the failure of fans, or by the explorations progressing more rapidly into depth than the main ventilating system. However, for many years it was possible to keep down to a reasonable figure the temperature to which the miners were subjected, and it appeared that by increasing the volume this condition could be maintained.

Past and present methods of ventilating.—In the first place natural ventilation was sufficient, later, furnaces had to be adopted during the hot season to assist the natural ventilation. As the mine became still deeper a Capel fan was installed at the top of the upcast "C" shaft to ensure a more constant volume of air. Finally, a Sirocco fan of larger capacity was installed in place of the former, the output of which could be increased by additional power, when required. Besides this, auxiliary fans are used on all explorations beyond the main system.

The existing ventilating system, which is referred to above as not satisfactory at the present depth, was forced upon us at a time when a more elaborate one of an entire independent air-way from surface down, which naturally recommended itself, would have been too expensive. The former represented the cheapest means of ventilation, and until quite recently met the case satisfactorily, as long as the system and supply of air was not interfered with by the above-mentioned causes. However, as depth has been attained the necessity for modification in the distribution of the air becomes imperative if the mine is to be worked to a much greater depth, of which there is every probability, seeing that the lode has so far shown so signs of failure in size or value in the lowest explorations made upon it, and as also there is apparently no geological reason against its continuance in depth; and the prospects of this company being able to work it profitably to a great depth seem only to be limited

by the measurable additions in cost of winding, hauling, handling, mineral and other engineering matters. All these increase a little more or less proportionally to the depth, with one exception, viz.: that of **increasing heat in depth, which has presented itself to our minds as by far the most important obstacle, that is to say, if it cannot be overcome by some satisfactory artificial means of cooling.**

It was in consequence decided some years back to institute investigations with the object of obtaining information as to the increasing air and rock temperatures and other factors that go to make against the miners' efficiency, and add to cost the deeper the mine is sunk. As regards the rock temperature, bore holes were made at the different horizons, or vertical depths, and the temperatures taken. For a considerable time, due to the holes being too shallow, or badly situated, and to our want of experience in the matter and somewhat unreliable instruments, our readings were only very approximate. Gradually, however, the conditions for performing this work were improved and our preliminary investigations from year to year went to show that **in spite of the increasing heat found at the moment of opening the rock the deeper we went, it gradually became cooler after it had been in contact with a current of ventilating air.** From the temperature readings we obtained of the rock at the moment of opening different horizons, we were able to construct a rock temperature grade as a guide to what we might expect in depth. Since then, other horizons in depth have been opened and our grade, as will be seen in the chart, agrees closely with the readings taken, with the exception of that at horizon 20, which is lower than it should be owing to the exceptional volume of ventilating air forced to that point by the auxiliary fans cooling down the rock before its real temperature could be taken.

As before stated, **without this rise in temperature from the rock and other causes, the probable running engineering expenses in working the mine down would not mean a very serious increase, and this has proved itself in practice as far as we have gone.** Supposing the lode continues the same in size and value to horizon 26 (a vertical depth of 7,626 ft.), it could be worked profitably to that point and even to a much greater depth, but from the grade on our temperature chart, the rock at horizon 26 would be no less than 126.5° Fahr. at the moment of opening, and supposing that the mine atmosphere derived from an abundance of air from surface were maintained, the very best result we might expect as regards temperature would be that represented by the black dotted line K on the chart, which we considered in the past showed probably the lowest limit of mean air temperature that could be attained after the workings were connected with the main ventilating system, as experience proved in the upper sections of the mine that that atmosphere had gradually cooled down a little more or less to that line. We have, however, of late realized from practice that the best we can now expect in the absence of artificial cooling would be as represented by the black line, which means that we are nearing a point where the efficiency of the men would be affected.

It will be seen from the chart that the rock that had been laid open and exposed to the ventilation for some time year by year fell to some extent, but it will be apparent that the deeper we went, the cooling effect of the ventilating air would become less efficient, as we were year by year largely increasing the rock area; but beyond certain reasonable limits we could