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CHEMICAL INTERFERENCE WITH THE MAIN AIR —CURRENT—

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In ventilating a mine, we have to take into consideration all substances which require oxidation, such as human beings, or rather the human blood; the horses; the flames of lamps; the dilution of gases; the flame of the furnace, (if any), and the gunpowder smoke. These items are the causes which draw upon the ventilating current chemically.

The first and most important is the pressure of fire damp, or Carburetted Hydrogen, Methyl hydride, or Marsh gas. Its chemical composition is as follows:

1 atom of carbon to 4 of hydrogen $C H_4$ is therefore its chemical symbol. Then twice the amount of Oxygen renders it violently explosive, and an explosion of fire damp is thus represented chemically:—

2 vols. + 4 vols. = 2 vols. + 4 vols.

$C H_4$ $2D_2$ $C O_2$ $20 H_2$

The four volumes of oxygen which 20 volumes of atmosphere air contain, produce 2 volumes of carbonic acid and 4 volumes of steam; on the condensation of the steam, 16 volumes of nitrogen remains mixed with carbonic acid. This product is the afterdamp. Here we have, then, a gas which possesses a great affinity for oxygen, and which, therefore, will weaken the effect of the main air current by absorbing a portion of its oxygen. In what proportion it will be absorbed, vol. for vol. is, if two bodies combine with a third body, they are multiples of the proportions in which they may combine with each other. To ascertain how much air will be polutted by the coal gas is the first question. This is calculated as follows:—The quantity of gas discharged into the air ways of a colliery will always bear a direct relation (1) to the area of the surface of the coal, roof, sides, bottoms, etc., exposed to the action of the ventilating current; (2) to the cubic contents wrought. Each piece of coal wrought discharges through its faces a small amount of gas. We must think of a small lump of coal as if it were a madel coal mine. To estimate the amount of air necessary to dilute the coal gas:—1 cubic inch of coal is capable of yeilding under an air pump, a volume of gas equal to its own bulk, therefore 1 cubic foot of coal will yield 1 cubic foot of gas. It will be seen by examining the nature of fire damp, that unless the gas is diluted—with more than 15 times its volume of air, it will be explosive, therefore, the amount of air required to dilute the gas yielded by one cubic ft. of coal = 15 x 1 that is the entire contents of the coal x by 15, but it is advisable to increase this number to 100 to provide for contingencies, such as blowers, etc., then 100 c. f. will be required for each c. f. of coal wrought, next we have the withdrawal of oxygen from the atmosphere by combustion and respiration. Then, if we have a furnace at the foot of the upcast shaft, then, since in oxidation, 1 atom of carbon unites with 2 atoms of oxygen following the laws of affinity in chemistry, we find that the atomic weight, or combining proportion is carbon 12, oxygen 16. The 0 will be represented by 32, since there are 2 atoms of this gas, the carbon by 12. Then $32 \div 12$ will give us the amount of 0 required to oxidise a piece of carbon. Now let us suppose that one lb. of coal is burnt in the furnaces per second. Then $32 \div 12$ = oxygen in lbs per second = $2\frac{2}{3}$ lbs. Therefore, 1 lb of Hydrogen will require 8 lbs of 0 by the same rule, for

1 being the atomic of H / 16 " " " 0 } = H_2 0^2 or $16 \div 2 =$ 8 lbs. The composition of air inhaled and exhaled is given as follows:—before entering the lungs:—N, 79.00, 0, 21 00. Then when exhaled N, 79.00 0, 17.05, C O2 305 $3\frac{1}{2}$ units of 0 are, therefore, extracted from the air by the action of the lungs, and applied to oxidise the carbon in the blood cells. Then 1 cubic ft. of air breathed will be vitiated by $3\frac{1}{2}$ per cent of carbonic gas, therefore each person will discharge from his lungs into the mine $.035 \times 60 = 2.10$ cubic ft. per hour. Some medical authorities state that an average exhalation of air is represented by one cubic foot per minute when the person is awake. A horse breaths 6.3 times the volume per minute of a man $\therefore .035 \times 60 \times 6.3 = 13.23$ c. f. of CO2 per horse per hour. We have now got to consider the effect of the lamp and gunpowder. We shall then be in a fair position to estimate the total chemical vitiation of the air of the mine for a given time. A candle or lamp produces about 2.51 c. f. of C O2 per hour by experiment, this is shown by the fact that if a candle is burned in a close vessel containing 0 c. f of air .2 of the volume of air is deprived of the 0. The proportion of 0 in the air is 21%, therefore $.2 \times 21 \times 60 = 2.52$ c. f. vitiated per hour per light, then x the number of lamps used by 2.52 for total vitiation. Gunpowder is our next item and is a more important one since the presence of nitrous fumes proves so detrimental to health, and the eye sight of men and horses in the mine. Mr. Andre e timates the effect of ordinary powder to be as follows:—1 lb. of powder produces .3 U C O2. 1 c. f. of C O2 weight .1164, then .3000