A PRACTICAL TREATISE ON FRICTION OF AIR IN MINES

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A Practical Treatise on Friction of Air in Mines by J. J. Atkinson

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J. J. ATKINSON

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A PRACTICAL TREATISE

ON

Friction of Air in Mines.

BY THE LATE

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1875.

PREFACE.

This essay by the late J. J. Atkinson, was prepared for the Manchester Geological Society. The recognized value of the paper led to its publication in England in such form as to satisfy the wide demand for so thoroughly practical a treatise.

It was first republished in this country in Van Nostrand's Magazine, and by reason of a demand for this special subject, it was considered advisable to give it the compact form of the Science series.

We would call attention of the reader to another work by the same author, also published in this series, on "The Gases Met with in Coal Mines."

Friction of Air in Mines.

The amount of friction is reckoned as estimated by the amount of the pressure or force required to overcome it.

NUMEROUS experiments have been made to find out the laws that govern the friction of air and gases, both in pipes having a uniform section, and, to a less extent, in the irregular air-ways of mines. By these experiments, the following laws have been found to hold good in practice:

The pressure required to overcome the friction of air increases and decreases in exactly the same proportion that the area or extent of the rubbing surface exposed to the air increases or decreases; so that when the velocity of the air, and the sectional area of the air-way, remain the same, the pressure required to overcome the friction is proportional to the area or extent of the rubbing surface exposed to

it; and hence, if we double or treble the extent of the rubbing surface, we also double or treble the friction, or, what is the same, the force or pressure required to overcome it. The rubbing surface, of course, depends upon the circumference or perimeter of the air-way, and upon its length. The rubbing surface is found by multiplying the perimeter by the length of the air-way, where it has a uniform section. A circular pipe or air-way offers less rubbing surface, for the same length, than any other form or shape of air-way of equal sectional area; because the circumference of a circle is less, in proportion to its area, than the perimeter or any other figure is to its area. A circle whose area is 1 has a circumference of 3.545, or rather more than $3\frac{1}{2}$; the perimeter of a square is 4, when its area is 1; so that about 7 yards of square pipe would offer the same resistance as 8 yards of round pipe, having an equal size or area of section, when the same quantity of air passes through them in a given time.

It is true that the friction of air or gas,

in passing through the same pipe or air-way, varies in just the same degree that the density of the air or gas may vary; but in air-ways in coal mines the air has always nearly one and the same density, and it is only in particular calculations that it becomes requisite to notice its changes of density, in reference at least to this part of the general subject, since they are so small in amount. This is the case as regards friction, but the effects of variations in the density of the air circulating in mines are more sensible in producing pressure, operating either in favor of or against the ventilating pressure, in rise or dip workings; but these effects belong more especially to another part of the subject. In an air-way 5 feet square, the perimeter of a section is $4 \times 5 = 20$ feet; and if it is 1,000 long, the rubbing surface is $20 \times 1{,}000 = 20{,}000$ square feet. In an air-way 10 feet square, the perimeter of the section is $4 \times 10 = 40$ feet; and if it was 1,000 long, the rubbing surface would be $40 \times 1{,}000 = 40{,}000$ feet; so that, on comparing the two