

air-ways, and considerable additional power would have been absorbed thereby in the case of the small air-ways, and a just comparison of the respective merits of the two systems rendered, if not impossible, at least it is quite more difficult and complicated. By having the sectional areas equal, the velocities are equal, and the powers absorbed in each case due to that source are also equal; we have, therefore, to consider only the total rubbing surface in each case to determine the respective merits of the two systems, and this, it seems to me, is the only fair ground for comparison.

We will assume also that both the ten small air-ways and the two large air-ways are of equal length, as to make either the one or the other the longer would again be to incur the stigma of unfairness.

The total sectional area of rubbing surface is the only fair ground on which to base a comparison. Well, let us now ascertain the total sectional area of rubbing surface in each case.

The rubbing surface in the ten small air-ways total—  
and the rubbing surface in the two large air-ways equals—

Now, the ventilating pressure necessary to produce ventilation varies directly as the rubbing surface, so that if 10 lb. of ventilating pressure per square foot were necessary in the case of the two large air-ways, no less than 23.08 pounds per square foot would be required in the case of the ten small air-ways.

This is got thus—

$$10 \times 120$$

52 equals 23.08 lbs. nearly.

Further, for the same quantity of air per minute, 2.3 times the power required in the case of the two large air-ways would be necessary in the case of the ten small air-ways.

This simply means, in practical form, that if, say, one ton of coal was sufficient to provide steam to drive the fan engine at the colliery, with two large main air-ways for 24 hours, it would take at least two tons six cwt. of the same class of coal to do the same work in the same time at the colliery having the ten small air-ways.

Again, methinks that two large main air-ways could be more easily and more cheaply kept in good condition and could be more profitably utilised (such as for haulage purposes etc.) than could the ten small air-ways, which would probably be of little use except as air-ways.

No, personally, I would certainly prefer a small number of large air-ways to a great number of small ones.

#### GEOLOGY.

Q. 11.—Describe the chief characteristics of the carboniferous strata, and of the strata overlying and underlying them in ordinary sequence.

A.—The carboniferous formation consists largely of three kinds of rock, namely, carboniferous, or mountain limestone, shale and coal. It derives its name from the Latin word *Carbo*, which forms one of its most conspicuous features. The mountain limestone which forms the lower part of the carboniferous formation stretches from the West of Ireland eastwards for a distance of 750 miles, across England, Wales, Belgium, into Westphalia. It attains its maximum thickness in Lancashire, where it exceeds 6,000 feet. But as the limestone is traced northwards, it is found to diminish in thickness, until in Scotland it is reduced to a few beds, each only a yard or two in thickness. From this change in the character of the rocks, the inference is drawn that the land lying to the north supplied sand, mud, and drifted plants which prevented the thick limestone from extending northwards. There can be no doubt that while this mass of limestone was being built up, the wide area of deposition in Western and Central Europe was undergoing a gradual depression. This conclusion is borne out by a few considerations. The organic contents of the lower and upper parts of the limestone are uniform throughout. The sedimentary strata that replace the limestone on the northern margin are also several thousand feet thick, and from top to bottom they abound with evidence of shallow water conditions of deposition. The frequent occurrence of ripple-marked and sun-cracked surfaces, the preservation of remains of terrestrial vegetation—some of it in its position of growth—proves that the mass of sediment was laid down in shallow water not far from the margin of the land. But probably the most interesting evidence of long-continued subsidence is furnished by the history of the coal seams. In the successive strata of a coal-field we are presented with the records of a prolonged period of subsidence, probably marked by longer or shorter intervals of rest. These more stationary periods are indicated by the coal seams, and their relative duration may be inferred from the thickness of the coal. The carboniferous flora must have been abundant, consisting almost entirely of flowerless plants, and the same species and genera ranged over the whole world, for their remains are found in carboniferous strata from the Equator to the Arctic Circle. Ferns, lycopods, and equisetacea, constituted the main mass of vegetation. The most abundant kinds of fern being *Sphenopteris*, *Neuropteris*, *Pecopteris*. Among the lycopods, the most common is *Lepidodendron*. Equisetaceae abound in the carboniferous swamps, the most frequent being *Calamites*, *Sigillaria*, from the seal-like impressions of the scars, and *Stigmaria* (roots).

The carboniferous system in Europe presents at least two well-marked sub-divisions. In the lower section the strata are largely marine,

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