triangular, and receive a rotary motion, combined with or apart from a forward and backward movement at pleasure, and can be placed at any desired angle to the audience. At every change of the scene they revolve through 120° or $\frac{1}{3}^{\text{rd}}$ of a circle, and the scenes when removed from sight are replaced by those which are to succeed them.

The traversing frames revolve on a centre, and are suspended from the border frames, or from the upper part of the theatre, for crossing the stage in any direction, and at any given inclination.

Several improvements in the mode of lighting the stage and house have been introduced with the machinery; they are more fully referred to in the detailed description which accompanies the ten elaborate drawings sent with this communication.

“On the Combustion of Anthracite, and its value as a Fuel for Steam Engine and other Furnaces.” By Andrew Fyfe, M.D.

Combustion of : n-
thracite.

Anthracite, although known as a valuable fuel for particular purposes, is so difficult of combustion, that it has hitherto been very partially brought into use; it has, however, become desirable to introduce it more generally, and the author having been engaged in testing the value of Mr. Bell's patent furnace, was induced to make some experiments on the use of anthracite in conjunction with that system.

Bell's
patent
furnace.

The objects sought to be obtained by the apparatus are, to insure a larger amount of evaporation, by passing heated air, unmixed with the products of combustion, through tubes in the boiler and surrounded by the water, thus increasing the evaporating surface; and that the surplus caloric taken originally from the fuel, and not given out in its passage through the water, should be beneficially used in aiding the combustion beneath the boiler.

Heated air

It has been found in the manufacture of iron that anthracite could be advantageously used by means of heated air; the author therefore considered that the experiments upon this apparatus (the intrinsic merits of which he does not at all discuss in this communication), afforded an advantageous opportunity for ascertaining in what manner this fuel could be successfully employed under steam boilers.

Conditions
of the ex-
periments.

The anthracite supplied to the author was unfortunately of inferior quality, analysis giving only of fixed carbon 71.4, and of volatile inflammable matter 13.3; the setting of the boiler required much alteration before sufficient draught could be procured. The

fuel was thrown on to the bars by hand, which is the worst manner of using it, as from its density, and its being a bad conductor of heat, it decrepitates when it first inflames, unless it is previously warmed—this was found to occur for a short time, but on the application of the heated air the decrepitation ceased, and combustion went on steadily.

In ascertaining the amount of evaporation, the water at a temperature of 45° was injected by hand from a vessel, the content of which was measured, and the level in the boiler regulated by the float and index.

The fire was brought up to a certain intensity before commencing, and was left in the same state at the end of the experiment; this mode of proceeding, although objectionable with bituminous coal, is not so with anthracite, as it does not swell during combustion so as to alter the bulk of the fire.

The results of an experiment extending over $8\frac{1}{2}$ hours without interruption, are then shown in a tabular form. In this trial, 448 lbs. of anthracite were thrown on the fire in four equal portions, at intervals of two hours; 3560 lbs. of water at 45° were pumped into the boiler and evaporated under a pressure of 17 lbs. per square inch. Results of the experiment.

After deducting $40\frac{1}{2}$ lbs. of unconsumed coal which fell through the bars, the amount of evaporation was found to be 8.73 lbs. of water for each pound of coal consumed. If the feed water had been at a temperature of 212° the evaporation would have amounted to 10.03 lbs. Evaporation.

During this trial the air in the tubes of the boiler never exceeded 430° , but on subsequent occasions it was raised as high as 700° .

This product of evaporation is below that obtained by other persons, which the author attributes to the inferior quality of the specimens of anthracite, and the admission of cold air above the furnace bars when throwing on the fuel.

His opinion is, that when anthracite is completely burned, the practical evaporative power will be found directly in proportion to the amount of fixed carbon contained by it—that with the exception of the loss of heat which is always transmitted to the brick-work of the furnace, and of that which is carried up the chimney to keep up the draught, the whole of that evolved by the fixed carbon will be retained by the water; because from good fuel there is little or no escape of gaseous matter, and hence the superior efficacy of anthracite. Efficiency of the fuel.

From the analysis of a number of specimens of anthracite, the author found the quantity of fixed carbon to amount to 90 per cent. Analysis.

The evaporative power of these fuels, as fixed by Berthier's process (la voie sèche), would amount to 12·3 lbs. of water for each pound of coal consumed.

Evaporative power of the fuel.

He calculates that 6 lbs. of anthracite will evaporate 1 cubic foot of water under the ordinary circumstances of a steam engine boiler, and taking the average specific gravity of bituminous fuel at 1280, while that of anthracite is 1410, there is a difference of nearly 10 per cent. in favour of the latter, considering the space in which it can be stowed.

Rate of combustion.

This is an important consideration for its use on board steam vessels, but it is essential that its rate of combustion should be such as to raise steam rapidly, its capabilities for which the author then proceeds to examine, and deduces from the experiments that the combustion of the anthracite was carried on so as to produce a greater amount of evaporation, in a given time, than could be obtained from bituminous coal. This result is attributed in some degree to the use of heated air.

The author recommends that the anthracite should be supplied to the furnace by a hopper through the boiler,* wherein it is warmed before reaching the fire bars, which obviates the inconvenience of decrepitation, and insures regularity in the supply of steam.

Mr. Lowe. Mr. Lowe saw no reason to doubt the results recorded by so accurate an experimenter as Dr. Fyfe, which proved that anthracite was efficient just in the proportion of the carbon it contained, but he was at a loss to reconcile this with the opinion of Mr. C. W. Williams, who recommended the addition of bituminous substances to pure carbon, as a means of increasing the calorific power of fuel. He must repeat the opinion expressed by him on a former occasion, that the coal most free from elementary oxygen, would in practice be found the most effective fuel. Neither could any fuel be used too dry or too hot. At the gas works under his charge, a considerable economy had been effected by Mr. Croll's patent process of using the coke as it was drawn from the retorts, and thrown in an incandescent state into the furnaces.

* *Player's Patent.*