

Between that date and the year 1860 various other inventions were patented for obtaining motive power by the explosion of various mixtures, gaseous and solid; but all the descriptions appeared to be somewhat obscure as to the nature of the explosive compounds to be used, and the means for obtaining them. Carburetted hydrogen, a constituent of coal gas, was mentioned by some; but it appeared that the idea of using coal gas, as manufactured for lighting purposes, for working engines, was first practically applied in the Lenoir gas engine, patented in 1860, and first introduced into this country at the Exhibition of 1862, where it attracted much attention. The general principles of the Lenoir engine were described, and it was pointed out that, among other defects of this engine, was the damage done to the working parts by the sudden and violent nature of the explosions, and also the necessity of the use of electricity for the explosion of the charges of gas and air with which it was worked. The latter objection had, however, now been overcome in more modern engines by the employment of gas jets for the same purpose. The author described the Otto and Langen gas engine, the chief improvement in which is, however, due to the compression before ignition of the charges of mixed gas and air, by means of which it is found that a much larger proportion of air can be employed than would form an explosive mixture at ordinary atmospheric pressures, and the force thus obtained is gradual and continuous, instead of sudden, resulting in an economy of gas and more regular working. Advantage has been taken of this discovery in several of the more recently designed gas engines. The general principles of the Otto were described, and its consumption of gas stated to be at the rate of about 21 cubic feet per horse-power per hour, as compared with from 40 to 70 cubic feet with engines of previous make. On account of the heat generated by the explosions in gas engines, it was found necessary to surround the cylinders with water, and that advantage had been taken of this in a gas engine called the Eclipse, in which the water, instead of being allowed to escape when heated, was stored in a separate chamber, where it generated steam, which was used together with the gas, to assist in working the engine. Attention was also drawn to the Bisschop gas engine, which is meritorious chiefly on account of the small sizes in which it is made, and which range from one half man or one-eighth horse-power upwards. This engine, although not comparatively economical in its consumption of gas, was recommended on account of its simplicity and small size, as available for purposes to which it would otherwise be impossible to apply mechanical power. As regards comparisons which have been made between the cost of working steam and gas engines, the author observed that the practice had generally been to take the total cost of working in each case, including labour, and that, when this was done, the comparisons were invariably in favour of gas engines; but he pointed out that such estimates were liable to be misleading. As a gas engine requires little or no attention, the results of the comparisons depend mainly upon the amount estimated for labour for the steam engine with which the comparison is made. With a small steam engine it would in most cases be unfair to estimate the whole time of one attendant, while, as the size increased, the proportionate cost of attendance would diminish. Instances were given where estimates had been made showing steam engines to be from twice to seven times more expensive in working than gas engines; but although such estimates had doubtless been made with every care, they only served to show that it was impossible to frame such comparisons so as to be generally true. By comparing the costs of the gaseous and solid fuels it was shown that gas must necessarily, both theoretically and practically, be more expensive than solid fuel. When, however, the labour, wear and tear, and first cost were also considered, the conclusion arrived at by the author was, that for engines of small sizes, gas would always be the most economical. Even with larger engines, if the same economy could not always be maintained, circumstances would in many cases render gas engines the most advantageous and convenient, particularly when only the intermittent use of an engine was required.

THE MEKARSKI AIR ENGINE.

For about three months during the autumn of last year the traffic of the Wantage tramway was conducted temporarily by means of locomotives driven by compressed air, on the Mekarski principle. One of these engines is now in London. These locomotives weigh about $7\frac{1}{2}$ tons each, and consist of cylindrical steel air reservoirs, a special regulating apparatus, and ordinary cylinders and driving gear. The locomotives are supplied before starting on a journey with air at a pressure of 450 lb. per square inch, the air being compressed by means of a stationary engine and plant.

On starting the engines the air passes through a reservoir of hot water and steam to the regulator and thence to the working cylinders. The hot water raises the temperature of the air, and thus increases its volume, and economizes the store, while it has the further important effect of preventing the formation of ice in the exhaust passages of the cylinders, which would otherwise take place as the spent air escaped. The moisture with which the air becomes charged, moreover, assists the lubrication of the working parts of the engine. By means of the regulator the pressure of the air when passing to the cylinders can be reduced to any desired extent. In practice the working pressure is constantly maintained at 90 lb. per square inch. The exhaust air escapes quietly from the cylinders, thus rendering the locomotive noiseless in this respect, while there is, of course, a total absence of smoke or other products of combustion. Ample brake power is provided, and the general mechanical arrangements are such as to place the engine well under the control of the driver. The system is carried out in two different ways; in one the engine is separated from the tramcar, while in the other the engine and car are combined. The principle, however, is the same in both, and is one which commends itself to notice for tramway work. The system has been employed for nearly two years past with every success on the Nantes Tramways, which are about four miles in length, and it is now being introduced into England, the offices of the company being at 3, Westminster Chambers, Victoria Street, London.

BUILDING IN JAPAN.

It is now pretty well known that the ancient empire of Japan has recently divested herself of her old social and political vestments, and commenced to array herself in those of a more modern type. She has, in fact, decided to institute and organize Western technical processes and industries throughout the various islands which make up the empire, and to invite experts to assist in the work from Europe and America. There is certainly a vast field thus opening up for the operations of those who choose to venture so far in quest of active employment, and who can carry with them talent, energy and enterprise. This holds good of representatives of every art, science, and manufacture at present in existence in Great Britain, and of architects and builders in particular. The general construction of houses in Japan has hitherto been of so primitive a character as to resemble very much that style which prevailed at home some hundreds of years ago. Purely Japanese buildings are generally, and almost without exception indeed, built of wood. Even the chequered tile and plaster constructions with which artists have made us familiar are formed of timber as a base; and this, therefore, serves as a support merely to the ornamental tiles. The utterly unscientific disposition of materials observable in almost all native structures, and the total absence of braced and trussed framing, prove that their builders were utterly ignorant of the first principles necessary to ensure the maximum of strength with the minimum of material. They have also ignored the use of diagonal members in their framing, and preferred the rectangular to the triangular division into bays. Some have, it is true, attributed this latter peculiarity to considerations respecting the contingency of earthquakes; but it need hardly be mentioned to our readers that the rectangular is far inferior to the triangular division for ensuring rigidity and solidity.

The truth is, in respect of all Japanese edifices as they stand at present, that their designers were innocent of any knowledge of the scientific rules which should govern design and construction, and hence, like some of our own earlier mechanical engineers, they placed too much material in the wrong form.

Then, again, the almost universal employment of wood in the construction of buildings is a mistake, and one which would not long exist if British counsels prevailed in Japan. It is unnecessary to say that the most important conditions influencing the durability of wood in such cases is, its position in regard to atmospheric surroundings. If, for example, it is subjected to alternate moisture and dryness it will soon fall into decay, and no climate is more fickle in respect to rain and sunshine than that of Japan. The Japanese strangely enough appear to have paid no attention to processes intended for the preservation of timber, such as injecting into its pores antiseptic salts. Red stucco, or plaster is the only preservation employed, and as this is sometimes spread over wood perfectly unseasoned, and perhaps full of sap, the consequences may readily be imagined.

In brief, architecture and building in Japan are not only in their infancy, but scarcely out of their swaddling clothes, and yet the country is rich in every variety of material for adaptation and development in those decorations.