

THE LOUISVILLE WATER WORKS.

The large pumping engines of the city water works of Louisville, Ky., are on the Cornish plan. They are exactly alike, each working a single-acting lift and force plunger pump. The dimensions of the principal parts of the engines and pumps are as follows, namely: Steam cylinder, *a*, 70 inches diameter, stroke of steam piston 10 feet. The beam, *b*, for each engine is double; the two members, 3 feet 5 inches apart from center to center, are each 31 feet 10 inches long between end centers, 6 feet 9 inches deep in the middle, with 3 inch thickness of web, and 9 inches width of center rib and outside flanges; the cylinder and pump ends of the beam are equal in length; each pair of beams weighs 42 tons. The beam vibrates on a main center or shaft, *c*, 20 inches diameter, 9 feet 8 inches long, with journals 15 inches diameter, and 19½ inches bearing. The plunger blocks, for the beam center of both engines, rest in pedestals bolted to a massive cast iron entablature, which (extending transversely across the house and into the brick walls) is supported by four Tuscan columns, *d*, of cast iron, standing on and anchored to the beam wall, by means of arched cast iron bedplates, built in the masonry. The piston rods are guided by parallel motions, and the pump connecting rods by cross-heads and slides; piston rods, *e*, 6¼ inches diameter and 16 feet long each; pump connecting rods, *f*, 8 inches diameter and 28 feet long each.

The pump barrels are 36 inches in diameter each, plungers 36 inches diameter, with stroke same as steam piston, 10 feet. The extreme lift of the pumps, when the river is at its lowest stage, is 21 feet 10 inches. The pumps are connected with the standpipe by two lines of 40 inch, flanged pipes, provided each with a stop gate near the standpipe. The pump valves, *h h*, are of the kind known as Harvey and West's double belt valve. The pumps and pump mains to the standpipe have a circular water way of 40 inches diameter throughout, thus admitting the introduction of pump barrels 40 inches in diameter, and increasing the present pump capacity 23 per cent whenever the consumption of water will demand a greater supply than at present provided for.

The metal (cast iron) of the pumps and pump mains is from 2 to 3 inches in thickness, varying as the forms vary from the cylindrical to the oval or rectangular. All the joints are made with lead by means of flanges and bolts; the flanges are from 2½ to 3 inches thick, and from 4 to 6 inches wide, with 1¼ inch bolts.

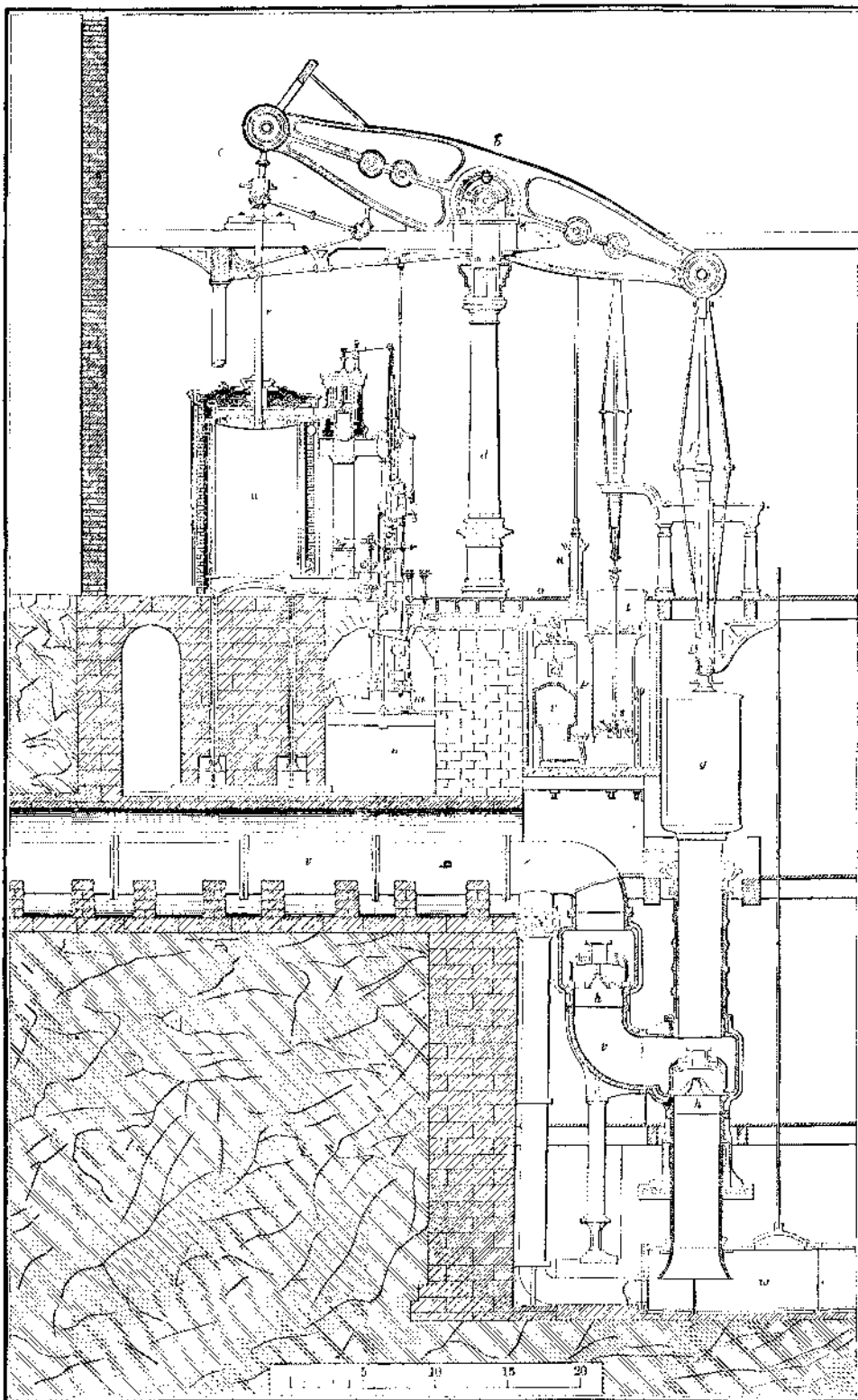
Each engine is provided with a battery of three single flue Cornish boilers. The performance of the engines has been very satisfactory. The highest daily duty (calculated by the Cornish method) was 48,363,344 lbs. of water raised 1 foot high per 100 lbs. coal; the highest monthly average was 35,957,629 lbs., and the yearly average duty 30,217,865 lbs. Cost of the engines and connections complete, \$117,753.64.

The cataract, *m*, is in the vault, *n*; the condenser and air pump are in the well below the main floor, *o*, of the engine house, *p* is the cistern, *r* condenser, *s* bucket of air pump, *t* hot well. *w* is the induction waterpipe at the foot of the pump stock, *v* the eduction main, *u* the feed pump.

Constructive Use of Wood.

The main stay of constructive woodwork is the mortise and tenon. A piece of woodwork which can be put together without glue, nails, or screws, and serves its purpose, is an ideal work of construction; but this is not always possible. Another principle of construction is that every piece of wood should be so placed that it can swell or shrink without injuring itself, or displacing any other piece. This is maintained in an ordinary panelled door, provided no mouldings are inserted. Still another principle is that mitre-joints should be avoided, whether for moulded work or not, for the reason that shrinkage causes all mitres to open. No piece of wood should be used unless the straight grain of the wood can be seen through its full length in one place. Inserted mouldings should be avoided as far as possible; and all mouldings for panel-work should be worked on the styles and rails. It is a general principle, observed in the best mediæval joinery, that all mouldings on rails which are horizontal should butt against the styles; and that styles should

be either plain, or should have mouldings stopped before reaching the joints with the rails. In practice all rail mouldings may be worked the whole length of the stuff used; and, if muntins (which are the middle styles) are used, the mouldings may be cut away to the square wood before the mortise is cut which is to receive the tenon of the muntin. Thus the mouldings will butt against the square sides of the muntin. All the parts for a door thus made can now be got out by machinery, and the door will be fully constructive in every sense of the word. There is no obstacle to this in the way of cost. The dovetail is a constructive device; and the dowel is admissible in places as a substitute for the mortise and tenon. Tongue and grooving is a legitimate device, both for ends and sides of boards. Beveling the edges of the pieces thus joined is better than beading. The best way to construct large panels is to make them of narrow strips, tongue and grooved, and bevelled at the joining edges. Such panels will never "draw." The shrinkage will be divided



PUMPING-ENGINE, LOUISVILLE WATER-WORKS.
(Theodore R. Scowden, Engineer.)

between all the joints. Solid table-tops should never be fastened with glue or screws, but should be secured with buttons fastened to the under side of the top, which travel in grooves cut in the framework to allow for expansion and shrinkage. These are but few of the principles to be observed in doing the best woodwork.

In all kinds of lumber, the heart should be rejected. All boards cut on a radius from the center to the periphery of a tree will remain true, while all others have a tendency to warp or check. The first are called "quarter-sawn." It is a peculiarity of oak that the best grain is found in quarter-sawn boards. It is only in these that the "silver-grain" is seen. This consists of a ribbon of very hard substance which grows out from the center of the tree. It is for this reason that oak is the most enduring wood: it has a grain two ways. All woods check in the direction of a radius from the center. Quarter-sawn oak cannot check.—*Andrews' Guide to Church-Furnishing.*

To MAKE a good varnish for gun barrels, take shellac 1 1-2 ozs., dragon's blood 3 drachms, rectified spirit 1 quart. Apply after the barrels are browned.

NEW YORK ACADEMY OF SCIENCES.

The regular monthly meeting of the chemical section of this society was held at their rooms, 64 Madison avenue, on December 11, Dr. J. S. Newberry, President, in the chair. Professor A. R. Leeds, of the Stevens Institute of Technology, read a paper entitled

A NEW TEST REACTION OF ZINC.

While testing before the blowpipe a new mineral from the Franklin zinc mines of New Jersey, Professor Leeds discovered that the reaction for zinc, when this metal is present in silicates in minute quantities, is much more easily obtained by the use of fused sodic chloride of sodium than with sodic carbonate. This is due to the greater volatility of zinc chloride over the oxide. The green color with cobalt was not readily obtained unless the assay itself were moistened with cobalt instead of the coating. It will be noticed that the number of blowpipe reagents is gradually increasing, and the tests are becoming more satisfactory and delicate.

NOTES ON THE ULTIMATE ANALYSIS OF CRUDE PETROLEUM

was the title of a paper by Professor S. F. Peckham, read by Professor Leeds, Chairman of the chemical section. The author stated his troubles in obtaining satisfactory results by combustion of crude petroleum with oxygen and oxide of copper, and how he overcame them. Instead of using the ordinary bulb for holding and weighing the liquid, he used a glass tube drawn out into capillary tubes at both ends, so that the liquid could be drawn up into it without being heated. The oil was placed in a platinum boat, and over it a brush of asbestos, which had been soaked in nitrate of copper and ignited, and thus covered with oxide of copper. Oxygen gas was employed in the combustion. Care is necessary to avoid violent explosions.

INDIUM IN AMERICAN BLENDES.

A paper on this subject, by Professor H. B. Cornwall, of Princeton, was also read by the Chairman of the section. The author has devoted much attention to the spectroscopic examination of American blendes for indium, and in several cases his labors have been crowned with success. In the *American Chemist* for January, 1873, he mentions several blendes then examined, in one of which, that from Roxbury, he found a considerable quantity of this new metal. In the present paper, he mentions several others in which traces of it have been detected, especially some from the far west.

Professor A. R. Leeds read a paper on the

CHEMICAL LITHOLOGY OF THE ADIRONDACKS,

and exhibited polished specimens of rock brought from the summit of Mount Marcy. The chemical study of the composition of rocks is a tedious and laborious one and Dr. Leeds and his assistants deserve great credit for their persevering labors, although the details are not such as to be of popular interest. Among other analyses reported was a quantitative one of basalt, in which eleven constituents were determined, including titanium.

The following papers were read by title: "Descriptions of New Noctuae, with remarks on the varia-

tions of larval forms in the group," by A. R. Grote, of Buffalo, and "An Index to the Literature of Titanium, from 1789 to 1876," by E. J. Hallock, of Columbia College.

The section on mineralogy met at the School of Mines, in 49th street, on December 18. Professor T. Egleston read a paper on the

SMELTING OF NATIVE COPPER

at Lake Superior. Dr. Bolton and Mr. Julian gave a sketch of a mineralogical tour in Western North Carolina, accompanied by the exhibition of a great number of specimens.

On December 29 ult., a terrible accident happened on the Lake Shore and Michigan Southern Railroad. The train fell through an iron bridge near Ashtabula, Ohio, the cars falling 75 feet. There were 175 persons on the train, of whom between 30 and 40 were killed outright. The wrecked train, as usual, caught fire, and the cars, etc., were totally destroyed.

FOR a cement for fixing metal letters to glass windows, take copal varnish 15, drying oil 5, turpentine 3, oil of turpentine 2, liquefied glue 5 parts. Melt in a water bath, and add dry slaked lime 10 parts.