work are so much cheaper than with us. The French founders are, however, very skilful, and some very remarkable works are to be met with in Paris, executed in cast-iron. The northern gate of the Madeleine, the fountains and lamp-posts of the Place de la Concorde, may be cited as illustrations.

1 (*b*). The best commercial wrought-iron is that from the province of Berri; but it is very unequal in quality, sometimes as tough as our best Welch iron, at others as short as the very commonest Staffordshire, owing to the bad manipulation in the factories. The very high price of iron, also, prevents so much attention being paid to the details of its production as is the case where its economy renders its use a matter of every-day necessity. Indeed, the state of the ironworks in France is a singular illustration of the evils of the protective system. The manufacturers have a monopoly; they fear no competition, and make a bad iron. The public pays dearly, and therefore uses as little iron as possible.

Since railways have been in fashion, however, the use of iron for roofs has become more general, and there are in Paris certainly some of the finest roofs in Europe. Amongst them may be cited the roofs over the Entrepôt réel des Marais, of the Halle aux Blés (in cast-iron), of the St. Germains and Rouen Railway, erected by M. Eugène Flachat.

The plate-iron box-girders are at present unknown; corrugated iron is but of very recent introduction, nor do the French architects appear to approve much of it.

Owing to the very high price of wrought-iron, the use of iron wire for suspension-bridges has been pushed to a very great extent throughout France. There are upon the Seine many very remarkable bridges executed with this material, such as the bridges at Triel, Gaillon, and Rouen. The iron wire is exposed to this inconvenience, that with all possible care in the fabrication of the chains, the separate threads cannot be drawn out to the full: the chains, therefore, always stretch, and the platform of the bridge necessarily sinks. Wire chains, however, bear a greater weight in proportion to their sectional area than square bars, and are more likely to be homogeneous in their strength. They avoid, moreover, the necessity for the coupling-links, which, on the latest suspension-bridges executed, augment the weight of the chain 31 per cent. beyond that absolutely necessary, supposing the chain to be of one piece. The surface of oxidation is greater for the wires than for the bar-iron chains, nearly in the proportion of 40 to 1, and this becomes one of the greatest practical objections, for not only does it necessitate frequent painting, but it diminishes, in time, the real strength of the wire cables. The practical strength of these is found, in fact, to be as 0·70 to 1·00 of the theoretical strength; after a few years it falls to 0·66. The voids in the wire cables, according to theory, should be to the solids as 0·1025 to 1·0000; in practice they are found to be 0·25 to 1·00. On the suspension-bridges, the Government engineers enforce a proof of 17 kilogs. per millimètre square of the sectional area of the iron-wire chains, to insure a surplus of strength as a guarantee against deterioration; on the bar-iron chains the proof is only 12 kilogs.

A very beautiful bridge was erected at Suresnes, by M. Flachat, of hoop-iron bands to form the main chains, which answered remarkably well. This application attained a sort of medium result, both as to cost and strength, between the systems hitherto employed.

There is a very beautiful adaptation of the use of the suspension principle to roofing purposes in the Panorama in the Champs Elysées, at Paris. The chains are of wrought-iron wire.*

2. *Lead*.—For building purposes, the bulk of the lead used is imported from England, Spain, and America. It is dearer than with us, consequently its use is not so general, zinc being generally substituted for it. The use and modes of fabrication, wherever it is employed, are precisely the same as in England.†

3. *Copper*.—France also draws the bulk of its copper from foreign countries, at very considerable expense; its use is therefore very much restrained in building. The only instance I know of its application on a large scale is at the Halle aux Blés, which was covered with copper in the year 1812, and I think at the Bourse.*

4. *Zinc*.—The high price of the two last-noticed metals has given rise to the use of zinc upon a very large scale throughout France. It is imported from Belgium and Germany in very large quantities, to the extent of 13,000 tons, worth 280,000*l*. Except upon the borders of the sea, it stands well in France; for the atmosphere does not contain (as in England, where so much coal is consumed) the carbonic acid gases which destroy zinc. On the contrary, in the interior, an oxidation of the external face of the zinc takes place, which prevents its decay. The roof of the palace on the Quai d'Orçay, the Northern, and some parts of the Rouen Railway Station, the Orleans Station, and a crowd of other buildings, are covered with zinc, to the perfect satisfaction of the architects.

The sizes of the metals usually employed for roofing are as follow:—Lead in sheets, 12 feet 3 inches long, by 6 feet 1½ inches wide; the thicknesses are either a full eighth, or a short 3-16th of an inch: the first weighs 89 [illegible] lbs. per yard square; the second weighs 118 [illegible] lbs. per yard square. The lap is generally made from 3 inches to 6 inches longitudinally.

The sheets of copper are made 3 feet 6½ inches long by 3 feet 3 inches; the thicknesses are 0·0021236 and 0·0024526 of a foot, the respective weights 13 [illegible] and 17·15 lbs. troy per yard superficial.

The sheets of zinc are made 6 feet 4 inches long by 3 feet 2½ inches, the thickness varying from a short [illegible] to a very full [illegible]; the weights are respectively 17·15 lbs.; 19·06 lbs.; 20·60 lbs. troy per yard superficial. The sheets of less thickness than these are rarely used in good buildings. Of late years, in the neighbourhood of Paris, zinc tiles have been much used; they are made from 14 inches to 16 inches long, by 12 inches to 14 inches wide; nailed at top, and fastened by hooks to the slates, which lie immediately beneath them.

The compound metals used are brass, bronze, and the galvanised iron. No difference exists in the mode of preparing these compounds from that observed in England. The bronze is, however, much more often employed than with us. For instance, the columns of the Place Vendome, and of the Bastille; the gates of the Madelaine and St. Vincent de Paul; the fountains of La Place Louvoise and the numerous statues which adorn all the quarters of Paris are in this metal.

Painting and Glazing.—The modes of house-painting employed in Paris are similar to those we employ, except that the oils are better, but the colours and white lead immeasurably worse. Indeed, there is not the same necessity for excellence in the painter's art, so far at least as mere flat tints and common graining are concerned, in a country where oak is so universally employed for joinery. For all objects of luxury, however, we are frightfully behind our neighbours. The decorations of Notre Dame de Lorette, the Madelaine, the former Chamber of Peers, the Louvre, and the Sainte Chapelle, cease to be mere decorations, to pass into the higher walks of art. St. Vincent de Paul, St. Germain l'Auxerois, offer illustrations of polychromic decoration, which contrast painfully with the attempts we see in London.

These two last-named churches may also be cited as specimens of the excellence our neighbours have attained in the art of painting on glass. For drawing and colouring, the windows of St. Vincent de Paul are superior to anything, either ancient or modern, it has ever been my fortune to examine.

The decorations, painting, and glazing of the cafés and shops might afford useful lessons to the architectural student. Great attention is shown to the distribution of the light, and the general tone of the colouring, so as to suit the goods exposed. Glass is cheaper than in England, and in consequence is more prodigally used. The window glass is, however, bad, both in colour and in its powers of resistance; it is thin, green, and wavy.

Although the above notice of the building materials employed in Paris, &c., has grown to a very great length, I have been forced to pass over some of the most important and interesting subjects the review suggests. The chemical process, called by the workmen salt-petring, and its action upon stones when laid bedwise, or against the bed; the manner in which stones are affected when exposed to the various strains; the composition of mortars and cements, and all the phenomena which attend their use in the air, or under water—salt or fresh; the qualities of woods and metals—have all glided before us; but from the limited time we can here devote to them, these subjects have not met with the attention they merit. Indeed, this remark holds good not only here but elsewhere. Very little is known, comparatively speaking, of the chemistry of our profession; what little we do know may principally be sought for amongst the French authors. Perhaps I may not have occupied your attention in vain, if my remarks should call attention to subjects so full of interest to us, but at present so involved in obscurity.

GEO. BURNELL.

BISHOPP'S DISC ENGINE.

PAYING a visit the other morning to the *Times* Printing-office, we saw the new *Disc Engine* that has been put up there to drive Applegarth's two rotary printing machines, by which the 36,000 copies, or thereabouts, matutinally required,* are whiffled off at the rate of about 5,000 complete copies per hour. In this engine, the advantages of which have been long known, the objections that alone kept it out of general use, appear to have been successfully overcome. It is a 16-horse power engine, on the high-pressure and condensing principle: it is, however, equally suitable to be worked as a simple low-pressure condensing engine.

It stands in the machine-room close to a wall, and occupies a singularly small space.† The shafting for driving the printing machines is carried by brackets fixed to the wall over the engine, and is driven by two bands: the drum on the engine-shaft is 30 inches diameter, and the two pulleys overhead 4 feet diameter.

Our impressions in favour of the engine were confirmed by inquiry. It seems that, before being erected at the *Times* office, it was tested, during a month, by Mr. Penn, of Greenwich, and Mr. Farey (both good authorities), in a corn-mill belonging to the former. The comparison was made with a beam-engine of the best construction; and, under similar circumstances, there was an important difference in favour of the disc engine, the engines driving alternately the same machinery, at an equal speed, from the same boiler.

Several disc engines have been fixed in various parts of the kingdom during the last eight years, but the arrangements lately patented by Mr. G. D. Bishopp have so much improved it, as to open to it a much larger sphere of action. This at the *Times* office was manufactured by Messrs. Joseph Whitworth and Co., of Manchester.

The peculiarity of the disc engine is, that it gives *direct motion* to a crank on the engine-shaft, and exerts a perfectly uniform force on it throughout the revolution. There are, therefore, no "dead points;" and when driving by gearing, without a fly-wheel, there is no back-lash in the wheels. Moreover, the steam can be cut off at a very early part of the stroke, without materially affecting the regularity of the driving force.

Other advantages besides the little space occupied are, that it can be fixed on the beams of a floor, or on a slight foundation, and that, although the speed of the piston (*i.e.*, of the disc rings) is only 200 feet per minute, the engine makes three times as many revolutions per minute as a common engine, and consequently, in most cases, much expensive gearing is dispensed with. It appears to us admirably

* France imported in 1845, 60,000 tons of cast and wrought iron, or steel.

† France imported in 1845, 23,000 tons of lead, of a prime cost value of 400,000*l*. sterling.

* France imported in 1845, 8,500 tons of copper, worth from 390,000*l*. to 400,000*l*. sterling.

* On the last day of Rush's trial, 44,500 copies were sold. On the day the Royal Exchange was opened by the Queen, 54,000 impressions were sold,—the largest number ever struck off.

† Seven feet long and four feet wide; and the highest part of the engine is only three feet above the floor of the room.