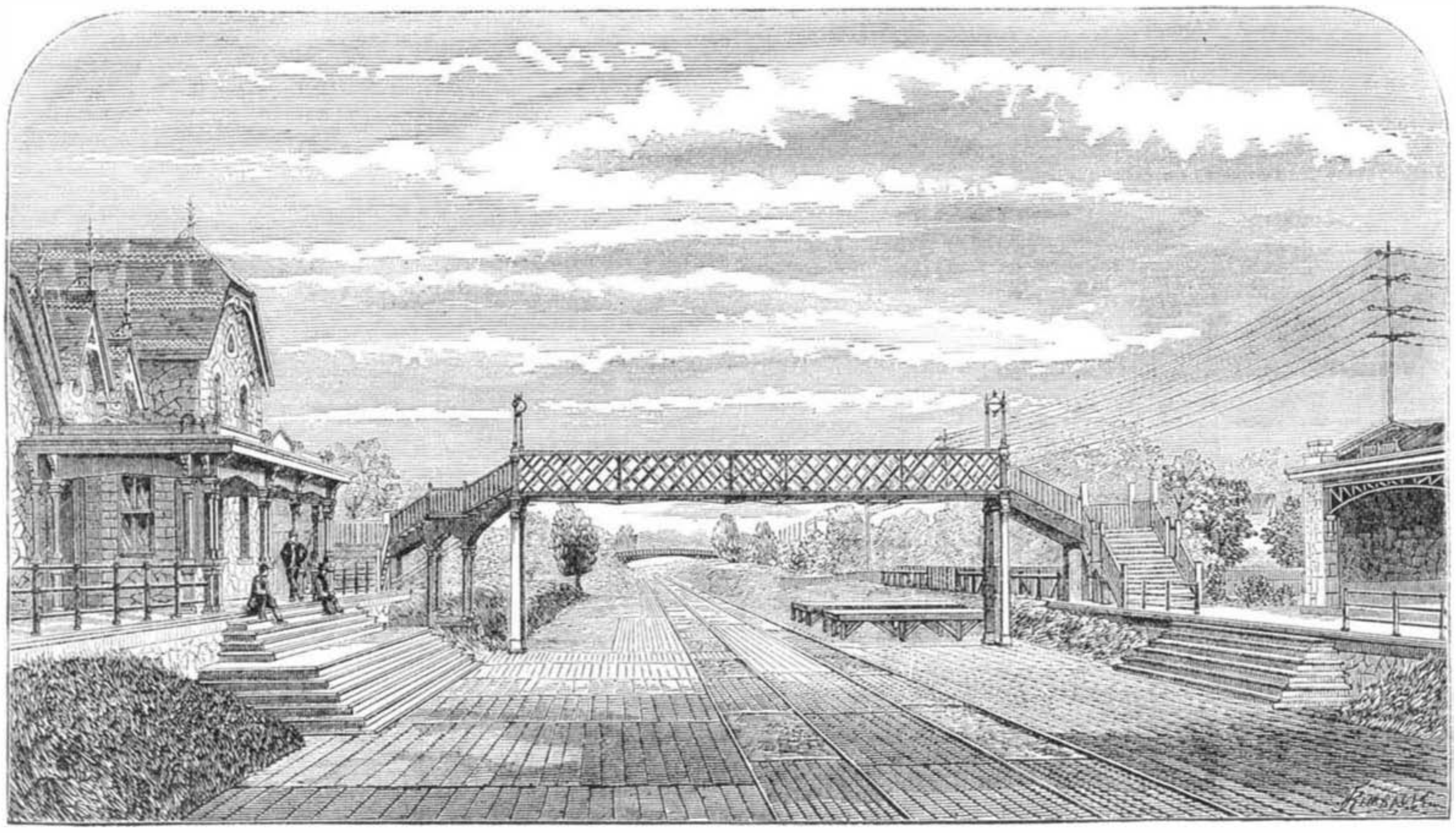
AMERICAN RAILROAD STATIONS.

Since the civil war, progress in the United States has been rapid and vigorous in all directions, but in no department has this been more marked than in railroads. The main lines or arteries throughout the country are becoming every day more substantial; and their permanent way, stations, warehouses, shops, etc., are rapidly assuming the solid appearance that we see on English and Continental roads. No road stands higher in this respect than the Pennsylvania Railroad; in fact, it has always maintained a prëeminent reputation in matters of this kind, with its iron bridges, its solid ballasted track, steel rails, and fine shops.

We publish an engraving herewith, taken from *Engineering*, of a passenger station erected recently on this line, at Bryn Mawr, eight miles from Philadelphia, a portion of the country thronged with summer residences and country seats of wealthy Philadelphians. It is only a sample of a number of others on the road, and shows what this road is doing for the comfort of its patrons.

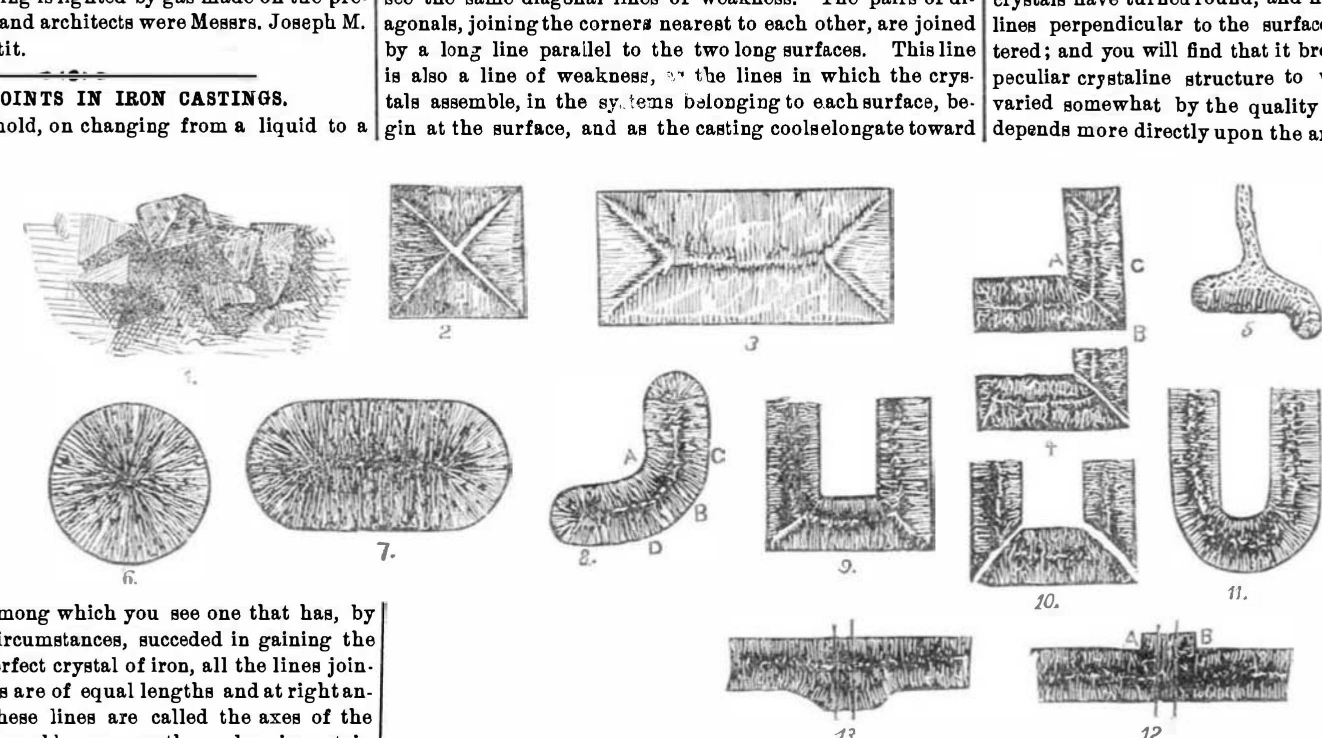


RAILROAD DEPOT AT BRYN MAWR, PA

This station consists of a main passenger building and agent's dwelling combined, on the south side of the road, and a passenger shelter on the north side, an iron foot bridge connecting both sides, to prevent the necessity of passengers crossing on the tracks. The buildings are constructed of a handsome native gneiss rock, with dark pointing, and Connecticut brown stone dressings. The interior is finished up with hard woods, black walnut and ash, throughout, and presents a very handsome appearance. The main waiting room covers an area of 24 feet by 37 feet, and has an open timbered roof. The building is lighted by gas made on the premises. The engineers and architects were Messrs. Joseph M. Wilson and Henry Pettit.

THE WEAK POINTS IN IRON CASTINGS.

Iron poured into a mold, on changing from a liquid to a solid state, becomes a mass of crystals. These crystals are more or less irregular, but the form toward which they tend, and which they would assume if circumstances did not prevent, is that of a regular octahedron. This is an eight sided figure, and may be imagined to be formed out of two pyramids having their bases together. In Fig. 1 is a group of crystals from a pig of iron, among which you see one that has, by the aid of favorable circumstances, succeded in gaining the natural form. In a perfect crystal of iron, all the lines joining the opposite angles are of equal lengths and at right angles to each other. These lines are called the axes of the crystal. The crystals assemble or group themselves in certain lines, in the direction in which the least pressure is exerted. When we define the direction of these lines as in the direction of least pressure, we deal with pressure due to the mass itself, and heat leaves a mass of iron according to the same law; and, therefore, the lines of assemblage will be in the direction in which heat leaves the body. This direction is always perpendicular to the cooling surface. We can now state the law upon which we shall base all of our reasoning on this part of our subject. In the case of any casting, upon the metal changing from a liquid to a solid state, the crystals arrange themselves in lines perpendicular to the cooling surfaces; or these lines lie in the same direction in which the heat went out of the iron. If the heat leaves all surfaces of a casting, then each surface will have the lines in which the crystals assemble, and which lie near to it, perpendicular to itself.



We may then briefly state the law thus: The lines about which the crystals assemble are perpendicular to the surfaces of the casting.

Fig. 2 shows a view of the end of a casting. This shows the assemblage lines, though the individual crystals are too small to be visible. In this figure you see the lines perpendicular to the bounding surfaces; but what I wish to call your attention to especially is the behavior of these lines at the corners of the castings. When two surfaces, as in this example, lie at an angle to each other, the systems of perpendiculars must meet in a plane diagonal to those surfaces. Some of the lines of each group run by into the lines of the opposite group, so that in the diagonal plane the lines interlock, breaking up the natural order, and making very poor connection. We shall find in every such case that the diagonal is the weakest part, and that the casting will bear less strain there than through a part where the lines lie parallel to each other. In the figure which we are considering, each corner has its weak line, meeting at the center of the casting.

In Fig. 3 we have a drawing of a flat bar, and in it we see the same diagonal lines of weakness. The pairs of diagonals, joining the corners nearest to each other, are joined by a long line parallel to the two long surfaces. This line is also a line of weakness, as the lines in which the crystals assemble, in the systems belonging to each surface, begin at the surface, and as the casting cools elongate toward the center. When they meet in the middle they do not form continuous lines through from one surface to the other. Before leaving this class of surfaces, I wish to refer to Fig. 4, also a drawing of a casting. In this way we observe the same phenomena as before, at all of the angles except at the angle, A. Here the metal lying mostly outside of this angle, the lines which we have been considering are perpendicular to the surfaces forming this angle, A, and extend beyond the angle until they interlock, as before, and, together with the diagonal from the corner, B, form a weak line, the entire distance from A to B. Now, though there is much more metal between A and B than between A and C, yet the casting will always break through A B, rather than through A C, the break taking the longer course.

Castings may be made which will not show this peculiar appearance, and may not have it in any marked degree; but if such castings are exposed to heat, the crystals will change position and assemble in lines perpendicular to the surfaces through which the heat entered the casting. The greater the heat the more marked will be this peculiar structure, and the law, as before stated, applies equally in this case, all the crystals finally assembling in lines perpendicular to the bounding surfaces which were heated.

This can be illustrated in the following manner: Take two pieces of zinc which have been rolled into sheets, and heat one of them just below the melting point. To make what I am going to say illustrate the point in question, it must be remarked that rolling any metal into a sheet elongates each crystal in a direction perpendicular to the pressure exerted in rolling—that is, lengthwise of the sheet; and if metal is drawn into wire the crystals are lengthened in the same way. If you bend the piece of zinc that has not been heated, you will find that it is tough, and can be bent many times without breaking, the crystals running lengthwise. Take the other piece of zinc that has been exposed to heat. In it the crystals have turned round, and have formed themselves in lines perpendicular to the surface through which heat entered; and you will find that it breaks when it is bent. The peculiar crystaline structure to which we have referred is varied somewhat by the quality of the metal used, but it depends more directly upon the amount of heat either passing out of or into a casting, or upon the rapidity with which the operation is performed.

We see from the foregoing remarks that the strength of a casting is greatly impaired by the lines of weakness caused by angles, especially re-entrant angles.

Now, let us look for a means of remedy. Referring again to Fig. 2, and then to Fig. 6, or comparing Figs. 3 and 7, we see that by making the angles into curves, the lines in which the crystals form themselves are all nearly parallel to each other, and the absence of abrupt changes of surface also avoids changes in crystalline arrangement, which will materially affect the strength of the casting. Compare Fig. 4 with Fig. 8, and you see that there is the same amount of metal through A B, in Fig. 8, as there is through A C, and yet the strength at the two places is nearly the same. And, of course, their