pendant-post, or wall-piece, the timber arch intercepting and conducting the outward thrust away from the foot of the rafters and the wall-plate, where it would have most power, and resolving it down inside the walls to such a depth, that were they thinner, or without buttresses, no strain could there be exercised upon them.

The ancient roofs erected in the fifteenth and sixteenth centuries are very instructive in their way, although the different quality of the materials of which they were composed, required for the most part, a management other than that to which modern builders resort. The style of the architecture required a certain steepness, and probably also, the imperfect porous covering substances, when copper, or lead were not used, rendered it desirable, that the rain should be carried off as rapidly as possible. The elevation, therefore, generally exceeded forty-five degrees: this great angle will at once account both for the character of their construction and of their decoration; indeed, the latter was made wholly dependent on the former, a principle which is sometimes lost sight of in modern structures.

The woods, also, had much influence; where rigid pine is now used, our forefathers employed oak, or chesnut: either of them cut into rafters, such as are common at present, would have been liable to cast, and to exhibit a distorted appearance from below. This was obviated by a more frequent use of purlins, and by the introduction of diagonal bracing; and as the latter traversed the under surfaces of the rafters, it was made the vehicle of an expressive decoration; and while they kept each individual rafter in its proper place, they contributed in the aggregate to stiffen the whole structure against the winds, to which its lofty elevation exposed it. The artificers of those times had a tougher, as we have now a more rigid material, whose respective qualities in each case suggest their own appropriate treatment.

The Paper is illustrated by a diagram, from which Plate 8 is compiled.

The Earl of Lovelace said he was unable to state the difference between the cost of construction described in his Paper, and the ordinary method of carpentry, because in the first construction of the kind the methods employed might not be so perfect as could be desired, and also because the men were not solely engaged upon it, for any consecutive period, as the timbers could only be operated upon when the steam had sufficiently softened them. He submitted, that the labour must be obviously less than for carpentry, and that a roof so constructed must possess greater strength, whilst it did not

push against the walls like an ordinary span-roof. The subject was interesting to Engineers, who were often called upon to construct roofs for buildings of large size, to which iron, notwithstanding its great advantage, was not always applicable, when more than an ordinary degree of ornament was required. The width of the hall, for which the roof had been constructed, was 24 feet, and the radius of the shortest curve of the main arch was 7 feet.

In answer to questions from Captain Moorsom, the Earl of Lovelace said it must be clear, that great advantage would arise from taking off the strain from the top of the walls and conveying it some distance down them, as was done by the hammer-beam in the old roof, only he thought it was better done on this system. The whole of this roof was so bolted together, that any action of wind upon it would be felt throughout the whole structure; he believed that was a principle much insisted on in the roofs of the middle ages. He did not pretend that the system was entirely new, for he was aware that it had been used in the construction of railway viaducts and bridges of large span; but the curve given to those arches was so slight, that it had not been necessary to employ steam for bending the deals. Philibert de l'Orme had also, about three centuries ago, described roofs, of which the principals were built with short planks cut to the required shape, and pinned together vertically. That method could not have been used for this roof, on account of the ornaments, as the outer planks would have been partly cut away in working the mouldings, and the whole strain would have been thrown upon one, or two of the inner planks.

Mr. Brunel could not conceive how the advantage of such a construction could be at all questioned; there was so much real utility in it, that the Institution must be indebted to Lord Lovelace for directing attention to so obvious an improvement in roofs which, in general, were expensive and troublesome. Mr. Brunel thought the roof he had constructed over the Bristol Station of the Great Western Railway was an improvement on the ordinary system, but he preferred this system to that which he had adopted. The roof he alluded to had a span of 74 feet; it was formed by framing timber together, plating them on both sides with iron, and disguising the construction by ornaments applied to the timbers, instead of working them in the timber, as had been done by Lord Lovelace. The style of architecture to which it had been applied, particularly demanded bold mouldings, which could, by this system, be worked on the edges of the bent timber, in the direction of the grain, and the strength of the wood was never impaired. In fact, he had seldom seen so simple and useful a roof, possessing such an

amount of stiffness, and at the same time avoiding all thrust upon the walls.

Mr. WALKER agreed, that there might not be a great degree of novelty in the roof, but there was much real utility in it, and much ingenuity had been displayed by the Earl of Lovelace, in the design and the construction. Mr. Walker thought the great advantage consisted in enabling roofs of such a peculiar form to be constructed out of ordinary deals, instead of cutting away a quantity of timber wastefully, and he thought it would have been very difficult to have found timber from which such short curves, as 7 feet radius, could have been cut. Perhaps, however, the most interesting result of all, was to find the noble Lord occupying himself practically with the details of construction, and then coming to the Institution to impart the information he had acquired, and to court discussion upon his works.

Mr. VIGNOLES corroborated the preceding remarks, and thought that one of the chief merits consisted in getting rid of the hammer-beams, and in preventing the thrust coming upon the top of the wall; he thought the principle of built-up and bent timber beams was capable of extension to ship-building; it was already used in mast-making, and there was not, in his opinion, any valid reason why this system should not be adopted, when it was considered what great pains were often taken to procure knees of timber of a particular shape, and which could, by the above means, be avoided. Timbers large enough for the roof of Westminster Abbey, and of the requisite shape, might in that way be obtained. Indeed, he thought the principle applicable to roof, ship, or bridge building.

The DEAN of WESTMINSTER remarked, that at Amiens there was a fine instance of construction of a roof with hammer-beams, which dated from the thirteenth century. He thought there was little chance of the proposed mode being applied to Westminster Abbey, as on an inspection made by Lord Lovelace and himself, a short time ago, there was not a foot of the timber roof which was not as good as when the roof was first erected. In answer to a question from Mr. Beardmore, the Dean of Westminster stated, that the timber of the Abbey roof was supposed to be built of chesnut, but it had not been examined microscopically.