of the truss—be lighter than, for secondary reasons, would be proper. The flanges also would be lighter, and English engineers prefer, even at some sacrifice of material, substantial members to the girders exposed to railroad service. For small spans also even a deep truss will not allow sufficient headway for overhead bracing. In longer spans, where the girders would be deep enough for such bracing, it must be remembered that if its use saves in vertical stiffeners, increased strains are thereby transmitted through the flanges to the end frames. But other reasons will be found generally to prevail with English engineers against the use of deep girders. One of these is that the platform of the bridge is so wide as to render overhead bracing almost impossible, unless a third main girder is used between the two outer ones. Charing Cross Bridge over the Thames at London is a case in point, and one which at first sight would appear to offer a favorable opportunity for deep trusses. The bridge is 970 feet long, five of the spans being 154 feet each, and the girders are 14 feet deep. The bridge forms the approach to an important terminal station and is made wide enough for four lines of rails. As constant shunting is going on from one set of rails to the others, an intermediate or third girder would prove an obstruction, and is therefore not introduced. Even if the girders were deep enough for overhead bracing, which they are not, such bracing across so wide a bridge would be difficult and expensive. The other reason is perhaps too æsthetic to have much weight in so utilitarian a country as America, but it has here. It is that deep girders form a deep sky line, obstruct the view, and are called ugly. Already there is in England a great outcry and much real or assumed indignation against the structures contrived by engineers. Girders deeper than absolutely necessary would not be allowed in an English city.

Mr. Bender, in comparing the American and European methods of forming compression members, speaks slightingly of riveted members. Perhaps he is not aware how carefully such can be designed to give trough or nearly tubular sections, and the extreme accuracy of the workmanship. With planed butt joints in the plates and exact rivet holes, such as are made in England, the immense superiority he claims for pins does not exist.

Mr. Bender is, from his position, probably committed to, and his name is certainly associated with a certain kind of structure of which the Phœnixville truss may be taken as a sample. He has apparently—I say this with all respect—neither the desire nor the facilities for making riveted structures, and therefore argues like an advocate or special pleader rather than a judge. In England the chief bridge-builders make either pin or riveted bridges as their customers, the engineers, may demand. Personally, so far as pleasure or profit in the manufacture comes into the question, I prefer the pin system, and am at present concerned in the manufacture of some pin bridges with properly formed eye-links. But every case is here decided on its merits, and pin trusses and riveted trusses are built side by side in the same workshop. If an American engineer of eminence were to establish himself in England with the desire and intention of introducing the system he now prefers, the very abilities which would have already enabled him to distinguish himself in his own country would lead him to modify his views under the new conditions presented. With English iron, with skilled English workmen and appliances at his command, he would find, as case after case came before him for consideration, that the deep pin trusses were not always the best suited for his purpose, and he would have to acknowledge that the best English engineers in making their designs did so, not in ignorance of the advantages which he claims for deep pin trusses, but because when all the circumstances and conditions were fairly weighed, the English system of riveted structure was very often the best.

The following may be taken as a summary of the English view of the case:

1. Pin connections are not suited for any but trusses of a size to require large pins. This applies only or chiefly to *railroad* bridges, as small pin trusses for road traffic may be more safely used.

2. The demand or necessity for large spans does not occur so often in England as in America, and therefore there are fewer opportunities for the judicious use of pin trusses.

3. Wherever the locality of the bridge allows of easy transport and erection, riveted connections are preferred by most English engineers as more permanent and satisfactory than pin connections, this always assuming the most accurate fitting of the parts and coincidence of the rivet-holes, conditions which are obtainable in bridges of English manufacture.

4. The comparatively few opportunities in England for making spans long enough to allow the advantageous application of overhead bracing render deep girders very uncommon, and, in the few cases where it could be applied, the secondary reasons before alluded to prevail and a depth of 1 in 9 is hardly ever obtained.

With regard to deterioration by rust, I am so entirely at issue with Mr. Evans that it is hopeless to argue the point. Plates and bars lapping over each other do not, if properly riveted, allow moisture to enter in, as he contends, although in structures designed by incompetent men a reckless piling together of plates and the unskillful use of numerous packing pieces do involve such risks. But even in American pin bridges I apprehend that in the upper members or flanges there is the same use of riveted work as in England. I deny that there is yet such experience of durability as to allow a fair comparison between pin and riveted connections. Both in respect to the hammering of pins and deterioration by rust 20 more years must elapse before a comparison can be fairly made. Links lapping over the top flange of a girder or over each other with a clearance, as is often the case, of from ¼ in. to ½ in., are neither close enough to keep out moisture nor far enough apart to permit easily of effective painting.

Before concluding this letter I must refer to your editorial remarks as to my statement about the accidents caused by the failure of American bridges. You say "there is as yet *no* instance of an iron bridge designed by any of our leading engineers or engineering firms which has ever given way. Can Mr. Matheson say the same for English bridges?" I cannot only answer this challenge in the affirmative, but I need not confine myself to the work of "leading engineers." *None* of our iron bridges give way, and in my letter printed in your journal of April 4, I was unnecessarily within the mark in stating that not one bridge per annum failed. I may as easily say not one in five years, for since the first construction of railways in this country there are not three such accidents recorded that I know of. But even confining yourself, as I do not, to bridges built by "reputable firms," you give six exceptions to your rule which go far to corroborate my first assertion. Nos. 1 and 5 are bridges in which the wooden beams decayed and gave way. We also have bridges with wooden floors which are not allowed to fail. In each of the cases Nos. 2, 3 and 4 the bridge did not give way but was "knocked down" by a train off the track. I specially drew attention in my letter to the fact that English bridges were made strong enough to resist a train which was off the track. No. 6 was a case where a bridge was designed for a light load and failed when subjected to a heavy load. Surely some engineer was responsible for this. In fact, cases Nos. 1, 5 and 6 suggest that the permanent engineers of a railroad rather than the manufacturers—as in America—should be the men responsible for the designs, and so be acquainted with the strength of their bridges and all that is required to maintain them.

Assuming that in England we are prejudiced unduly against pin bridges, at any rate to those we have, and they are many, we give a fair chance by examining the pins occasionally and preventing rust. But how shall we calculate the risks in America, where a Fink truss with innumerable rods, pins and nuts may be used on railroads where the permanent engineer allows wooden beams to become rotten and loads never anticipated or provided for to pass over his bridges? Our absurd English caution appears to be more needed in America than at home.

My share in this controversy is now ended, and I can only hope that your readers may after all give English engineers credit for not being so very far behind the age. I have to thank you for giving up so much space in your journal to my letters, and remain, Sir, Yours faithfully,

EWING MATHESON.

LONDON, June 30, 1874.

Remarkable Locomotives.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I would like to add to your account of large engines on the Lehigh Valley road that there is also with the "Janus," the "Bee" and the "Ant" now running on the mountain grade at Wilkesbarre, built by Norris Brothers at Lancaster, Pa., which have 20x26 in. cylinders and ten 4 ft. 6 in. driving-wheels, weight 65 tons each without the tender; also one of the mogul pattern, doing good service on a mountain grade that rises 1,200 feet in 13¾ miles through a winding course.

I believe the smallest locomotive in the world is the one to be seen in the South Side Railroad shops at Petersburg, Va. This engine is of the Mason pattern in every particular and of the ordinary American plan—four wheels coupled and a pair of forward trucks. The driving-wheels are 8 in. in diameter, cylinders are 2 in. by 3½; I do not know the capacity of the boiler, but should judge it to be about 2½ gallons to the third gauge cock. The entire engine and tender is less than four feet long; the gauge is only 9 inches, and she will weigh when in full working order less than 250 pounds. She is a complete engine in every particular and has all the attachments of the ordinary Mason locomotive engine. Her diminutiveness may be judged from the fact that an ordinary sized man cannot reach the reverse lever through the windows, it is so small; and this machine has actually run a train of coaches at a fair held in Petersburg four years ago. She was propelled by steam produced by fire in the fire-box. This engine was built under the direction of Captain James Robinette, Master Mechanic, and by the order of General William Mahone, President of the Atlantic, Mississippi & Ohio Railroad Company. If there is a smaller locomotive in the world than this it would astonish me more than this did when I saw it, and I would like to learn of it through the columns of the GAZETTE.

GEORGE A. HAGGARTY.

Are English Cars Smoother in Motion than American?

TO THE EDITOR OF THE RAILROAD GAZETTE:

If the substance of a paper read at the recent meeting of the American Society of Civil Engineers be a fair theme of discussion before it has appeared in print,* I wish to ask if it be really true that the English railways run on the average, or even occasionally, carriages which are incomparably smoother in their motion, and thus easier to ride in, than are our standard eight or twelve wheel cars?

If I understand the paper in question, it set forth that the rails used upon English lines are more perfectly adapted to the duty required of them than ours are, and hence the rail surface upon which the cars travel may be and is kept in more perfect condition than it can be on our lines, and hence the carriages run more smoothly than ours do.

I endeavored to set forth in your columns some three years ago my own views upon this point, which were to this effect: that the absence of the truck with its provision for side swaying of the body of the car permits an uneven side-knocking to be imparted to the car as the wheel flanges strike the rail first on one side and then on the other, and also that the practice, almost if not quite universal, of attaching the long side springs to the body of the carriage by links and tension screws that pull upon the spring lengthwise causes a vibration of a nature wholly different from that arising from or due to the elasticity of the spring, and I do not see any way in which this motion or jarring can be obviated or removed except by entirely changing the way of placing and attaching the spring.

I also described this motion as being almost identical with that experienced in our lighter passenger cars when running at good speed with the brakes set hard, as when approaching a station, and this impression I have found agrees with the experience of several others with whom I have spoken of it.

We shall soon know whether our American plan of trucks under long cars will not give a remarkably greater ease and smoothness of motion to the trains on English lines than they now commonly have, for I believe it is understood that the Pullman cars just starting on the Midland Railway are in all these respects built entirely upon our American plan.

I have an impression that we shall hear of at least the thought of seasickness on the part of some of the English travelling public, in their first use of the Pullman cars, in consequence of the swaying motion which in some small degree at least is sure to be experienced even upon the costly and very perfect track of the Midland Company.

I do not see how it can be claimed that average English carriages, even the best of them, run or can run as smoothly even on their perfect tracks as our average car of recent construction will run on our good average track, and I believe that our best cars, when placed on the best English track, will show an ease and quietness of motion incomparably greater than has been experienced hitherto on such track in the best four or six wheel English carriages.

A JUNIOR MEMBER.

*This letter was received before the publication of the paper referred to.—EDITOR RAILROAD GAZETTE.

Some Limitations of Mechanical Improvements.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The instructive paper read by Captain Tyler before the Society of Arts, and given in the last number of your paper, opens, among other important questions, that of how far automatic signals and similar appliances are, and may be trusted to be, really and entirely automatic. Without undertaking to enter into the details of construction by which the most approved signals are rendered interdependent, and so automatic in producing the result sought to be accomplished by the signalman perhaps many yards away, it is well to point out the dangers, or some of them, that may not be fully appreciated by those seeking, in increasing numbers and with growing perseverance, to urge their devices upon the attention of railroad managers.

The contrivances and appliances for signaling are not the only parts of the machinery of railroads that are thus in danger of being improved, as many inventors claim they may be; but many of the simpler, and even rudest parts, as they may seem, are attacked by way of improvement, which, because of their simplicity, are nearly perfect, although they may be rude and primitive by the side of the elaborate and perfect device of some one of those inventive men whose name is legion, but whose art is barren of any really useful result.

The common car-axle box may be named as one of the parts, liable to give occasional trouble by heating, and by breaking or by wearing out, but how could anything be simpler, consisting of fewer parts, and hence, because of this simplicity, almost impossible to be got out of order? Yet what railroad man has not been beset by those who have contrived and perfected, if their own story were to be believed, just the very box that will run with less oil than any ever heard of before, which cannot heat, cannot lose off the door or cover, and which, in fact, only needs to be put on to a thousand cars to demonstrate to the world the entire futility of any attempt to think of getting along with anything except just that very box?

Probably few men appreciate the need of the most perfect contrivances, for even the minor parts of their plant and machinery, more fully than these very railroad men who seem so slow to adopt the multitude of plans, or any of them, urged thus upon their attention, since they only know the need of using the very best contrivance for any given purpose, and the risks or dangers that are daily run, even with that which experience may have shown is really to be trusted, although subject to some uncertainty. They know, too, at a glance, or the really experienced among them do, where the weak points lie of a new device, presented to them for adoption or examination, better than any one who has not passed through the same school as themselves, and hence arises the fact, so often noted, that a railroad man may have urgently brought to him for use some device embodying exactly what his experience had suggested to him years before as a possible way out of some difficulty, but which upon trial proved in fact to be a way into more difficulties than had before existed, and some that had not been thought of at all.

A great variety of examples can be named of a kind exactly similar to those mentioned, but these two points need only to be urged at this moment, namely, the chance of failure in the contrivance from inherent defects of manufacture or of the material of construction, and also the chance of failure in the use of the contrivance itself. So long as the fallible men must be employed to make and use all the details of railroad machinery, upon whom, too, Captain Tyler must rely for the perfect working even of the splendid interlocking signals of the great English railway stations, so long constant watchfulness must be the price of safety, and this watchfulness must be maintained not only in the signal box at the moment of forwarding a passing or a halting train, not only on the locomotive where danger never sleeps, but even more (and certainly first) in the making and constant inspection and care of those qualities and adjustments which alone make and maintain the automatic or perfect working of any fixture or part, upon which as a key or sensitive spot the whole welfare may depend.

P. BARNES.

Edgar Thomson Steel Works, Pittsburgh, July 13, 1874.