Below is an estimate of its cost. If the professional reader should think the item of grading too low, (and it is, I suspect, the only one on which he will have any doubts) let him take the profile of almost any road in the United States, and relocate it, in imagination, so as to adapt it to sixty feet grades, and he will find the allowance to be ample.

Estimate per mile, single track, of such a Railroad as the foregoing.

Grading, culverts, drains, road-bridges, &c.,	\$ 4,000
Fencing, (1400 panels at 50 cents, \$700; but allowing fencing only half way.)	350
Land damages,	400
Cross-ties—1760, at 25 cents,	440
String timbers, 35 thousand feet board measure, at \$ 25,	875
Iron flanged bar—24 tons, at \$ 65,	1,560
Splicing plates,	30
Spikes,	100
Workmanship, 1760 lineal yards, at 50 cents,	880
Surveys, engineering, instruments, &c.,	800
Earle-izing, 13,000 cubic feet, at 2½ cents,	325
Incidentals,	220
<hr/>	
Total,	\$ 10,000

In northern climates, a small addition to this sum would be advisable for broken stone under the cross-ties.

Thus we see, that such a road as we speak of, can be constructed for the moderate sum of \$ 10,000 per mile. Yet how many railroads are there in the United States, not enjoying even the limited business to which this road is adequate at two trips daily, on which not only thousands, but tens and hundreds of thousands have been thoughtlessly squandered for light grades, heavy rails, and powerful engines.

[TO BE CONTINUED.]

Facts and Observations on Four and Six Wheel Engines. By JOHN HERAPATH, Esq.

[CONTINUED FROM PAGE 249.]

London and Birmingham Railway.—Conceiving, the only way I could possibly come to a right conclusion of the cause of any difference in the safety of the engines, was to travel upon them, I procured orders for permission to do so. These orders are absolutely necessary on some of the lines where the injunctions are most strict not to allow any one to go upon the engines. On the London and Birmingham it is as much as a man's place is worth to permit it.

By taking the engine, I was enabled to decide very easily respecting the sinuous motion which is indeed, upon any line in good order, the only sensible motion; for the pitching motion is obviously insensible if the road be good, the draughts steady, and the coupling link about upon a level, or not much above the axle of the driving wheels. The rolling motion, too, I have not yet been able to detect, unless the road was out of order.

My method of judging of the amount of sinuous motion was to fix myself firmly at the end of the engine, and observing how much a point on the front of the frame of the engine deviated to the right or left of the rail, taking as much care as I could to make the visual line fall at the same distance in all engines before the front axle. This is the best practical method I could think of, and though it might not be mathematically accurate, perhaps it would be much more easy to find fault with it than practically to find a better. By a little care one is able to decide pretty correctly in this way, of the difference of sinuous motion between two engines. For instance, if one appears to deviate two inches and another three, which a practised eye can appreciate very well, the one has half as much motion again as the other, and so on. I have thought of, and tried, other ways for the same object, but could find none so satisfactory as this simple plan.

The front rolling motion I have best detected by watching the motions of the front fire-box—not the motion of the chimney, for that is often loose and a bad guide—with regard to the road or rails, taking care, however, to distinguish between it and the sinuous motion. In the hind part of the engine it becomes sensible by leaning one's back or shoulder against the side of the fire-box. In a similar way is the pitching motion discovered, that is, by watching the lifts and depressions of the front of the smoke-box, and by leaning against the hind part of the fire-box. But a person with a sensitive foot, and accustomed to ride upon engines, will soon feel any pitching in the engine. Engines which appear to one standing on the platform to move very smoothly, when tested this way, that is, by leaning against the fire-box, will often develope the most unpleasant motions, and create very disagreeable sensations.

But besides the rolling, pitching, and sinuous motions, some engines have a shuffling motion on the platform from side to side, keeping time nearly with the beats of the pistons. It is made manifest by leaning against the side rails on the platform. Others again have the same shuffling motion in length, discoverable by the same method as the pitching, and distinguished from it by its quickness and regularity, and keeping time with the pistons.

Again, there is often a vertical roughness upon the platform, very different over the same ground on different engines, and a most treacherous guide it is to try an opinion upon; the causes of which I shall describe in my report.

Monday, November 15, I started from Camden Town station on No. 41, taking the morning mail train which was driven by a very intelligent man. This engine, a four wheel one, was one of Mr. Bury's make, and one which, from its being so high, some might call

top-heavy. Its motion, however, was very free from rolling or pitching, except in some few places where the road has suffered from the late bad weather. I could, indeed, perceive no sensible difference between the rolling or pitching motion of this engine, and that of any of the three six-wheel engines, I rode on the Saturday previous on the South Western Railway. The apparent sinuous motion was about two inches, except once or twice when it might have reached two and a half or three inches. This, reduced to the distance of the axles, would make a real sinuous motion of one to one and a half inch. In other respects the engine was very pleasant to ride on, and I understand is esteemed to be a very good one. I stopped at Tring, but when I arrived a Wolverton I very carefully gauged the inside bearing marks of the flanches, and found them to be four feet seven-ninth inches, the gauge of the rails being four feet eight and a half inches. The distance from the extremity of the fire-box to the middle of the hind axle is four and three-quarter feet, distance of the centres of the axles six feet, and total length of the body of the engine, including the fire-box, is fourteen and three-quarter feet. The driving wheels are five and a half feet diameter, the cylinder thirteen inches, and the stroke eighteen inches. I was informed that it consumed twelve cwt. of coke, on an average, between Camden Town and Wolverton, fifteen miles, or twenty-six and a quarter lbs. per mile, but these data we shall hereafter have more accurately. This engine runs up with the night mail and down with the morning mail every day, and has had, I was informed, no material repairs done to it for about eight months.

All the mail train engines are an inch greater in diameter in the cylinders than the engines of the other trains, though the driving-wheels appear to be nearly the same, that is five and a half feet. The coupling link appeared to be about two or three inches above the level of the driving-wheel axle.

This engine is fitted with a guard to clear the rails, and a ballast gauge; that is a bar hung upon a pin coming down a little distance from the inside of the fore wheel to within two or three inches of the level of the axle, on the top of which bar, in a notch, is supported a lever, which, when the bottom of the bar is struck by the ballast being too high, is released, and falling, sets a whistle off; thus telling the tale of the ballasters having neglected their orders as to the height of the ballast where the roads are repairing. This happened in our journey, and was obliged to be reported at head-quarters. Such is the attention to everything on this line which may engender accident.

At Tring I left this engine and waited for the next train, having been informed that all the engines are changed at Wolverton.

The engine I now got on was No. 50, a four-wheel engine, made by Benjamin Hick. Its length, from the end of the fire-box to the axle of the driving-wheels was four and a half feet, ten feet to the fore axle, and thirteen and a half feet the extreme length of the engine. The driving-wheels as before were five feet six inches, cylinders twelve inches, with eighteen inch stroke. This was a much lower engine than the former, and I suspected at first a more steady one, but on getting up its velocity I found it had considerably more sinu-

ous motion, which I suspect was chiefly on account of its flanches being only 4 feet 7.1 inches, to a gauge of 4 feet 8½ inches, and great play in its bearings. The coupling link was placed about the same as in No. 41.

The engine driver informed me that No. 50 consumed about fourteen cwt. of coke in the journey of fifty-one miles, or 30.7 lbs. per mile; but with a strong head wind often-times it made a difference of two or three cwt. more.

At Wolverton I got upon No. 54, another of Bury's engines. This in cylinder, stroke, height, and distance of axles, was nearly a counterpart of No. 41, but its extreme length is half a foot less, and the gauge of its flanches four feet 7.6 inches. It had, therefore, about three-tenths of an inch more play on the rails, and it appeared to me to be less steady than No. 41, and not so lively as No. 50, but steadier. The driver said it consumed a ton of coke in its journey between Wolverton and Birmingham, sixty miles, or about 37.3 lbs. per mile; but the accuracy of his statement I should doubt, as he appeared to be not well-informed. At Rugby I got inside, having traveled eighty-five miles outside in rather sharp and snowy weather upon three of the Company's engines.

I could get no information from the men of any peculiarities in the structure of any of these engines, that is, whether they worked expansively or not, but with all this I expect to be supplied by the Company's officers.

As far as I have yet seen, Bury's engines do not deserve the character given of them of being "top heavy." One thing, however, is to be said that the road, taken altogether, is in so good a state of repair as not to exhibit any imperfections, if they exist. Indeed the term "top heaviness" in a good road is unintelligible; it can be only in roads much out of order, and curves badly constructed, that it can have an existence. On the London and Birmingham line there is no expense spared to make and keep the road in a perfect state of repair, and with a few exceptions it is in excellent order.

But though I can at present see no foundation for the clamour raised against Mr. Bury's engines, I must confess I think they can and ought to be made more comfortable for the men. The platform, for instance, round the fire-box is open at the sides, and bitterly cold, while a very little expense would remedy the defect. Indeed, upon the South Western, Birmingham and Gloucester, and Liverpool and Manchester, engines, that I have ridden on, it is done, and I cannot see why it should not be on the London and Birmingham.

Another fault I have to find with the fitting-up of these engines is, that many of them have no "dashing," or "splashing," guards, over the front wheel. In wet weather the wheels for want of them throw the oxide of iron from the rails, dirt, and particles of ballast, over the engine and the men, in a most annoying degree. Nay, from the several sharp blows I have myself had in the face with these particles, I am inclined to think it is not without danger to the men's eyes, and may therefore deter them from keeping so good a look-out as they otherwise would. The force of this seems now to be seen, for as fast as the engines undergo repair they are provided with splashing guards.

While I am complaining I must also be permitted to prefer another complaint, namely, against the breaks on the tenders. On Mr. Bury's tenders lever breaks are used, upon the arm of which the men stand, over the side between the tender and engine, pressing it down with the weight of their bodies. Should their feet slip, destruction is almost inevitable. Indeed, upon one of these dangerous things a man lately lost his life on one of the lines, and that Company are now preparing what they call shoes for the handles. But if these breaks were fitted as they are upon the tenders of many lines, with a screw and handle, or wheel, all this danger would at once be avoided.

Mr. Bury will not, perhaps, thank me for telling him thus publicly of his faults, but I do it because it is the most effectual way to cure him of committing them again. Besides, to confess the truth quietly, I have a little mischievous inclination just now to grumble and pick holes where I can. It is exhilarating to an exhausted frame, a sort of unction to the bumps and bruises I have gotten in my long and fatiguing journey.

[The rest of this communication we have deferred, the information from the London and Birmingham Railway coming only just before Mr. Herapath's departure.]

Railway Mag.

[To be continued.]

Progress of Practical & Theoretical Mechanics & Chemistry.

Remarks on Ships of Wood and Iron.

Remarks on the relative advantages of the employment of wood and iron in the construction of ships have appeared at different times. in Journals devoted to inquiries relating to subjects of this nature, but a spirit of partizanship has been commonly displayed by the respective advocates of wood and iron in favour of their own views. In an endeavour to avoid this charge, it will be expedient to advert in the first instance, to the different modes in which wood can be employed in ship building, especially as the advocates of iron are in the habit of referring to the defects of ships built of timber, which are capable of being obviated by a different system of construction.

The relative merits of wood and iron for this purpose will, I apprehend, come more fairly before the public by an exposition of some of the plans that may be adopted in the construction of ships of wood; and it appears to me that three well marked systems may be distinguished. 1st. The common plan of timbers, whether framed or single, separated by spaces from each other, whose principal connexion with each other, arises from an external and internal series of planking. 2nd. The plan used in her Majesty's dock yards, of timbers wedged up solid, and covered by an external planking, (timbers placed close together I conceive would be found to be a better method.) 3rd. A plan of constructing vessels of any size by two or more connected series of planks without timbers; this method has not been extensively used. Clinker-built boats belong to this third system, and perhaps also iron vessels, inasmuch as the plates of iron of which they are formed are of far more importance than the iron ribs, which occupy the position of timbers.