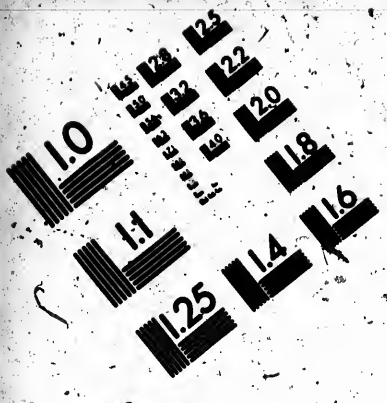

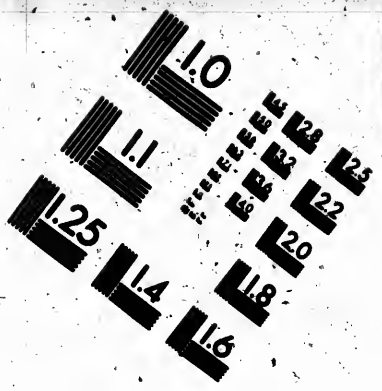

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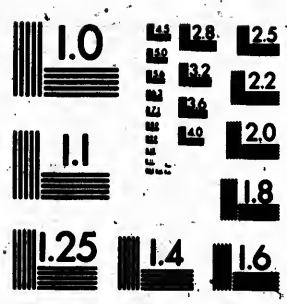

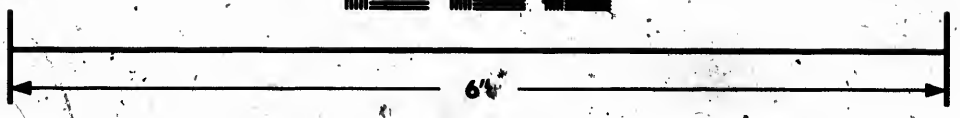

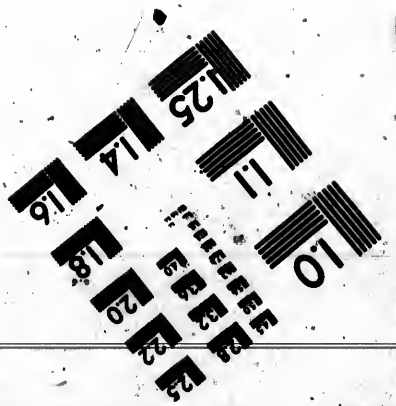

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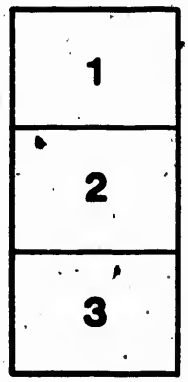

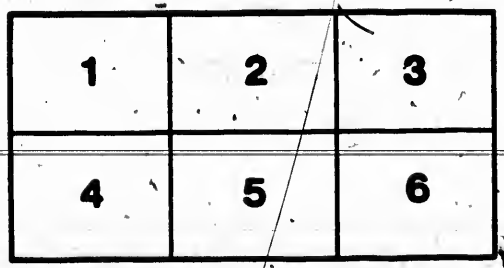

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Richard Eaton, Esq.re
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AMERICAN LOCOMOTIVES.

To the Editor of "ENGINEERING."

SIR,—The American railroad engine, as compared with European locomotives, bears upon its face the stamp of much fertile originality, similiar to that of American steamboats and bridges, when confronted with transatlantic works of a kindred class. There are differences, in the construction and working of American means of land-and-water intercourse, which may be called only *external* ones, arising from the peculiar tastes and manners of the people; but, between American engineering practice and that of the old country, there are also *principal* distinctions, called for, often, by strictly limited expenditure, by the necessity of speedy completion, and dictated in many cases by Nature herself.

It is on the American continent, where some of the grandest wonders of the world, of nature and of art, simultaneously appear before the traveller—whether he be traversing endless prairies and the Sierra Nevada on the Pacific railroad, or skirting on a "floating palace" along the beautiful scenery of the American Rhine: the Hudson river. And probably there is no other place on the whole globe where such an impression of might and majesty is left upon the mind—no other spot where such a sublime scene of Eternal power and of mortal effort burst upon the view, as at the Falls of Niagara and the suspension bridges. It was a bold idea to stretch such a wonderful structure, as was completed by Mr. [illegible]ling, across Niagara river, which signifies, in the symbolical language of the Iroquois Indians, "*Thunder of Waters*," streaming deep below the table land through its rocky bed, and boiling and leaping and foaming onward to the whirlpool;—and there is also the new and graceful, 'though less monumental, Clifton bridge, suspended like iron cobweb over that tremendous ghost of spray and mist, that perpetually arises from the bright-green water in its giant leap!

Such challenges, and many other difficulties, the American en-

gineer has met with an initiative, an amount of pluck and mechanical instinct which — as must be universally admitted — do him much individual credit and honours the whole nation. But to return to our subject, viz.: "American locomotives." I have examined them in detail at the manufactory, witnessed their performances on all kind of track, and I am compelled to confess, that what I saw far exceeded my anticipations.

Beginning with the engine and the various mechanical details, as designed and constructed in the manufactory, a very marked difference, as compared with English practice, will be noticed. The boiler is invariably lighter, the maximum thickness of the iron plates composing the barrel and fire-box being $\frac{3}{8}$ in. (with the exception of the tube plates, $\frac{1}{2}$ in. thick), while steel plates from $\frac{1}{4}$ in. to $\frac{5}{16}$ in. are frequently used. The boiler tubes are generally of iron. The longitudinal seams of the boiler and fire-box casing are double rivetted, and they are moreover strengthened, in many cases, by flat bars of iron, placed sometimes across the joint at short intervals, sometimes right along the joint on the inside of the boiler. The fire-box crowns are usually stayed by transverse stays, composed of two plates $\frac{1}{2}$ in. thick, which are welded together at the ends; these stays being connected to the crown of the fire-box casing by sling links. The fire-box casing is generally raised above the boiler barrel, the junction between the two is effected in a simple manner by the "connection sheets," forming a short conic barrel, and dispensing thus with the tedious operation of moulding the front casing plate to any intricated shape. No solid wrought-iron rings are interposed at the fire-door and fire-box bottom, but the plates are flanched so as to meet, when they are rivetted together. The smoke-box is usually cylindrical, forming a continuation of the boiler barrel, and resting on a cast-iron saddle, which carries in its turn the cylinders, and, in some cases, also the bogie pin.

One of the peculiarities in American locomotive construction is the framing, which is made of square bar iron, welded together, slotted, planed all over and entirely finished. The "bar frames," besides being very rigid in every direction, admit of easy access to the link motion; they form at the same time a good base for attaching the various brackets and guide-plates. The cylinders, which are usually outside, are hung from the top bars of the frames, in order to insure

a firm base for the cylinders, and to prevent independent strains on the frames, a cast-iron separate bed-plate or "saddle" is inserted between them, or the cylinder castings are made to extend inwards, where they are firmly bolted together. The valve-chests are on the top of the cylinders—a very good plan, by the by—the valves receiving their reciprocal motion, through the intervention of rocking shafts, from the eccentrics and motion links, which are placed, as in English engines, inside the frames.

As a rule, the various details of the motion and gearing are admirably well proportioned and carried out, although, for the sake of cheapness, "professional etiquette" is sometimes grossly neglected, as witness cast-iron piston-rod crossheads, cast in one piece with the pin and guide-blocks! The ends of the connecting and coupling-rods, where they take hold of the crank-pins, are always fitted with straps, secured similarly to the large ends of connecting-rods for inside cylinder engines. The brasses are generally closed on the outside, so that the crank-pins may be entirely enveloped, and by this "dodge" (which is well worthy of imitation) the pins are kept out of the way of dirt. An attempt is often made to guide the piston-rod crossheads by bars, arranged *above* the centre-line of the cylinders, as shown by your illustration of a goods locomotive for the Pennsylvania railroad, on page 156, vol. vii. Sometimes a single guide-bar only is employed, care being taken, however, to give it the necessary rigidity, and to provide ample bearing surfaces for the upward thrust and the downward pull of the connecting-rod. The object of this arrangement, which is identical with the plans of Mr. Stroudley and of Mr. Reynolds (likewise illustrated in *Engineering*,) is to clear the bogie wheels, or to effect, in the case of an engine with the leading wheels coupled, a reduction of the distance at which the cylinders are apart transversly.

The cast-iron wheels form another distinctive feature in American practice. The small chilled cast-iron disc wheels of their engine-tender and car trucks answer admirably well, being cheap, strong and durable at the same time; but, as regards the driving wheels with hollow spokes and rim, they are, after all, but a primitive contrivance as compared with the solid wrought-iron wheels now manufactured to such perfection by the leading British locomotive makers, and especially by some Belgian and French firms. To turn out a really

good wrought-iron wheel, special tools and appliances, and superior manual skill, are indispensable, and it is, perhaps, the lack of these that has prevented the Americans from making an attempt in this direction.

The boiler feed-pumps also deserve mention, injectors being totally ignored, or, if employed at all, of such dimensions as to serve merely as auxiliary boiler-feeders. The pumps are always placed on the outside of the frames, and, frequently, even outside the coupling-rods, in which latter case they are bolted on the guide-bar brackets, being thus of very easy access. The pumps are usually worked from the piston-rod crossheads, and they are provided with two air-chambers, one for the suction and one for the delivery-pipe.

Much ingenuity is displayed in the manner of setting engine and tender on the wheels; in fact, the problem of making an easy riding engine, offering, at the same time, the least amount of internal resistance, has been solved by the Americans most successfully. Much might be written on the history of the swivelling-truck, the faithful "track-feeler" of the American locomotive, and it would take a very graphic pen, indeed, to record fully all the modifications and transformations this useful contrivance has already encountered. Swivelling-trucks—better known, perhaps, by the quasi-mysterious name of "Bogies"—are employed as carriers under the engines, tenders and cars on all American railways, but, as far as I could learn, no attempt has ever been made to utilize the advantages of the bogie system in that part of the engine, which, properly speaking, supplies the traction power; in other words, the steam-cylinders and gearings are always fitted to the main system of the engine, independently of the bogies. If the trucks, as they roll along, are watched from the car-platforms, it will be noticed that they get the more uneasy the more the speed increases, manifesting, at high speeds, a strong "galloping" movement; and this characteristic phenomenon would, perhaps, be seriously aggravated by the additional disturbing forces resulting from the employment of steam-cylinders. At all events, the check-chains provided throughout, in connection with the American trucks, are not suggestive of abundant safety. For heavy work, at very slow speeds, however, such as climbing crooked inclines, it would be advisable to employ engines mounted upon two steam-trucks, whereby both the power and the flexibility of the

locomotive would be increased. Compensating levers are used on all American engines, not only between the coupled driving-wheels, but often, also, between the front pair of coupled wheels and the bogie. In many cases the equalization of the weight is still further carried out by the employment of transverse compensating beams, as used also by Borsig, and on almost all the German locomotives.

As regards the general form of American locomotives, the most striking feature is the extent to which the weight is subdivided over a greater number of wheels. The standard passenger engine has invariably four coupled driving wheels, one four-wheeled truck under the forward part of the locomotive, and two four-wheeled trucks under the tender, making in all sixteen wheels against the ten or twelve wheels of an English engine of similar proportions. On some lines, the goods traffic is worked by exactly the same type of engine, the increased traction power being obtained merely by a slightly reduced diameter of the driving wheels, and a few tons more adhesion. But, what may be termed the "standard" goods engine, has generally six coupled driving wheels of from 4 ft. 3 in. to 4 ft. 8 in. in diameter, while the driving wheels of the passenger engine range from 5 ft. to 5 ft. 8 in. in diameter. The weight of the passenger locomotives, loaded, is from 27 to 30 tons, of which weight 60 to 65 per cent. rest on the coupled wheels. The weight per driving wheel on the goods engine is very seldom more, but having usually two coupled wheels more, the adhesive power of the goods engine would consequently be 50 per cent. greater than that of the passenger engine.

In outside appearance and finish the American locomotives present much original conception and, not unfrequently, real artistly merit. The Yankees seem to place great pride in their engines; and it is indeed a proud sight to see an American engine entering a station, blazing in polished brass, embellished with rich peinture, bells ringing and whistle roaring—a sight very apt to compensate, temporary, for the noted shortcomings of American stations. At a first glance, some of the accessories, that give so much individuality to the engine, as cow-catchers, signal bells, tremendous head-lights and mighty steam-whistles may appear somewhat superfluous, but this idea is soon dispelled when a journey is made on the engine foot-plate. It will then be observed that there is nobody to keep the track; at way-crossings

there is no barrier of any kind, but a board is stuck up instead, bearing one of the following warning descriptions: Railway crossing! Look out for the engine! or, as here in Lower Canada: Traversée de chemin de fer! The well-known voluminous smoke-stacks are necessary on account of some kinds of fuel consumed, while the commodious "cabs" shelter the men, through summer and winter, in the performance of their arduous duties.

We will now proceed to witness the performance of American engines. One of the most striking observations is the ease, not to say "grace," with which the comparatively light locomotives do their work—and heavy work, too—over the rough roads of the United States and Canada. Mr. Eugène Flachat is evidently of opinion that the engines are worked at the sacrifice of regularity, speed and security, for, on page 229 in his "*Traversée des Alpes*," he says:—

"Les machines Américaines ne sont pas construites d'après un "système qui produise pour elles une adhérence supérieure aux "autres, mais elles sont employées sur les rampes au maximum de "leur puissance motrice et de l'adhérence disponible: de là une "irregularité dans leur marche qui ne se concilierait ni avec la "fréquence des trains sur nos lignes, ni avec la sécurité qui est la "première condition de cette manière de voyager.

"Le train américain est considéré comme un navire voguant à "travers l'Océan. Il marche vite quand les circonstances sont favo- "rables; il marche lentement quand le travail s'accroît par les "variations du profil; il franchit de très-fortes rampes en réduisant "considérablement sa vitesse, sans que la machine soit douée d'aucune "supériorité quant à la production de vapeur et aux moyens de "transmettre sa puissance motrice des cylindres aux roues."

The average gross tonnage of passenger trains here is probably double that of English trains; still, with from six to seven passenger cars, weighing, loaded, about 20 tons each, a baggage-car of the same weight, and a Pullman drawing-room or sleeping-car of from 30 to 35 tons weight, the engine gets quickly away from the stations, and without "slipping." Of course there must be some material reason to account for the superior useful effect given by American engines. In the first place, American engineers generally take the car friction at five pounds, and the engine friction at ten pounds per ton, irrespective of atmospheric resistances. These low figures—ac-

cepted, probably, more by long experience than by any direct experiments upon train resistances—must be attributed chiefly to the employment of bogie rolling-stock, central buffers with loose couplings and oil-tight axle-boxes, which latter are always lined with an excellent bearing alloy. I have had some conversation, on the subject of locomotive performances, with one of the leading railway engineers in the States, and although the theories then advanced may not universally be accepted as infallible, yet they carry such weight with them that it will be well to enumerate them here. These points, which are independent of train resistances, refer essentially to the great steaming power of the American locomotive boilers, and to the manner in which these boilers are being worked and fed. The quick steam-generation is mainly due to three causes, viz., the intensity of the fire, the thinness of the plates composing the fire-box, and the extremely forced draught. By these means a boiler of moderate proportions and heating surface is worked up—though at a more rapid rate of combustion—to an extent never attempted abroad. The injector has been condemned by the Americans as being an expensive boiler-feeder. Counter pressure steam-brakes are equally unpopular out here, but each swivelling truck under the train, with the exception of the leading engine bogie, is always furnished with a hand-brake.

Great activity prevails in American railway matters, and all the locomotive works are consequently very busy. I understand that Messrs. Baldwin, of Philadelphia, will have turned out not less than 200 locomotives during the last twelve months. Locomotive building on this continent must, indeed, have made great progress of late, as verified by the perfect organization of the workshops and the systematical manner in which the work is turned out. In general, my visit to this great country has made a lively impression on me, which, I am sure, will be shared by most impartial critics, that, in the specialty of locomotive construction the Americans are fully equal, if not ahead, of the best European practice.

I remain, Sir, yours faithfully,

A. BRUNNER.

Montreal, January 1, 1871.